FACULTY OF ENVIRONMENT AND TECHNOLOGY

UNIVERSITY OF THE WEST OF ENGLAND

Name: Samanthi Manoja Tanabe (13970960)

A thesis submitted in partial fulfilment of the requirements of the University of the West of England, Bristol for the degree of Doctor of Philosophy in Construction Management

A risk allocation framework for public private partnerships (PPP) water infrastructure projects in Sri Lanka

February 2022

ABSTRACT

In Sri Lanka continuous infrastructure development is necessary for the country's future but this creates a serious financial burden for the government. To deliver infrastructure within constrained public finances, it is necessary for the government to consider a novel approach for infrastructure projects. One proposed approach is Public Private Partnership (PPP), a form of best sourcing that is used to work with private sector. However, PPP based projects are complex and difficult undertakings that involve a variety of risks. Conflicts related to the extent of transfer of risks from public to private sector can also be seen in such ventures. Therefore, this research addresses the issue of risk allocation between sectors in implementation of PPP based project using the context of water supply projects in Sri Lanka.

The methodology adopted in this research was the quantitative approach. Initially, various risks associated with PPP based water supply project were identified through literature review and a questionnaire survey (1st Questionnaire) to Sri Lankan experienced project practitioners in the public and private sectors. In the questionnaire survey, 60 valid and usable responses were returned out of 100 potential respondents. Subsequently, relative importance value of the risks was estimated applying Analytical Hierarchy Process (AHP) for the data collected through the 2nd Questionnaire survey to the same 60 respondents as replied to the 1st Questionnaire.

The risk allocation framework is suggested based on an assumption developed in this research which underlies the relation between the relative importance value and the project practitioners' perception to a risk, that is if a project practitioner considers controllability of his/her organization to a risk is low, the risk might be a higher priority/importance for the organization to manage. Risk management capability of the contracting parties was quantitatively assessed in terms of least in control by the party and the risk allocation was made based on the risk management capability, considering the sector specific conditions of water supply and locally focused risk list in Sri Lanka. The risk allocation framework developed in this research is highly consistent with risk allocation identified through prevalent discussion on nature of risks and the better party for allocation.

The framework was validated through the 3rd Questionnaire survey to the same 60 research participants as replied to the previous two questionnaires. In this questionnaire survey, 23 valid and usable responses were returned. The results obtained from this validation process indicated

that the majority of the respondents accepted the research findings and recommendations, and that the framework was valid and capable for use in practice. These research outcomes will assist the government introducing PPP based infrastructure projects in the water supply sector and will inform the private sector in considering their participation in PPP based projects.

DEDICATION

This thesis is dedicated to my loving family and especially to my late mother

Mrs. D.N. Ratnayake, who has been there for me by my side in life and spirit.

ACKOWLEDGEMENT

I wish to express my sincere thanks to Prof. Paul Olomolaiye, Director of Studies and Supervisor for providing me with valuable guidance.

I place on record, my sincere gratitude to Prof. Jessica Lamond my supervisor, for her constant guidance, patience, and encouragement in helping to complete my thesis.

The last four years have been extremely difficult due to many life changes and decisions. Although I never had the privilege to meet her in person other than a skype meeting, she has been supporting me never to give up, which I must have thought of many times. I am grateful to both of their professional support in helping me to complete the thesis.

Prof. Paul Olomolaiye and Prof. Jessica Lamond have been there for me every step of the way and I am extremely grateful for your assistance and suggestions throughout my work on the thesis.

As a part time student living abroad it was not easy getting things always right and achieving my goals wouldn't have been the same if not without them.

I would like to also take the opportunity to specially thank Dr. Alistair Clark (Faculty Director of Research), Dr. Patrick Manu and Ms. Marisa Downham (Graduate School Team Leader) for all her help and tolerance every time I called from overseas regarding so many matters. Always having the time to help me out.

A kind thank you to Ms. Christine Elliott from the credit control team for all her kind arrangements for my payments.

I am particularly grateful for the support from Prof. Niranjan Gunawardena and I furthermore I owe my profound gratitude to Prof. Malik Ranasinghe (University of Moratuwa) for his heartfelt guidance and support.

I am extremely grateful to my loving father Mr. P. G. Ratnayake for his love and care, for always being there to help me jump obstacles in life.

I would like to also acknowledge my loving husband Isao Tanabe, who has been helping in every step of the way.

And my loving son Taka Tanabe who is my pillar of support throughout my life's journey.

His sweet hug and word "Mummy" has been the light for overcoming all life's challenges.

Lastly a paw thanks to my loving pet Snowy who has travelled with me and been such a sweet support through times of good and bad.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AHP   Analytical Hierarchy Process

ADB   Asian Development Bank

BOI   Board of Investment

CECB   Central Engineering Consultancy Bureau

C.I.   Consistency Index

CSF   Critical Success Factor

FSE   Fuzzy Synthetic Evaluation

FX   Foreign Exchange

GDP   Gross Domestic Product

IFC   International Finance Corporation

MIGA   Multilateral Investment Guarantee Agency

MLR   Multiple Linear Regression

MOF   Ministry of Foreign Affairs

NWSDB   National Water Supply and Drainage Board

PIP   Private Infrastructure Project

PPP   Public Private Partnerships

PSBR   Public Sector Borrowing Requirements

RFP   Request for Proposal

SPC   Special Purpose Company

USAID   United States Agency for International Development

CHAPTER ONE: INTRODUCTION TO THE RESEARCH

1.1 RESEARCH BACKGROUND

It is essential for Sri Lanka to develop infrastructure projects to improve the lives of the population and for sustainable growth. Conversely, the financial burden for the Sri Lankan government is serious. Continuous infrastructure development is necessary for the country's future but the financial burden to be transferred to the future generation should be minimized. To resolve this dilemma, it is necessary to consider different approaches for formulation and implementation of infrastructure projects. One prospective approach is proactive involvement of the private sector in infrastructure development projects. The Government of Sri Lanka has identified private sector participation and financing as the key to achieving its plans for new and improved infrastructure (USAID, 2017). This research was undertaken to identify the risks in the private sector involvement in infrastructure development and explore a framework of adequate risk allocation between the public and private sectors for infrastructure projects in Sri Lanka.

1.1.1 Conventional Infrastructure Development and Constraints

In Sri Lanka, as elsewhere, the provision of public service and infrastructure in many countries has traditionally been the undertaking of the government (ADB, 2009). However, **with increasing population pressures, urbanization and other development requirements, the government's ability to adequately address public needs through traditional ways has been heavily constrained** (ADB, 2009). The Government of Sri Lanka has begun to increasingly look to the private sector to participate in and provide public services in partnership with the public sector (USAID, 2017).

However, Rashed, Faisal and Shikha (2011) states that while promoting the concept of PIP (Private Infrastructure Project), it is important for Sri Lankan Government to identify and assess the potential fiscal risks arising from PIP. PPP or PIP is still an emerging concept in many developing countries, including Sri Lanka. Considering the development of the country, **the Sri Lankan Government has not established any appropriate functions or systems for identifying and assessing the potential risks arising from**

PPP infrastructure project. Rashed, Faisal and Shikha (2011) further states that a risk analysis method related to government guarantees in water supply sector projects that consider the sector specific conditions is not established in Sri Lanka.

Furthermore, Osei-Kyei, Ameyaw, & Chan (2017) state that future research should adopt a more locally focused interviews and case study analysis to unravel CSFs (Critical Success Factors) in managing operational PPPs. However, **any risk list specifically for a PPP based infrastructure project in water supply sector in Sri Lanka is not identified in published literatures.** In this research a locally focused risk list is created through a questionnaire survey with the experienced Sri Lankan project practitioners in the public and private sectors.

Considering the above-mentioned situation related to introduction of PPP based infrastructure development by the Sri Lankan government, outcomes from this research will offer a valuable assistance both the government and the private sector in formulating and implementing PPP based infrastructure project in water supply sector.

1.1.2   Introduction of Private Sector into Infrastructure Development

Conventionally in the procurement of public physical assets, government and public agencies have engaged the private sector to construct facilities and/or supply equipment, and public agencies will then own and operate the facilities or equipment to deliver services to the public. However, Public Private Partnership (PPP) is another form of sourcing that can be used to work with the private sector to deliver services and a favourable approach for a government that is expecting further involvement of the private sector in development of new physical assets/infrastructures. Under PPP the private sector can look forward to providing a wider range of services and over a longer period. Through closer collaboration with the private sector, it is expected that public services can be delivered with greater value for money by making optimal use of public and private sector expertise, resources and innovation to meet public needs effectively and efficiently (MOF Singapore, 2012). The role of government in providing the public service can be switched from a provider to a buyer of services through PPP and the government can focus on its core responsibilities of policy-making and regulation (MOF Singapore, 2012).

1.1.3   Conflicts Between Public Sector and Private Sector in PPP based Projects

Infrastructure projects involve a variety of risks which were traditionally borne by the government. The PPP concept is considered to transfer, in part, those risks to the private sector. Adequate risk allocation between the public and the private sectors is therefore considered to be key to successful PPP projects. However, the objectives which are pursued by the public and private sectors through implementation of such ventures can also often be seen to be conflicting. While private-sector participation in infrastructure projects offers substantial benefits, it is also a complex and difficult undertaking that requires a clear understanding of the concepts, and trust between the public and private sectors (Ranasinghe,1998 from early on it has been recognized). In part, this conflict relates to the extent projects represent a transfer of risk from public to private sector or should be subject to risk sharing.

From the above discussion, research problem to be addressed in this research is summarized below.

Research problem to be addressed

Neither the Sri Lankan Government nor research has established any appropriate functions or systems for identifying and assessing the potential risks arising from the growing number of PPP infrastructure projects in the water sector.

1.2 RESEARCH QUESTIONS

This research addresses the issues of risk sharing in the implementation of PPP using the context of water supply projects in Sri Lanka. Based on the foregoing discussion, the following fundamental research questions adopted.

RQ1: What are the most critical risk factors in implementing a PPP based water supply project in Sri Lanka for the public and private sectors, respectively?

RQ2: What are the differences or similarities in risk perception between project practitioners of both sectors in PPP water supply project in Sri Lanka?

RQ3: How can the differences or similarities in risk perceptions between project practitioners of both sectors be properly identified?

RQ4: How can the risk factors be adequately shared between the public and private sectors, minimizing the conflicts between both sectors.

1.3 RESEARCH AIM AND OBJECTIVES

1.3.1 Research Aim

The goals which are pursued through the implementation of an infrastructure project by the public sector and the private sector are often conflicting. This conflict may be partly attributed to different perceptions of risks between both sectors. Therefore, the aim of this research is to develop a framework for allocation of risk between public and private sectors engaged in PPP infrastructure projects within the water supply sector in Sri Lanka.

The proposed framework is designed to create consensus in assessing project risks and an adequate allocation that is acceptable to both sectors, thereby contributing to the success of private sector involvement in public infrastructure projects.

1.3.2 Research Objectives

The following objectives are planned to fulfil the aim of the research.

1) Understand the concepts and research related to frameworks to manage risks in PPP water supply projects, through literature review.
2) Identify and classify the dominant risks associated with the PPPs models which could be applied for the water supply projects in Sri Lanka, and identify the risk perceptions of Sri Lankan project practitioners.
3) Assess the relative importance of the dominant risk factors in risk allocation in the context of Sri Lanka's water supply projects through questionnaire with experienced practitioners of PPPs project in both public and private sectors.
4) Propose a framework for future use in adequate allocation of risks between the public and private sectors in implementing PPPs water supply projects in Sri Lanka.
5) Validate the proposed framework through with some of the respondents who answered to the questionnaire on risk identification and assessment.

1.4 SCOPE OF STUDY

The research will be conducted for the purpose of exploring an appropriate framework for risk allocation between the public and private sectors in implementing PPP infrastructure projects in Sri Lanka, focusing on the water supply sector. PPP based project delivery is still an emerging concept in many developing countries, including Sri Lanka. Sri Lanka has some experience in implementing projects adopting the PPP concept, however these experiences have been limited to sectors such as ports, telecommunication and power, and thus research on both PPP project and PPP project in water supply sector are very limited.

Implementation of an infrastructure project in water supply sector is closely related to satisfaction of basic human needs and therefore, a high financial return from the project has not traditionally been expected by the government in decision around project implementation. Tawalare and Balu (2016) state about a revenue risk in water supply project showing an example that in India offering water to thirsty person is sacrosanct and thus the public water supply was either free or at the minimal cost for many years. In addition, Dharmapala and Ranasinghe (2006) state that the water users should pay the full cost of service to reap the maximum benefit to the economy as well as attracting competitive private providers, however if the social affordability level is inadequate, the Government should complement user fees with carefully targeted subsidy payment. Considering the basic nature of an infrastructure project in water supply sector, the government would like to more involved in the project and control over it even if it is a PPP. According to Tawalare and Balu (2016), there is a strong political pressure on municipality administration for increasing water tariff. Irwin (2007) states if the government insists on control over investment decisions to projects, it may have to give guarantees or finance the investments itself and thus bear risks in a different way.

There has been very little research on the PIP fiscal risk management process and very little empirical research on the contingent liability from South Asian context (Rashed, Faisal and Shikha, 2011). The risk analysis method related to government guarantees in water supply sector project considering the sector specific conditions is not established in Sri Lanka. Based on this recognition of risks in dealing with PPP, it is necessary for Sri Lankan government to establish appropriate system for assessing and managing the risks for individual PPP infrastructure project in water supply sector. Considering this situation

in PPP research in Sri Lanka, in this research data collection and data analysis have been carried out applying questionnaire surveys for the practitioners in the public and private sectors who have experience in infrastructure projects.

In many literatures related to PPP based infrastructure development, it is commonly stated that the most important key to success of an infrastructure project involving the private sector is adequate allocation of risks associated with the project (see section 2.2.3). This research will explore differences in perception to risks in implementing PPP infrastructure projects between both sectors and a framework for adequate risk allocation which is acceptable to both sectors.

1.5 RESEARCH DESIGN

It is considered logically effective to adopt post-positivist position in this research as discussed below. Trochim (2006) states that most post-positivists are constructivists who believe that we each construct our view of the world based on our perceptions of it because perception and observation is fallible. According to this, it is considered that each of the research participants also construct their view of the world based on their perceptions of it. According to Creswell (2009), social constructivists hold assumptions that individuals seek understanding of the world in which they live and work, thus individuals develop subjective meanings of their experiences. Trochim (2006) also mentions that the positivist believed that the goal of science was to uncover the truth, whilst post-positivists believe that the goal of the research is to rely as much as possible on the participants' views of the situation being studied (Creswell, 2009).

A point of this research is how people's judgments, ideas, opinions or perceptions, which results from fuzzy human cognitive processes, can be incorporated within a quantitative assessment of risk. It is not a simple statistical processing of data, but an attempt to quantify the knowledge and the experiences of professionals/experts or their judgment based on the experiences. The basic approach of this research is considered to consist of three steps, that is the first step is a qualitative interpretive approach including identification of research gap, identification of risk factors associated with PPP water supply projects and design of questionnaire which is to be a base for the quantitative analysis at the next step, the second step is a quantitative approach through which a

6

quantitative analysis for assessing relative importance of the risk factors applying AHP technique for the questionnaire output from the respondents and at the third step a constructivist approach is taken for construction of a framework on adequate risk allocation, based on a general consensus that risks should be allocated to the contracting party best able to control and manage them (Ameyaw and Chan, 2015a) and validation by feedback to the respondents.

The features and the magnitude of the risks identified for a project are different depending on the nature of project, the project scale and the implementation method. It is, therefore, necessary to identify and assess the risk categories and the risk factors from various aspects before allocation, to realize an adequate allocation for the public sector and the private sector, respectively. For identification and assessment of risks in this research it was considered essential to use the knowledge and experience of the professionals/experts which have been engaged in PPP infrastructure projects in Sri Lanka.

1.6 STRUCTURE OF THE THESIS

The thesis consists of seven chapters. The content of each chapter is summarized below.

Chapter One: Introduction to the Research

This chapter provides the background of the thesis and explains the justification for the research based on the existing knowledge gaps. This chapter also provides the research questions, aim and objectives, scope of study and outlines the research design. Finally, this chapter indicates the thesis structure.

 Chapter Two: Literature Review

This chapter provides the literature review to define the scope of the research. At first infrastructure development involving private sector in Sri Lanka is presented, subsequently the basic concept of Public Private Partnerships (PPP) is explained, including its advantage and drawback. Overview of implementing PPP is further explained. Furthermore, PPP based projects in water supply sector are specifically considered from risk management viewpoints. It considers the previous research on the quantitative approach for formulation of risk allocation strategy between the public and private sectors.

Chapter Three: Research Design and Methodology

This chapter discusses and justifies the research design and methodology adopted for the study. The methodological paradigm and the research paradigm adopted to this research are discussed and justified. Subsequently, the research strategy is discussed and justification of those adopted to this research are provided. In addition, data collection method and the analysis method are explained as the research process. Furthermore, strategies that were used for considering ethical issues are also provided.

Chapter Four: 1st Questionnaire Survey and Discussion of Findings

This chapter provides the results and findings of the 1st questionnaire survey. The purpose of the 1st questionnaire is to identify the predominant risks out of numbers of risks which were identified through literature review. This questionnaire is made of structured inquiries for the target respondents (the research participants). This chapter presents the positions of respondents and the departments or organizations they belong to as well as the questionnaire result. Finally, it provides discussions on the findings. Based on the outcomes from the analysis and discussions in this chapter, the risks to be examined in the 2nd questionnaire were identified.

Chapter Five: 2nd Questionnaire Survey and Discussion of Findings

This chapter presents the results and findings of the 2nd questionnaire survey. This questionnaire is prepared based on the 1st questionnaire results and the survey results are explained. Finally, this chapter presents quantitative assessment on perceptions to risk factors by respondent.

Chapter Six: Framework Development and Validation

This chapter presents the framework that was developed based on the findings through the questionnaire surveys and accompanying recommendations. It also discusses feedback from the framework evaluation where perspectives were sought from the research participants on the framework and recommendations.

Chapter Seven: Conclusion and Recommendation

This chapter presents the conclusion to the research by providing the research outcomes to achieve the research questions and objectives. Research contribution to the knowledge

as well as practical implications are highlighted. The study limitations and consequent recommendations for further research are provided.

1.7 SUMMARY

This chapter presents the research background and justification for this research based on existing gaps in knowledge. The literatures reviewed indicate that although PPP based infrastructure development is a prospective approach, management of the risks involved in a PPP project is the most vital issue. This chapter discusses the research questions focusing on risk sharing in implementation of PPP based infrastructure projects and indicates the research aim, objectives and scope of study. In addition, the chapter presents an overview of the research design and methodology. Finally, the structure of the thesis is provided to overview the entire research, summarising the content of each chapter.

CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter review of the literatures related to PPP based infrastructure project, including the background of introduction of PPP concept in the world and in Sri Lanka, basic concept of PPP, overview of the implementation and the risks associated with PPP based infrastructure project.

At first, the background of necessity for introducing PPP concept into development of public infrastructure in the world and in Sri Lanka is reviewed. Subsequently, the general features of infrastructure development under PPP concept, including the basic concept and the associated risks are reviewed. Furthermore, review of general risks associated with a PPP based project are indicated and the risk allocation concept is discussed. Lastly, the risk management in PPP based infrastructure project is reviewed, highlighting the keys to success of a project.

2.1.1   Private Sector Involvement in Infrastructure Projects

Worldwide governments are promoting PPP for implementing Private Infrastructure Project (PIP) (Rashed, Faisal and Shikha, 2011). There is no universally accepted definition of PPP, as it is not a "one-size-fits-all" approach and many countries adapt the PPP model to their specific needs (USAID, 2017). It can be said that PPP is the comprehensive concept for implementation methods of public infrastructure project which are undertaken with proactive involvement of the private sector, and PIP is used as a term that means a public infrastructure project in which the private sector is closely involved. Infrastructure is an essential foundation for improvement of people's lives and the sustainable growth of a country. It might, therefore, appear obvious that the term infrastructure project is synonymous with public infrastructure project implying the responsible organization for implementation, including finance, is the government. In these terms, PIP is contradictory to the definition of infrastructure project. Some historical background demonstrating why and how the public sector has desired involvement of private sector in development of public infrastructure and the change of implementation models of PPP projects are presented in the subsequent section.

2.1.2   History of PPP

(1)   PFI in UK

The concept of private finance of public infrastructure in England has its origins in the late seventeenth century (Heinecke, 2002). However, according to House of Commons Treasury Committee (2011), an announcement of the Chancellor of the Exchequer Norman Lamont in the Autumn Statement in 1992 about "ways to increase the scope for private financing of capital projects" is the beginning of what was to become known as the PFI. The UK government in the early 1990's faced a lack of sufficient public funds to adequately improve public infrastructure. Heinecke (2002) states that the government was forced to introduce the PFI system which was an innovative solution to secure needed investments in public infrastructure without further increasing Public Sector Borrowing Requirements (PSBR). UK government has fiscal rules that define the purpose of borrowing and the ratio of net public sector debt to Gross Domestic Product (GDP), (House of Commons Treasury Committee, 2011), and it is, therefore, considered that UK government could not increase the borrowing. Private infrastructure projects are considered to have emerged in UK as public infrastructure project initially expecting private finance and have been developed and innovated in UK and other European countries to a PPP system which includes variety in implementation method of PPP project, including PFI (Private Finance Initiative) since the early 1990's.

(2)   PPP History in USA

In considering the PPPs history in USA, the role of the non-profit sector is highlighted. Moulyton and Anheier (2001) state that co-operation between government and the non-profit sector has a long history in this country and that it is deeply rooted in the national ideological and cultural make-up. In this sense, the United States are considered to have established a unique PPP system, involving the non-profit sector, to provide public services. Moulyton and Anheier (2001) further state that public-private partnerships are a basic characteristic of the American political and social welfare system. However, since the start of the 21st century, the role of for-profit firms became more pronounced. The partnerships will commonly involve three parties including for-profit firms in addition to the two traditional parties, government and non-profit providers. Thereby recent practice establishes more project-specific organizations that are no longer strictly bound by their legal form or sector membership (Moulyton and Anheier 2001). This new trend, that leads to major changes in the traditonal PPPs of the USA, is considered closer to the PPP system that was developed in European countries.

2.1.3 Global Deployment of PPPs

PPP schemes were developed and evolved in UK and other European countries since the early 1990's and have been introduced by many countries in the world. This is especially true in emerging economies where governments similarly face a lack of public fund, however continuous infrastructure development is indispensable for their economic growth and enhancing their people's life. It is, therefore, important for the governments to introduce private finance of the infrastructure development through PPP schemes. However, the PPP activities of those countries are different depending on development status of the environment for introducing PPPs, such as regulatory framework, institutional capacity for implementation, PPP market maturity and financial facilities (ADB, 2019).

Looking at the world trend of infrastructure investment in PPPs, World Bank group, PPIAF (2016) indicates the historical trends of total global investment in PPP infrastructure projects for the period from1991 to 2015. These trends are mainly influenced by the economies of the five major emerging countries, including Brazil, China, India, Mexico and Turkey. However, World Bank group, PPIAF (2016) also mentions that the share of total investment of the five major countries has declined since 2009 and this situation is due to an emerging expansion of investment by developing countries outside of the five major countries in PPP infrastructure. As Jomo et al. (2016) mentions, in Latin America the share of private infrastructure investment in the early-1990s was largest in the world, however no remarkable increase of the PPP activities has been observed since mid-1990s, while PPP activities surged in East Asia and Pacific and South Asia since the early-2000s. In contrast, the number of finalized PPPs infrastructure in Sub-Saharan Africa is less than half of South Asia.

2.1.4 Infrastructure Development Involving Private Sector in Sri Lanka

The Government of Sri Lanka identifies private sector participation and financing as the key to achieving the new and improved infrastructure plans for continuing economic growth and expansion, and the government begins to focus on the private sector to participate in and provide services in partnership with the public sector, (USAID, 2017). Ranasinghe (1998) states that this is partly because the government does not have sufficient resources to undertake the large investments that are required for infrastructure projects and partly because of expectations of improved efficiency and innovation.

While PIP (Private Infrastructure Project) is still an emerging concept in many developing countries, often the private sector in these countries participated in infrastructure projects only after government supports like revenue guarantee, exchange rate guarantees were included. Such liability adopted by the government entails significant future contingent liabilities (Rashed, Faisal and Shikha, 2011). Therefore, proper risk analysis and management of these guarantees are important for government and private sectors. While in the context of infrastructure, Sri Lanka has some experience in PIP arena that have been limited to the port, telecommunications and power sectors. According to USAID (2017), although the aggregate number and value of these PPPs is impressive (PPP project count of 73 and total investment of 6,131 million USD from year 1990 to 2014), it should be noted that the projects (with the exception of two port projects) are either in the electricity or telecommunications sector. Kim, Lee and Pradeep (2019) indicate that in case of Colombo Port Expansion project, 2007 which was undertaken under BOT concession, the public sector procured US$ 480 million (61.5% of the total project cost) using ADB loan and the private sector's investment amounted to US$ 301 million (38.5% of the total project cost). Regarding institutional framework, USAID (2017) states that PPPs in Sri Lanka were, and are currently, being implemented pursuant to the 1998 Guidelines on Private Sector Infrastructures Projects (BOO/BOT/BOOT PROJECTS) Part II, and various PPP-related institutions were established within the 1998 Guidelines. However, USAID (2017) further states that the Guidelines have no force and effect and many of these institutions are inactive, therefore concluding that it is essential for the Sri Lankan government to develop new PPP policy which serves as a basis for further development of the PPP legal and institutional framework.

In case of public water supply projects, while projects have stronger public nature compared to transportation, telecommunication and power sectors and the purpose is directly related to satisfaction of basic human needs, the private sector will, nevertheless, call for commercial viability in PPP projects. Major sources of invested fund recovery for projects are service tariff or user charge (USAID, 2017). Private sector would consider easiness of the fund recovery and further profitability of the project as a guideline in decision of participation in PPP project because these factors are affected by the type and extent of risks that private sector takes. In the context of these commercial factors, it is assumed that the risks associated with PPP projects in telecommunication and power sectors can be managed by private sector, without expecting large extent of risk share by the public sector. According to USAID (2017), it is fact that foreign private

entities have participated in many PPP projects with ownership of 45 % to 100 % and long contract period in telecommunications and power sectors in Sri Lanka from years 1990 to 2014. On the other hand, private sector would expect large extent of government support in decision of participation in PPP water supply project, considering the risks associated with fund recovery and profitability. However, no appropriate institutional and organizational system of government support in this context is not established in Sri Lanka. This situation is considered to result in no experience in PPPs project in water supply sector. It is, therefore, necessary to consider adequate risk allocation for project formulation and the implementation model for water supply projects through PPP concept. The further discussion on PPP based water supply projects and justification for focusing on water supply sector in this research is given below and in the subsequent section 2.4.

While promoting the concept of PIP, it is important for Sri Lankan Government to identify the potential fiscal risks arising from private infrastructure project (Rashed, Faisal and Shikha, 2011). In initiating development of any PPP based infrastructure project, especially in water supply sector in Sri Lanka, the government should recognize that it would be required to provide a large extent of the government support or guarantee to the project participants in the private sector because considering the basic project nature, the government would like to more involved in the project and control over it even if it is a PPP based project. However, as Rashed, Faisal and Shikha (2011) points out, this support will be a significant fiscal risk to the government. It will not be easy for the government to discover the balance point between the advantage and the drawback associated with PPP based infrastructure project. It is, therefore, essential for Sri Lanka government to create appropriate institutional and organizational arrangements for analysing and reporting possible fiscal liabilities for individual PIP and for formulating applicable type(s) of PPP model considering the specific risks associated with the model before it is awarded, possible at feasibility stage.

Irrespective of the government policy of infrastructure development through PPPs and the implementation situation of the PPPs projects in port, telecommunication and power sectors that are categorized into economic infrastructure, there is no promotion of PPPs projects for water supply that is categorized into public infrastructure, as ADB (2019) reports that to date, no water PPP project has reached financial close in Sri Lanka; therefore, no typical risk allocation has been defined. Development of water supply infrastructure is an essential component which contributes directly to enhancement of people's life standard. **It is an important subject how satisfaction of**

basic human needs can be realized through PPPs projects where commercial viability also must be considered. This is the reason why this research has focused on water supply projects. The outcomes of this research are envisaged to contribute to assisting the government in undertaking the activities mentioned above for promoting PPPs project in water supply sector.

2.2 PUBLIC PRIVATE PARTNERSHIPS (PPP)

2.2.1 Basic Concept

Kwak, Chih and Ibbs (2009) state that the term "PPP" is still not clearly defined, and several definitions of PPPs have been used by different scholars, governments, and international organizations such as HM Treasury (2013); World Bank IFC MIGA (2012); European Commission (2003); UNESCAP (2011). Although these organizations show their own definitions of PPP, the key elements common to all the definition are that the Public Private Partnership (PPP) is collaboration between the public and private sectors, aimed at the implementation of project or provision of services traditionally provided by the public sector.

Cooperation is based on the assumption that each party can implement its own tasks that were entrusted thereto, more efficiently than the other party. With the division of tasks, responsibilities and risks, under PPP, the most cost-effective way to create the infrastructure and delivery of public service is achieved (Kwak, Chih and Ibbs, 2009).

Although there is variety in PPP models, in much of the literature on PPP and in guidelines for formulation and implementation of PPP based projects, it is commonly mentioned that Public Private Partnership (PPP) is another prospective form of sourcing that can be used to deliver services that require the development of new public infrastructures (Kwak, Chih and Ibbs, 2009; HM Treasury, London, 2013; World Bank IFC MIGA, 2012; European Commission, 2003; UNESCAP, 2011). The Ministry of Finance (MOF), Singapore (2012) illustrates the typical PPP models together with the extent of the private sector involvement, as shown in Figure 2.2.1 below.

Procurement | Public Private | Privatization
of Asserts | Partnership

★ Traditional
Procurement of
Asserts

   ★ Design-Build-
Operate (DBO)

      ★ Design-Build-
Finance-Operate
(DBFO) & Govt-Own

         ★DBFO & Pte-Own, but
Transfer to Govt at
end of contract

            ★ DBFO & Pte-Own
(No transfer)

               ★DBFO & Pte-Own
(Govt is regulator)
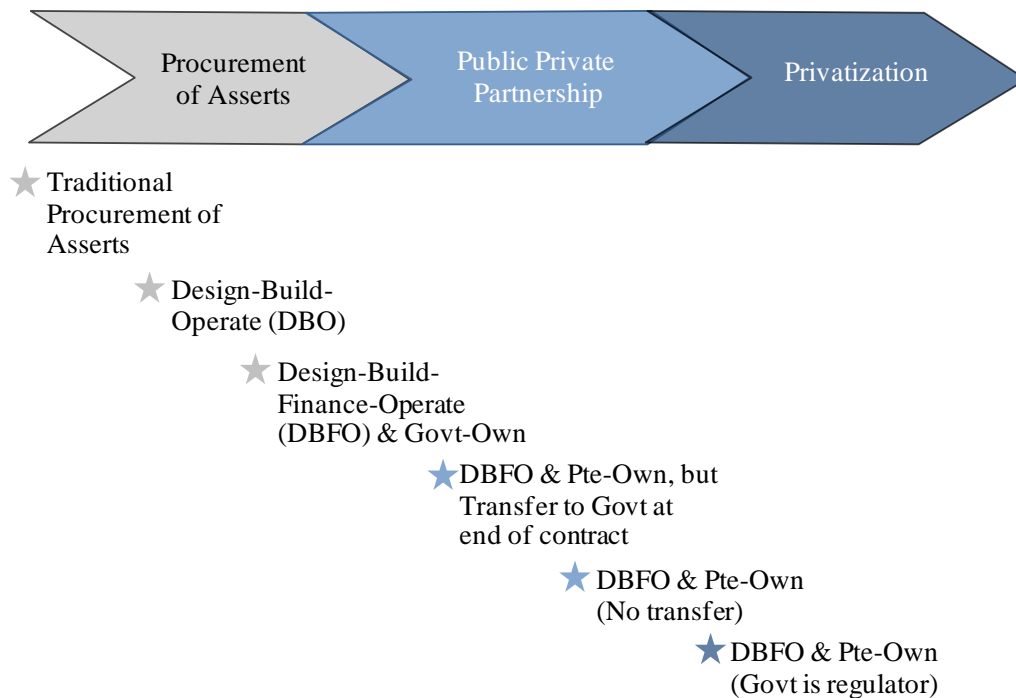
Source: MOF Singapore, 2012

Figure 2.2.1 Typical PPP Model

PPP models are typically a variation of the Design-Build-Finance-Operate (DBFO), or the Design-Build-Operate (DBO) model. The description of these two typical models is given below.

<u>Design-Build-Finance-Operate (DBFO) model</u> (MOF Singapore, 2012)

"DBFO is the most common form of PPP, involving the integration of these four functions, Design, Build, Finance and Operate, within one PPP service provider. The PPP provider will secure its own financing to build, maintain and operate the facilities to meet the public sector's requirement. The private provider will be paid according to the services delivered, at specified performance standards, throughout the entire contract length. This ensures optimal use of capital resources in government projects as well as greater certainty over future government cash flows. The approach also transfers financial risks to the private sector, which will do the due diligence to ensure financial viability of the project."

<u>Design-Build-Operate (DBO) model</u> (MOF Singapore, 2012)

"One possible variation to the DBFO model is the DBO model, i.e., the public sector provides the funds for the design and building of the facility, and then continues to engage the same

private vendor to operate the facility. The operator is then paid a management fee according to performance standards. This model may be suitable for very large projects for which the private sector is unable to finance wholly."

Compared to the conventional way of private involvement in the procurement of public assets, PPP refers to long-term partnering relationships between the public sector and the private sector to deliver services (MOF Singapore, 2012). It is a favourable approach for a government that is expecting further involvement of the private sector in development of new physical assets or infrastructures.

2.2.2 Risks in PPP Projects

While involving the private sector can be an important option for sustainable economic growth of a country, various types of risks exist in implementing infrastructure projects. The features and the magnitude of the risks identified for a project are different depending on the project. It is, therefore, necessary to formulate and assess a project from various aspects (World Bank IFC MIGA, 2012; Meyer, 2012; Puentes, 2012; European PPP Expertise Centre, 2013; ADB, 2009; Schaferhoff, Campe and Kaan, 2009; World Economic Forum, 2008; Li *et al.*, 2005a; Jin and Zhang, 2011; Ranasinghe, 1998, 2000).

Ranasinghe (1998) states that while private-sector participation in infrastructure projects offers substantial benefits, it is also a complex and difficult undertaking that requires a clear understanding of the concepts, and trust between the public and private sectors. For example, Kim *et al*. (2011) showed experience of South Korea during 1990s that created higher fiscal risks to the government through Minimum Revenue Guarantees (MGRs). To promote PPP infrastructure projects, the government guaranteed private investors part of expected revenue for a project, by paying the investor the difference between expected revenue and actual revenue falling below the guaranteed level. When projects started operation, the generated demand was only 50 % of expected demand on average. The government had paid more than 1 billion of dollars in total from year 2001 to 2008. Chou *et al.* (2012) indicates experience of PPP project in public transport sector in Taiwan. The Taiwan High Speed Rail (THSR) is the first HSR performed by the BOT and the operations are successfully and safely underway, however the private company involved in the project is facing nearly financial bankruptcy due to its limited ridership and its over-optimistic forecast. These are not cases of failure in water supply project, however it implies that failure in

risk analysis such as demand risk and in formulating PPP contract result in a large financial burden to the government.

As an example of a failure of water supply project, in India from mid to late 1990s PPP initiatives in water supply were attempted in the states/cities of Goa, Pune, Hyderabad and Bangalore. The PPP projects were proceeded to bidding stage to procure private operators, however those were abandoned due to issues of high water-tariff setting by the private party and lack of political support (Hoque, 2012). As Irwin (2007) states, the government may have to give guarantees to insist on control over investment decision to projects though it is a fiscal risk to the government to give the guarantees. However, as the result of governments failure in taking this risk, it is considered that the private party applies high tariff setting to take risks associated with the project operation without government support, such as demand risk, unpaid risk by consumers and political risks.

As described in the previous Section 1.1.3, share of project risks out of the disadvantages associated with PPP based project is most vital. Therefore, a framework for adequate risk allocation to be developed in this research could suggest assistance to the project stakeholders in formulating and implementing PPP based water supply project.

2.2.3   Key to Success of Private Sector Involvement

The keys to success of a project involving the private sector are as follows (ADB, 2009):

"1)How the private sector and the public sector can reasonably **share the risks**,

2) How a government (or utility) can prepare a request for proposal (RFP) in which the private sector is interested, and

3) How the final contract between private sector and public sector can be honoured on the long term."

As discussed in the previous Sections 1.1.3 and 2.2.2, the above key 1) is a critical element to formulate an appropriate PPP structure for delivering public facilities and services. Thus, in this research the focus is put on risk and its proper sharing between the public and the private sectors. Discussions on the risk share or allocation are attempted in the subsequent Section.

2.3   RISK SHARE IN PPP

2.3.1   Identification of Risks

A component critical to any PPP structure is the risks involved in the development of the project. An illustrative list of risks associated with a project and its consequences is suggested by (ADB, 2009) as shown below.

Table 2.3.1 Generic Risk Categories (ADB, 2009)

No.	Risk Category	Description of Risk	Direct Consequence
1	Commissioning risk	The risk that the infrastructure will not receive all approvals to satisfy an output specification, such as expected changes in legislation which allows for a specific output specification not materializing	Additional ramp-up costs, cost of maintaining existing infrastructure or providing a temporary alternative solution where these ideas to delay in the provision of the service
2	Construction risk	The risk that the construction of the assets required for the project will not be completed on time, within the budget or to specification	Additional raw materials and labor costs, cost of maintaining existing infrastructure or providing a temporary alternative solution where these ideas to delay in the provision of the service
3	Demand risk	The risk that the actual demand for a service is lower than planned	Reduced revenue
4	Design risk	The risks that the proposed design will be unable to meet the performance and service requirements in the output specifications	Cost of modification, redesign costs
5	Environmental risk	The risks that the project could have an adverse environmental impact which affects project costs not foreseen in the environmental impact assessment	Additional costs incurred to rectify an adverse environmental impact on the project, incurred from the construction or operation of the project or pre-existing environmental contamination
6	Financial risk	The risk that the private sector over-stresses a project through inappropriate financial structuring	Additional funding costs for increased margins or unexpected refinancing costs
7	Force majeure risk	An act occasioned by an unanticipated, unnatural or natural disaster such as war, earthquake or flood of such magnitude that it delays or destroys the project and cannot be mitigated	Additional costs to rectify
8	Industrial relations risk	The risk that industrial relations issues will adversely affect construction costs, timetable and service delivery	Increased employee costs, lost revenue or additional expenditure during delay in construction or services provision (post-construction)
9	Latent defect risk	The risk that an inherent defect exists in the structure being built or equipment used, which is not identified upfront and which will inhibit provision of the required service	Cost of new equipment or modification to existing infrastructure

10	Operating risk (service under performance)	The risks associated with the daily operation of the project, including an unexpected change in operating costs over budget	Increased operating costs or reduced revenue over the project term
11	Performance risk	The risk that the operator will not perform to the specified service level, such as the government authority permitting off-take of less than required demand	Cost of failing to comply with performance standards
12	Change in law risk	The risk that the current regulatory regime will change materially over the project or produce unexpected results	Cost of complying with new regulations
13	Residual value risk	The risk relating to differences from the expected realisable value of the underlying assets at the end of the project	Lower realisable value for underlying assets at the end of the project term
14	Technology obsolescence risk	The risk that the technology used will be unexpectedly superseded during the term of the project and will not be able to satisfy the requirements in the output specification	Cost of replacement technology
15	Upgrade risk	The risks associated with the need for upgrading the assets over the term of the project to meet performance requirements	Additional capital costs required to maintain specified service

Source: ADB,2009

The list of risks presented above is generic and indicative in nature and it is important that the list is made as exhaustive as possible (ADB, 2009). ADB, (2009) further mentions that the detailed project-specific risks are required to be identified and detailed out. In this research a number of risks associated with PPP based infrastructure project in water supply sector are identified in terms of risk category and risk factor. The risk identification in this research is conducted with reference to several literatures including the above generic risk categories.

2.3.2 Allocation of Risks

Balanced allocation of all the identified risks plays a critical role in the successful implementation of any PPP structure. The general principle governing risk transfer is that each risk should be allocated to whoever is best able to manage it at the least cost, taking into account public interest considerations (ADB, 2009). Ameyaw and Chan (2015b) also states it is a general consensus that risks should be allocated to the contracting party best able to control and manage them. Therefore,

optimal rather than maximum transfer of risk needs to be undertaken and the important risk allocation factors to be considered during risk allocation include (ADB, 2009):

1) The nature of the project

2) The respective strengths and ability of each sector to manage a risk (this may change over time as each sector's risk mitigation skills improve)

3) Flexibility of the output specification (whether any constraints exist which influence the method for managing risk)

4) Previous levels of risk transfer (this indicates the historical success of each sector in managing particular risks and the potential ability to manage risks in the future)

5) Prevailing market attitudes towards risk

6) Public interest factor

7) Other policy considerations

8) External environment, economic scenario, risk appetite of foreign institutions services in the following table.

A question in allocating the risks is how the general consensus and the important factors indicated above from 1) to 8) can be specifically applied for the risk allocation process. The risk allocation consensus and the important allocation factors are qualitative concepts and the risk allocation might be eventually determined through discussion and agreement among many experienced project practitioners, based on the concepts. The experienced project practitioners both in the public and the private sectors are considered to have sufficient knowledges for risk allocation such as the risk allocation factors specified in the above 1) to 8). In this research a risk allocation framework based on the quantified data which is derived from the experienced project practitioners' knowledges and experiences is explored. Finally, the risk allocation framework suggested in this research is validated through feedback to the experienced project practitioners. An example of a risk register, with its associated risk allocation, from a PPP project is displayed in Table 2.3.2 below.

Table 2.3.2 A Risk Resister and Allocation in PPP Water Supply Project in Indonesia

No.	Type of Risk	Code	Risk Factor	Risk Allocation		
				Public	Private	Share
1	Political risk	R9	Nationalization/expropriation	✓		
		R10	Non availability of FX		✓	
		R11	Transferability restriction of FX		✓	
		R12	Exchangeability restriction of FX		✓	
		R13	Breach of contract by Government	✓		
		R14	Premature termination by Government	✓		
		R6	General changes in legislation	✓		
		R7	Discriminatory changes in legislation	✓		
		R8	Specific changes in legislation	✓		
2	Macroeconomic risk	R23	Inflation fluctuation		✓	
		R24	FX fluctuation		✓	
		R25	Interest rate fluctuation			✓
3	Production-related risk	R29	OM cost escalation		✓	
		R30	Equipment defect-caused interruption		✓	
		R31	Nonavailability of raw water	✓		
		R33	Technical leakage during distribution		✓	
		R34	Electricity blackout		✓	
		R35	Environment protests causing interruption	✓		
		R36	Water meter manipulation		consumer	
		R39	Low quality of raw water	✓		
4	Force-Majeur risk	R18	Natural disaster	✓		
		R19	Manmade disaster		insurance	
		R20	Declared war	✓		
		R21	Riots	✓		
		R22	Terrorism attack	✓		
		R32	Labour strike		✓	
5	Project-related Risk	R1	Construction cost escalation		✓	
		R2	Land cost escalation	✓		
		R3	Construction time overrun		✓	
		R4	Protracted negotiation on land price	✓		
6	Business risk	R5	Tariff uncertainty	✓		
		R15	Breach of contract by operator		✓	
		R16	Premature termination by operator		✓	
		R17	Abuse of power by Government officials	✓		

	R26	Failure in financial closure		✓	
	R27	Failure in refinancing		✓	
	R28	Demand uncertainty		✓	
	R37	Entry of new competitor		✓	
	R38	Unpaid bills by consumers	consumer		

Source: Wibowo, A., & Mohamed, S. (2008). Perceived Risk Allocation in Public-Private Partnered (PPP) Water Supply Project in Indonesia

2.3.3   PPP Model Best Suitable to Project Requirements

There are many business models or contracts to be applicable for PPP based project. As described in Section 2.2.1, the typical models are Design-Build-Operate (DBO) or Design-Build-Finance-Operate (DBFO) and their variation models including the status of the ownership of the constructed assets. Selection of PPP model best suitable for a project is a key to success of private sector involvement and it is necessary to be clearly described in the RFP and the project contract as mentioned in Section 2.2.3. In the case of water supply systems, the entire system from water source to the end consumer can be unbundled into some components, that is referred to as the value chain for water supply, including raw water off-take system, raw water conveyance and treatment, treated water transmission line and distribution system to the end consumers. The project nature, including project requirements, types and extent of risks associated with project is different by each component of the value chain. ADB (2009) states that the public sector needs to clearly understand the project requirements across the value chain of water supply and review in the context of the possible PPP models, providing information of some successful examples of PPP models that were adopted for water supply projects in India, in the context of water supply value chain as summarized in Table 2.3.3 below.

Table 2.3.3 Successful PPP Models in Context of the Value Chain

Parameters	PPP Model		
	BOT basis concession contract for integrated water supply system	Performance-based management contract for O&M of entire water supply services	Service agreement for only metering billing and collection
Project scope required to private operator	Construction of raw water off-take system and treatment plant, Operation and management of the entire water supply system from	To undertake the activity of O&M of the entire water supply system from source to the consumers, including metering, billing and collection of revenues	Installation of water meters at the end consumers, To undertake the activity of O&M of the water meters, including metering, billing

23

	source to the end consumers		and collection of revenues from the end consumers.
Fund requirement for private operator	High investment for construction of facilities, A fixed monthly payment as licence fee to the government	No investment need, Payment of a fixed licence fee, (All the major capital cost required for improving service are born by the government.)	Investment for meters at the end consumers
Fund recovery of private operator	To levy and collect revenues from the consumers	To levy and collect revenues from the consumers, or To handover the revenues to the government and in return operator's fee is paid by the government.	Recovered from the consumers as part of the water supply bill, A fixed annuity payment is made by the government.
Typical concession period	20 to 30 years	Not specified	Not specified

	PPP Model		
Parameters	DBOOT basis concession agreement for bulk supply system	Concession agreement for distribution system	
Project scope required to private operator	Construction and O&M of raw water off-take system and treatment plant, (Responsibility for treated water transmission and distribution to the water supply network rests with the government.)	Construction/rehabilitation of distribution system, O&M of the entire water supply system	
Fund requirement for private operator	High investment for construction of facilities, O&M cost	High investment for construction/rehabilitation of distribution system, O&M cost	
Fund recovery of private operator	Water charge is paid by the government for the treated water produced.	Investment fund is fully reimbursed by the government. An operator fee is paid by the government.	
Typical concession period	20 to 30 years	5 to 10 years	

Source: ADB (2009)

The above-referred information shows that successful PPP models in water supply project are developed to manage the specific risks associated with the components of the value chain, through

allocation of the risks between the government and the private operator. The type and extent of risks are specifically related with the components of individual water supply project. Therefore, the best suited PPP model for the project should be identified based on adequate risk allocation that can be agreed by both sectors, to avoid conflicts related to the extent of transfer of risks from public to private sector.

2.4 PPP BASED INFRASTRUCTURE PROJECT IN WATER SUPPLY SECTOR

Implementation of an infrastructure project in water supply sector is closely related to satisfaction of basic human needs and therefore, a high financial return from the project has not traditionally been expected by the government in decision around project implementation. However, practical application of the PPP concept is often fraught with difficulties in terms of project development, transaction and especially, government support/guarantee requirement to develop a commercially viable private infrastructure project (PIP) (Rashed, Faisal and Shikha, 2011). Considering the basic nature of an infrastructure project in water supply sector above mentioned, the government would like to more involved in the project and control over it even if it is a PIP. However, as Irwin (2007) states, if the government insists on control over investment decisions to projects, it may have to give guarantees or finance the investments itself and thus bear risks in a different way. Irwin (2007) further provides example of how project guarantees can create large fiscal exposure for the government and contributes to this issue through describing the conceptual framework for assessing contingent liabilities and the government's contingent liability exposure.

There has been very little research on the PIP fiscal risk management process and very little empirical research on the contingent liability from South Asian context (Rashed, Faisal and Shikha, 2011). Under this situation, they deal with the fiscal risk management process and provide policy option for fiscal management for PIP. The risk analysis method related to government guarantees in water supply sector project considering the sector specific conditions is not established in Sri Lanka. Irwin and Mokdad (2009) state that before implementation of a PIP deal, governments need to understand and analyse the contingent liabilities for PPP projects, showing successful cases of management of contingent liability on government guarantee to PPP projects in Australia, Chile and South Africa. Based on this recognition of risks in dealing with PIP and looking into these successful experiences in other countries, it is necessary for Sri Lanka to establish appropriate system for assessing and managing the risks for individual PIP.

2.5 RISK MANAGEMENT IN PPP BASED INFRASTRUCTURE PROJECTS

According to ADB (2009), the keys to success of a PPP based project is identified as: the negotiation around how the private and public sector can reasonably share the risks; the possibility to prepare a request for proposal (RFP) in which sufficient private sector interest is allowed for; and ensuring that the final contract between the two sectors can be honoured in the long term. Especially, the first key – how to allocate the responsibilities or risks reasonably between both sectors, is a prerequisite for the other two keys. The risk allocation framework established and suggested in this research is expected to contribute to assisting the Sri Lankan government in achieving the first key. Consequently, the government can prepare an attractive RFP for the private sector. In addition, this risk allocation framework is expected to contribute to assisting the private sector as well in considering participation in a PPP based infrastructure.

Type and extent of risks to be considered in evaluating a public infrastructure project under PPP scheme will be different by the nature of the project and the implementation mode. There is no list of risks that is applicable to all PPP projects and there is also no risk classification approach that is universally agreed to as best. The risks a PPP project may be exposed to are affected by a number of factors, such as the type and scale of a project, the country where the project is located, and the type of PPP implemented. In addition, the importance of a particular risk factor may also be different from project to project and/or from country to country. For example, political risk is more important in developing countries than in developed markets (Kwak, Chih and Ibbs, 2009).

It is therefore indispensable to understand, first, the entire mechanism of PPP scheme and then to assess all the risk factors associated with PPP projects. The perspective of this research is eventually to propose an adequate risk allocation framework for PPP based infrastructure development project (highlighting water supply sector) and to contribute to successful formulation and implementation of the PPP water supply project in Sri Lanka.

2.5.1 What is expected from PPP by Different Practitioners

(1) Interview Survey Result

Chan and Cheung (2014) show an interesting result of interview survey with different group of experienced practitioners in PPP projects, regarding their perspectives on procuring public works projects. The interviewees are selected from the different groups in different status as shown below.

26

Geographical Difference: Hong Kong and Australia

Group: Public sector (government officials or former government officials),

Private sector (manager or director of private companies such as construction company, project management company and bank) who have been involved in PPP project.

The questionnaires and responses from the interview are summarized in Table 2.5.1.

Table 2.5.1 Background of PPP Project Practice by Country

Country	Honk Kong		Australia	
General Country Situation Regarding PPP Project	Hong Kong may not have the necessary talents for conducting PPP project because of less experience of PPP projects. With increasing number of PPP projects conducted in Hong Kong there is a need to start training their own people.		Australia has conducted many more PPP projects compared to Hong Kong, so they have built up and trained their own resources and expertise over time.	
Respondents Group	Public Practitioner (7 persons)	Private Practitioner (7 persons)	Public Practitioner (7 persons)	Private Practitioner (7 persons)
Q-1: Have you conducted any research looking at local case studies? Responses: • Local case studies • International case studies • Other research conducted	 • 1 • 3 • 5	 • - • - • -	 • 4 • 2 • 5	 • - • - • -
Q-2: How would you compare PPP with traditional procurement method? Responses: • Using a public sector comparator • PPP utilities private sector finance/difference in finance structure • PPP projects gain private sector's added efficiency/expertise/management skills • Each project is unique • Better integration • Better value for money • Larger projects • Different risk profiles	 • 2 • 1 • 2 • 2 • - • - • - • -	 • - • - • - • - • 2 • 2 • 0 • 0	 • 0 • 4 • 2 • 0 • - • - • - • -	 • - • - • - • - • 0 • 1 • 3 • 3
Q-3: Which type of project do you feel is best to use PPP? Responses: • Economically viable • Large operating element/cost • Scope for innovation • Any nature • Sufficient risk transfer	 • 3 • 2 • 0 • 0 • 0	 • - • - • - • - • -	 • 3 • 0 • 3 • 2 • 2	 • - • - • - • - • -
Q-4: What do you feel are the key performance indicators in a PPP project? Responses: • Traditional KPIs; cost, time, quality • Contract terms	 • 3 • 0	 • 1 • 2	 • 1 • 4	 • 0 • 1

• Contractor's performance	• 2	• -	• 2	• -
• Risk/Risk management	• 1	• 1	• 2	• 3
• Economics	• -	• 4	• -	• 5
Q-5: In general, what do you think are the critical success factors leading to successful PPP projects? Responses:				
• Appropriate risk allocation	• 4	• 2	• 1	• 1
• Competitive procurement process	• 0	• -	• 5	• -
• Project objectives well defined	• 3	• 3	• 3	• 2
• Government support	• 0	• 2	• 2	• 1
• Economically viable	• 1	• 2	• 2	• 2
• Good relationships/partnering spirit	• 2	• 2	• 2	• 2
Q-6: Does your organization/company have any in-house guidance/practice notes? Responses:				
• No	• 4	• 3	• 0	• 2
• Yes	• 3	• 0	• 6	• 1
• Refer to others	• 2	• 4	• 1	• 4
Q-7: Which PPP projects has your company been involved? Responses:				
• Local and international projects	• -	• 4	• -	• 2
• Local projects	• -	• 3	• -	• 5
Q-8: Please describe the implementation process in these projects (mentioned in Q-7)? Responses:				
• Reduce competition	• -	• 0	• -	• 2
Q-9: What were the major reasons for adopting PPP in these projects (mentioned in Q-7)? Responses:				
• Private sector expertise	• -	• 5	• -	• 1
• Government needs	• -	• 2	• -	• 4
• Value for money	• -	• 3	• -	• 0
• Transfer of risk	• -	• 1	• -	• 2
Q-10: Which type of project would your company be most interested in applying PPP? Responses:				
• All	• -	• 5	• -	• 1
• Project with prospect of success	• -	• 2	• -	• 1
• Economic infrastructure	• -	• 0	• -	• 3
• Social infrastructure	• -	• 0	• -	• 3

Note: '- 'no such question was made.

Source: Chan and Cheung (2014)

(2)   Summary of Findings

The interview result shows that there observed a number of differences and similarities regarding the recognition/understanding on PPP projects and expectation from PPP projects between the two countries and between the public and private sectors. Even for very basic factors, such as the reason for applying PPP for infrastructure development and the critical success factors (CSFs) of PPP, the responses from each country and each party are not necessarily same. This result is

logical as each country will differ in practice of PPP, culture, geographical locations, experience, tradition, and also politically, economically and socially.

On the other hand, there are some questions for which both countries give the same responses. This implies that in application of PPP project or selecting any PPP structure/model for an infrastructure project, it would be necessary to make an in-depth study on various factors which are unique to the country situation, including the public sector and the private sector. Whether or not PPP based infrastructure is appropriate in the country and in the sector and what kind of PPP structure/model is accepted by the public and private practitioners. This process would be closely related to the 1st to 3rd steps of PPP procedure mentioned in the previous section,

Hence it is of interest to clarify the situation of Sri Lanka regarding adopting PPP procurement method for infrastructure development (highlighting water supply/sanitation sector), through conducting the similar interview survey.

2.5.2 Quantitative Approach for Formulation of Risk Allocation Strategy

As described in many literatures, including ADB (2009), World Bank IFC MIGA (2012), European Commission (2003), UNESCAP (2011), etc., an adequate risk allocation between the public and the private sectors is an essential key to success of PPP infrastructure projects. A number of risk factors and the categories in PPP projects or the critical success factors of PPP projects have been identified and discussed in governments' guidelines and in many research cases, such as Li and Zou (2012) and Wibowo and Mohamed (2010). Jin and Zhang (2011) states that the risk allocation framework has been tested and generally supported by using multiple linear regression (MLR) technique. However, they further state MLR analysis bears a number of inherent limitations, which include only considering linear relationship, being probability-oriented, and being unable to identify all the factors necessary to reflect realistic situations, therefore non-probability-based analysis techniques are required and non-linear relationships need to be considered.

Perceptions to risks or critical success factors which influence to the projects are different by people's situation even if they are the professionals/experts of PPP projects. Risk allocation strategy may vary from risk to risk and from project to project (Jin and Zhang, 2011). It is apparent from this discussion that people's perception to risks do not show a linear relationship among them, and this is considered an essential reason for the inherent limitation of MLR. In formulation of an

adequate risk allocation when there are a number of determinants for the allocation, it is considered important how much weight should be put on each determinant or risk factor, and that this risk ranking or prioritization is made incorporating the unique factors to the objective country situations. If this prioritization process could be supported by any quantification technique, the result could be acceptable for different party, such as the public and private sectors.

Collection of Expert Opinion and Quantification Technique of People's Perception, Idea or Feeling

Intending to incorporate the perceptions or ideas to the risks in PPP infrastructure projects unique to the objective country, a questionnaire survey for the professionals or experts who have been engaging in PPP projects is applied in many conference papers or research cases. For example, Sy Tiend et al. (2015), Shuaib, Dahiru, and Ruya (2015), Rohman, Doloi and Heywood (2015) use questionnaires to acquire people's ideas regarding critical risk factors in PPP transportation project, critical success factors of PPP projects and community perspectives of the social benefits of PPP toll road projects, respectively. Ameyaw and Chan (2015c) adopt a ranking-type questionnaire survey in data collection for their research on evaluation and ranking of risk factors in PPP water supply projects in developing countries. Furthermore, Ameyaw and Chan (2015a) obtain the data on risk management capability of the public sector and the private sector through a questionnaire survey for the experts involved in PPP water supply projects.

For quantitative assessment of critical risk factors, critical success factors or community perspective of PPP infrastructure projects, Wibowo and Mohamed (2010), Sy Tiend et al. (2015), Shuaib, Dahiru, and Ruya (2015), Rohman, Doloi and Heywood (2015) apply statistical analyses for the data quantified based on 5 points Likert rating scale. For modelling optimum risk allocation in PPP projects Jin and Zhang (2011) apply artificial neural networks also for the data quantified using Likert rating scale. Ameyaw and Chan (2014) also use a seven-point grading system to rate the relative importance of each perceived critical success factor (CSF) in implementing PPP water supply projects in Ghana, for further quantitative analysis. It, however, does not seem that these literatures clearly conclude how the quantitative analysis results can contribute to formulating the appropriate allocation policy or strategy of risks between the public and private sectors. In case of Analytical Hierarchy Process (AHP) that was adopted in this research, the base of quantitative assessment of risk factor is a simple pairwise comparison between two items by decision-maker,

compared to the Likert rating scale technique, it is considered easier for decision-makers to present the difference or priority ranking in relative importance among risks, based on their perceptions or ideas.

2.5.3   PPP Project Procurement Process and Risk Allocation Framework

(1)   PPP Project Procurement Process

In order to consider how a risk allocation strategy which is elaborated by government can be practically incorporated into PPP project implementation, discussion on the procurement process of PPP project is made below.

The project procurement is the latter stage in the entire activities for formulating and developing a project before transferring to the implementation stage including design, construction and/or operation stage. According to ADB (2009), a detailed implementation plan for the contractual structure, that is termed as the transaction structure, needs to be prepared, which includes clear and precise definitions of the scope of work and the roles and responsibilities of the two contracting parties – government agency and private provider. From the aspect of contractual structure, Li *et al*. (2005b) regard government agency and private provider as the public client and the private bidders, respectively. The transaction structure is prepared by the government agency – the public client for providing all information required for PPP contract. The risks associated with the project and their allocation between both sectors are also provided as part of the information. The procurement activities are carried out through bid procedure where the request for proposal (RFP) is issued to the private bidders. RFP documents is prepared by the public client, based on the transaction structure. Therefore, during the bid procedure, risks and the allocation are indicated to the bidders and the bidders can prepare their proposals upon recognizing the risks and the allocation that is intended by the public client. In this procurement process of project operator, an assumed risk allocation scheme is provided to the private bidders by the public client. According to Li *et al*. (2005b), risk allocation framework is a common method that can be adopted in the course of bid procedure for PPP/PFI projects to show the risk allocation strategy of public client to the bidders, and the private bidders can estimate their bidding prices based on the risk allocation framework provided in the bid documents by the public client, looking into recovery of the cost of managing the allocated risks to them through the bid-price mechanism. It is, therefore, clear that while a balanced risk allocation framework developed based on full understanding and precise

31

assessment of risks is an important key to project success, as Ng and Loosemore (2006) state presenting a highly controversial railway project in Sydney Australia, an imbalanced distribution of risks can lead to project failure.

(2)   Exploration of Risk Allocation Framework for PPP

Risk allocation framework has been proposed by many researchers. Peckiene, Komarovska and Ustinovicius (2013) mentions that risk allocation among contracting parties has been studied by a number of researchers all over the world. Through literature review, some examples of research methodology that is applied for proposing risk allocation framework or strategy, such as preferred risk allocation, optimal risk allocation or balanced risk allocation are summarized below Table 2.5.2.

Table 2.5.2 Research Cases on Exploring Risk Allocation Framework in PPP/PFI Project

Research	Data collection method	Conversion method of collected data (respondents' perceptions/experiences on allocation of specific risks) to numerical data	Decision-making analysis method for risk allocation using quantified data of project practitioners' perceptions and experiences
Wibowo and Mohamed (2008)	Questionnaire survey for selected project practitioners both in public and private sectors	Survey participants are asked who best retain a particular risk. No conversion of collected date to numerical data.	Decision-making approach is not taken. Central tendency of risk allocation is presented. Precise assessment of associated risks for risk allocation of a specific PPP project is necessary for a specific project.
Li *et al.* (2005b)	Questionnaire survey for selected project practitioners both in public and private sectors	Survey participants are asked to choose risk allocation preference of a particular risk out of public, private or share. No conversion of collected date to numerical data.	Decision-making approach is not taken. Central tendency of risk allocation is presented. Precise assessment of associated risks for risk allocation of a specific PPP project is necessary for a specific project.
Ke *et al.* (2010)	Questionnaire survey for selected project practitioners both in public and private sectors	Survey participants are asked to choose risk allocation preference of a particular risk out of 5 categories, 1: sole responsibility of public, 2: major responsibility of public, 3: equal share between public and private, 4: major responsibility of	A two-round Delphi survey, Risk allocation preference is indicated with the range of calculated mean score. It can convert descriptive and linguistic terms into quantitative outcomes though more calculation is required.

		private or 5: sole responsibility of private. Five-point Likert scale for the five categories as shown above.	
Ameyaw and Chan (2015b)	Questionnaire survey for selected project practitioners both in public and private sectors	Seven-point grading system for relative importance of each Risk Allocation Criteria (from 1: extremely high importance to 7: extremely low importance)	Fuzzy Synthetic Evaluation approach. While it can convert descriptive and linguistic terms into quantitative outcomes, this approach is tedious in terms of calculation, particularly when several risks, risk allocation criteria (RAC) and decision makers are involved (Ameyaw and Chan, 2015b).
Jin and Zhang (2011)	Questionnaire survey for selected project practitioners both in public and private sectors. The answers required to the potential respondents are highly specialized and may give considerable extent of load to the respondents. The survey response rate of 11.4% may indicate the implication.	Survey participants are asked to choose one answer prepared by the researcher regarding the environmental factors when PPP partners deciding risk allocation strategies, and to specify risk proportion that could be transferred from public partner to private partner and would make the management of the risk most efficiently. Five-point Likert scale for the five choices of answer prepared by the researcher.	Artificial neural networks. It can convert descriptive and linguistic terms into quantitative outcomes. As the questionnaire survey applied for this method has highly technical and specialised nature, it would not be easy to access to proper project practitioners and to obtain reliable answers.
Li and Zou (2012)	Questionnaire survey for selected project practitioners both in public and private sectors.	Pair-wise comparison among elements with respect to their importance to the entire decision problem.	Fuzzy approach using analytical hierarchy process (AHP), in order to deal with vague and uncertain nature of risks. It can convert descriptive and linguistic terms into quantitative outcomes. In addition to AHP calculation, calculation steps of fuzzification and defuzzification are required.

In the six literatures indicated in the above Table 2.5.2, a structured questionnaire survey for selected project practitioners both in the public and private sectors is adopted to collect the data, that is, perception of the questionnaire respondents in preferred allocation of specific risks associated with PPP/PFI infrastructure projects. Peckiene, Komarovska and Ustinovicius (2013)

presents as a result of the study on analysis methodology for risk allocation between construction parties that the most popular method in analysed article is questionnaire survey. Out of the above six literatures, Li *et al.* (2005b) and Wibowo and Mohamed (2008) propose an appropriate risk allocation framework based on the central tendency of risk allocation preference perceived by questionnaire respondents, by simple statistical processing for the collected data. In these two literatures, a risk list prepared by researcher is given to the questionnaire respondents and the respondents are asked to identify which sector (public or private) should be more suitable to control a specific risk in the list. Risk allocation is decided by the higher percentage value allocated by respondents for public or private sector. The obtained risk allocation strategy is considered to be influenced by number and subject of respondents. Ke et al. (2010), Ameyaw and Chan (2015b), Jin and Zhang (2011) and Li and Zou (2012) propose an appropriate risk allocation framework by applying analysis of decision-making technique under multiple conditions for the collected data – respondents' idea, perception or experience in allocation of specific risks between the public and private sectors. Risk allocation is decided using an index obtained through analysis adopted by researcher. While the risk allocation strategy can be presented in quantitative manner through conversion of the descriptive information of the respondents' idea or perception to more suitable sector to control a specific risk, this method needs a complicated mathematical approach. Strengths and weaknesses are inherent in respective analysis methods adopted in each research for exploring an appropriate risk allocation framework.

Although risk allocation frameworks are proposed applying some different analysis methods of decision-making technique, based on information collected from experienced project practitioners in the specific sector, as Ameyaw and Chan (2015a) concludes, finally future research needs to cross compare the decision-making results, using the same data set, considering on the advantages and disadvantages of different methods.

2.6   SUMMARY

While requirements of development are increasing in many countries in the world, the government's ability to address public needs through the traditional ways has been heavily constrained. This situation led governments worldwide to increasingly look to the private sector and promoting PPP for implementing Private Infrastructure Project (PIP). In the context of worldwide view of the infrastructure development, the situation of infrastructure development in

water supply/sanitation sector in Sri Lanka was also reviewed and it came to conclusion that it is necessary to explore some way to address successful implementation of PPP based project.

In the context of this research aim, "To develop a framework for allocation of risk between public and private sectors", the literature review was commenced from understanding the general features and structures of PPP based infrastructure projects, including the advantages and disadvantages. Subsequently, the general implementation process of PPP infrastructure projects was studied.

The literature highlights the critical importance of adequate risk allocation between the public and private sectors as a key to the success of PPP based infrastructure projects, especially highlighting discussion on the project nature in water supply sector in comparison with other sectors, such as telecommunications, power and port. Important risks associated with the PPP projects are also identified and the importance of those risks is quantitatively assessed or prioritization of the risks is made applying some quantification techniques. Commonly, in recognition of the lack of an objective method to quantify, experiential knowledge of PPP practitioners is used by collecting the data through questionnaire survey with the well experienced PPP practitioners in the public and private sectors. It, however, does not seem that these literatures clearly conclude how the quantitative analysis results can contribute to formulating the appropriate allocation policy or strategy of risks between the public and private sectors.

In this research, quantification of relative importance of risks associated with PPP water supply project in Sri Lanka will be attempted using Analytical Hierarchy Process (AHP). Experiential knowledge of PPP practitioners in public and private sectors in Sri Lanka will be collected for AHP analysis through questionnaire, and a framework of appropriate allocation of risks between the public and private sectors will eventually be proposed, based on the quantified importance of risks by considering any linkage with risk management capability of respective parties to be involved in PPP water supply projects. Lastly, some research cases in which a risk allocation framework is proposed are provided and the research methodology including data collection method and analysis method adopted in each research are compared. This cross-comparison review will help to discuss research approach, analysis method and assumption used in this research.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

The section covers approach/philosophy followed by a detailed research design. In this research five objectives are proposed as indicated in section 1.3.2 and the third objective is considered to be a key activity. In order to develop a participatory framework for adequate risk allocation, at first it would be necessary to consider what the adequate allocation or share of risk(s) is, or how risk(s) can be allocated or shared between the public and private parties so that both parties can come to agreement to proceed with a PPP water supply project. In this research an attempt to investigate the adequacy of risk allocation will be conducted based on the data obtained by quantifying the participants' knowledge, perceptions and experiences. It is evident that the subject matter of adequate risk allocation belongs to the positivist quantitative tradition. A participatory framework for adequate risk allocation acknowledges the need for a quantitative measurement of selected attitudes and quantitative assessment of main risk categories. The approaches to fulfil the objectives are discussed in the following section.

3.2 RESEARCH PHILOSOPHY

3.2.1   Methodological Paradigms

Creswell (2009) states that paradigms (philosophies) are latent in research, however Creswell (2009) also mentions that they form the research strategies and it is necessary to identify the paradigms. The author suggests that individuals preparing a research proposal or plan make explicit the larger philosophical ideas they espouse because this information will help explain about the reason for choosing the research strategy and method.

When discussing philosophy underlying in a research approach, the terms ontology and epistemology are often used in literatures. The concepts of ontology and epistemology are generally explained in many literatures as major branches of philosophy. According to Holden and Lynch (2004), ontology (reality) and epistemology (knowledge) are core assumptions which delineate two major philosophical approaches to research. The ontological question may be that what reality exists there and what nature the reality has, and it may be a base of all sciences, studies and research including this research, or in other word it may be a motivation to start a research and continue to explore the research theme. On the other hand, the epistemological question may be

that how reality can be known and thus, it may give some implication of the way how to explore the research theme to researchers. In this sense the epistemological concept may be more matching with discussing research approach/framework/design and helpful for researchers of natural science and social science in developing the research design. Grix (2002) states that epistemology is one of the core branches of philosophy that is concerned with the theory of knowledge, especially with regard to its methods, validation and the possible ways of gaining knowledge of social reality. As researchers seek to make an original contribution to knowledge through the creation and interpretation of new knowledge (The Quality Assurance Agency for Higher Education, 2011), it will be important to learn the epistemological concept, which is concerned with the ways to achieve knowledge, as above stated by Grix (2002).

Creswell (2009) uses the term "worldview" for ontology and epistemology and regards these two concepts as a basic set of beliefs that guide action. According to Creswell (2009), worldview is a general orientation about the nature of research that a researcher holds. The author further states that the types of beliefs held by individual researchers will often lead to embracing a qualitative, quantitative, or mixed methods approach in their research and indicates four different worldviews, including post-positivism, constructivism, advocacy/participatory and pragmatism. The major elements of each position presented by the author are provided in Table 3.2.1.

Table 3.2.1 Major Elements of Philosophical Position

Post-positivism	Constructivism
➢ Determination ➢ Reduction ➢ Empirical observation and measurement ➢ Theory verification	➢ Understanding ➢ Multiple participant meanings ➢ Social and historical construction ➢ Theory generation
Advocacy/Participatory	Pragmatism
➢ Political ➢ Empowerment Issue-oriented ➢ Collaborative ➢ Change-oriented	➢ Consequences of actions ➢ Problem-centred ➢ Pluralistic ➢ Real-world practice oriented

Source: Creswell (2009)

The choice of philosophical position as indicated above has implications in conducting research, however as Holden and Lynch (2004) states that philosophical positions as above are a continuum's polar opposites with varying philosophical positions aligned between them and researchers must bear in mind that "What to research?" may have a major impact on methodological choice. The authors conclude in their research that elasticity in "What to research?"

is gained only through an intermediate philosophical position, thereby allowing researchers to match philosophy, methodology, and the research problem.

3.2.2   Research Paradigms Adopted for This Research

This research is seen to have some implications of positivism in relation to the aim, data to be used, concept and unit of analysis. However, it is considered logically effective to adopt post-positivist position in this research as stated below.

The aim of this research is to propose a framework on adequate risk allocation, based on a general consensus that risks should be allocated to the contracting party best able to control and manage them. For fulfilling the aim, the knowledge of professionals or experts which have been established through experiences unique to each person are analyzed and it is attempted to generate meanings from the data set in order to identify patterns or relationships to build a theory. Considered the nature of the data set (observations) to be collected in the research, it is considered that the reality involved in the observations is not a single reality but multiple according to the knowledge and perceptions which are individually established in human (research participant) through their experiences. Therefore, knowledge or perceptions of the research participants for a risk factor is presumed different respectively. This implies to the researcher that all observation is fallible and has error.

In a positivist view of the world, science is seen as the way to get at truth, to understand the world well enough so that we might predict and control it. The world and the universe were deterministic (Trochim, 2006). The author also states that one of the most common forms of post-positivism is a philosophy called critical realism, and although positivists were also realists, the difference is that the post-positivist, critical realist recognizes that all observation is fallible and has error and that all theory is revisable. Trochim (2006) further states that most post-positivists are constructivists who believe that we each construct our view of the world based on our perceptions of it because perception and observation is fallible. According to this, it is considered that each of the research participants also construct their view of the world based on their perceptions of it. According to Creswell (2009), social constructivists hold assumptions that individuals seek understanding of the world in which they live and work, thus individuals develop subjective meanings of their experiences. Creswell (2009) further states that these meanings are varied and multiple, leading the researcher to look for the complexity of views rather than narrowing

38

meanings into a few categories or ideas. It can be understood that the researcher observes multiple reality in the post-positivist field. Trochim (2006) mentions that the positivist believed that the goal of science was to uncover the truth, whilst social constructivists believe that the goal of the research is to rely as much as possible on the participants' views of the situation being studied (Creswell, 2009).

Based on the above discussion, it is logical to adopt post-positivism as an overarching research paradigm for the phenomenon being investigated in this research.

3.3 RESEARCH STRATEGY AND METHODS

Subsequent to adoption of the philosophical position in research, researchers also adopt a research strategy and specific research method for collecting and analyzing data. According to Creswell (2009), the research strategy (i.e., strategy of inquiry) provides specific direction for procedures in a research design. Creswell (2009) also states that the two dominant categorizations of research methodologies that derive from the philosophical positions are quantitative and qualitative research although mixed method strategies also exist.

3.3.1   Quantitative Research Strategies and Methods

According to Creswell (2009), quantitative research strategies refer to research designs that employ numerical and objective measurements in addressing research questions, it therefore aligns with deductive reasoning where there is *a prior* formulation of theories or hypotheses that are operationalized and subjected to rigorous empirical testing. Quantitative research approaches focus on testing theories by examining the relationship between variables. There are two main quantitative research approaches; experiments and surveys (Creswell, 2009). Experiments and surveys are discussed in the subsequent sections.

Experiments

Shadish, Cook and Campbell. (2002) says that experiments are investigations that seek to measure the effect of manipulating one variable against another variable in a controlled environment, and to test causal relationships between variables, all experiments involve at least a treatment, an outcome measure, units of assignment and a form of comparison based on which change could potentially be attributed to the treatment. Pure experiments are characterized by the random assignment of treatment which is easier to achieve with objects in a laboratory than with humans

in the field (Shadish, Cook and Campbell, 2002). Quasi-experiments are experiments that retain similar properties as true or pure experiments but where treatment for comparison is not randomly assigned (Shadish, Cook and Campbell, 2002).

Surveys

Surveys involve the assessment of thoughts, feelings and opinions through the administration of questionnaire instruments. Questionnaires are usually administered to a representative sample selected from a wider population although census surveys can also be undertaken to collect information from everyone (Gomm, 2004). The issue of statistical representativeness is a very important consideration in survey research (Gomm, 2004). Stangor (2010) points out that the advantages of surveys are that they are relatively inexpensive in reaching a large number of respondents in different geographical areas, are more likely to produce honest responses due to anonymity of respondents and are less likely to be influenced by the characteristics of the researcher. Stangor (2010) also states that the downside however remains that surveys are often structured, cross-sectional and shallow in nature and therefore only suited for producing a 'snapshot' of opinions, attitudes or behaviors of a group of people at a specific time. On the other hand, in longitudinal surveys, data is collected over long periods of time. Measurements are taken on each variable over two or more distinct time periods. This permits the measurement of change in variables over time.

3.3.2   Qualitative Research Strategies and Methods

Creswell (2009) says that qualitative research strategies refer to research designs that explore meanings and causal interactions using textual rather than numeric data. Qualitative strategies align with inductive reasoning which there is a prior hypothesis to be tested empirically as is done in deductive research (Creswell, 2009). Qualitative research approaches are aimed at exploring the meanings that individuals attach to human or social problems. According to Manu (2012), qualitative researchers tend to collect four kinds of data: interview data; observation data, document data, and audio-visual data. The common forms of data analysis used in qualitative strategies are text analysis and image analysis. The samples collected are often small as the focus is obtaining in-depth meaning and not generalization.

3.3.3   Major Differences Between Quantitative and Qualitative Methods

Mack *et al.* (2011) outlines the major differences between quantitative and qualitative research methods as shown in the Table 3.3.1 below.

Table 3.3.1 Comparison of Research Strategies

Comparison Items	Quantitative Strategy	Qualitative Strategy
General framework	➤ Seek to confirm hypotheses about phenomena ➤ Instruments use more rigid style of eliciting and categorizing responses to questions ➤ Use highly structured methods such as questionnaires, surveys, and structured observation	➤ Seek to explore phenomena ➤ Instruments use more flexible, iterative style of eliciting and categorizing responses to question ➤ Use semi-structured methods such as in-depth interviews, focus groups, and participant observation
Analytical objectives	➤ To quantify variation ➤ To predict causal relationships ➤ To describe characteristics of a population	➤ To describe variation ➤ To describe and explain relationships ➤ To describe individual experiences ➤ To describe group norms
Question format	➤ Closed-ended	➤ Open-ended
Data format	➤ Numerical (obtained by assigning numerical values to responses)	➤ Textual (obtained from audiotapes, videotapes, and field notes)
Flexibility in research design	➤ Study design is stable from beginning to end ➤ Participant responses do not influence or determine how and which questions researchers ask next ➤ Research design is subject to statistical assumptions and conditions	➤ Some aspects of the research are flexible (for example, the addition, exclusion, or wording of particular interview questions) ➤ Participant responses after how and which questions researchers ask next ➤ Research design is iterative, that is, data collection and research questions are adjusted according to what is learned

Source: Mack et al. (2011)

3.3.4 Deductive Process and Inductive Process

As referred in the previous sections, two terms, deductive and inductive, are used for explanation of a contrast between quantitative research strategy and qualitative research strategy. Deductive and inductive research methods are generally known as term to explain the different way of inference that is a logical process to reach a conclusion from a premise. It may be understood that deductive method is to explain a special phenomenon that is observed there based on a general law already established, and on the other hand inductive method is a reverse way, that is, to derive a general law from a group of individual and simple phenomenon observed.

In order to contribute to the selection of an appropriate research strategy and method, the concept of the two research methods is reviewed. Trochim (2006) briefly explained the essence of the two research methods of reasoning as given below.

1) Deductive research method

Deductive reasoning works from the more general to the more specific. Sometimes this is informally called a "top-down" approach. Research might begin with thinking up a *theory* about the topic of interest. It then narrows that down into more specific *hypotheses* that can be tested. The research narrows down even further collecting *observations* to address the hypotheses. This ultimately leads us to be able to test the hypotheses with specific data -- a *confirmation* (or not) of our original theories. This process is illustrated as below.
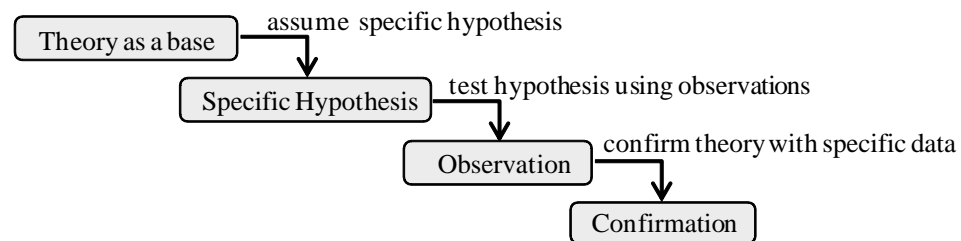
Source: Trochim (2006)

Figure 3.3.1 Deductive Reasoning Process

2) Inductive research method

Inductive reasoning works the other way, moving from specific observations to broader generalizations and theories. This is informally called a "bottom up" approach. In inductive reasoning, Research begins with specific observations and measures, begins to detect patterns and regularities, formulate some tentative hypotheses that can be explored, and finally end up developing some general conclusions or theories. This process also illustrated as below.
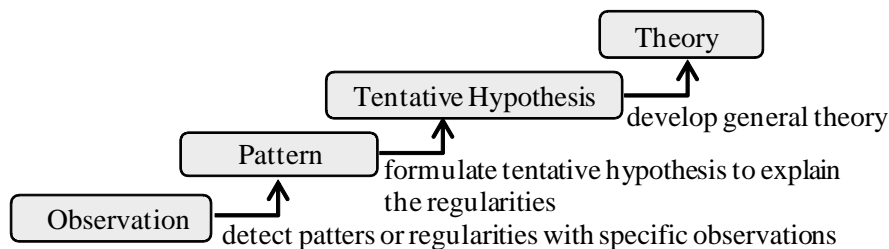
Source: Trochim (2006)

Figure 3.3.2 Inductive Reasoning Process

3.3.5   Research Strategy Adopted to This Research

In order to meet the research aim, a quantitative strategy is adopted. In this research relative importance of risk factors associated with PPP based water supply project is assessed using quantitative data collected through a questionnaire survey with research participants. This relative importance of a risk is assessed in association with risk control or management capability of PPP project practitioners that was also attempted to quantify. This research focuses on examining the relationship between the above two factors that can be regarded as variables. A technical point of this approach is how people's judgments, ideas, opinions or perceptions, which results from the fuzzy cognitive process of human, can be incorporated within a quantitative assessment. It is an attempt to quantify the personal knowledge or perceptions of professionals/experts based on their experiences.

Considered above discussion, it is evident that an appropriate research strategy is quantitative strategy and the research approach is enabled by applying inductive method. As Creswell (2009) states that inductive reasoning is an approach used in qualitative research, therefore some have suggested that the application of inductive approach is associated with qualitative methods of data collection and data analysis, whereas deductive approach is perceived to be related to quantitative methods. However, Dudovskiy (2018) states that the above idea is not absolute, and in some instances inductive approach can be adopted to conduct a quantitative research as well. Dudovskiy (2018) also mentions that inductive approach aims to generate meanings from the data set collected in order to identify patterns and relationships to build a theory; however, inductive approach does not prevent the researcher from using existing theory to formulate the research question to be explored. The author shows the following Table 3.3.2 to illustrate the relation amongst the patterns of data analysis, research strategy and research approach.

Table 3.3.2 Data Analysis Pattern by Research Strategy and Approach

	Qualitative strategy	Quantitative strategy
Inductive approach	Grounded theory	Exploratory data analysis
Deductive approach	Qualitative comparative analysis	Structural equation modeling

Source: Dudovskiy (2018)

The data analysis pattern used in this research is exploratory data analysis, therefore the research strategy and approach adopted for this research is considered to be justified. By detecting any patters or regularities in the data-set gathered from the research participants, it will be possible to

derive any participatory framework as general theory which contributes to adequate risk allocation or share of risks between both public and private sectors.

3.4 RESEARCH PROCESS

This research consists of three steps as indicated in Figure 3.4.1. The first step is identification of research gap, identification of risk factors associated with PPP water supply projects and design of questionnaire which is to be a base for the quantitative analysis at the next step. At the second step data analysis is conducted for assessing relative importance of the risk factors and risk control or management capability of PPP project practitioners quantified by applying AHP technique for the questionnaire output from the respondents. At the third step it is attempted to develop a framework on adequate risk allocation, based on a general consensus that risks should be allocated to the contracting party best able to control and manage them (Ameyaw and Chan, 2015c) and the validation by feed back to the respondents.

The features and the magnitude of the risks identified for a project are different depending on the nature of project, the project scale and the implementation method. It is, therefore, necessary to identify and assess the risk categories and the risk factors from various aspects before considering the allocation, to realize an adequate allocation for the public sector and the private sector, respectively. In parallel, it will be necessary to consider the risk control or management capability of project practitioners for the risks. Because it can be assumed it a normal practice that project practitioners would like to determine the types and magnitude of risk they take, according to their risk control or management capabilities. This assumption is related to the general consensus in risk allocation stated by Ameyaw and Chan (2015c). When a project practitioner, whichever public sector or private sector, is asked about the importance of a risk, what is the reason why he thinks it is very important or it is not so important. The reason may be associated with the level of risk control or management capability of his sector and the extent of his expect that the risk should be taken by another sector. It is, therefore, useful in this research to examine the risk control/management capability of project practitioners as well.

For identification and the assessment of risks and the risk control or management capability of practitioners in this research it is considered to use the knowledge and experience of the professionals or experts which have been engaged in PPP infrastructure projects in Sri Lanka. Those knowledges are quantified for further discussion on the features and relative importance of

various risks which are associated in implementation of PPP infrastructure projects. Based on the discussion/analysis results regarding the features of those risks and risk control/management capability of project practitioners, a participatory framework for dealing with those risks will be developed.

This research process composed of 1) research design and data collection step, 2) data analysis step and 3) framework development and evaluation step are shown in Figure 3.4.1 below.
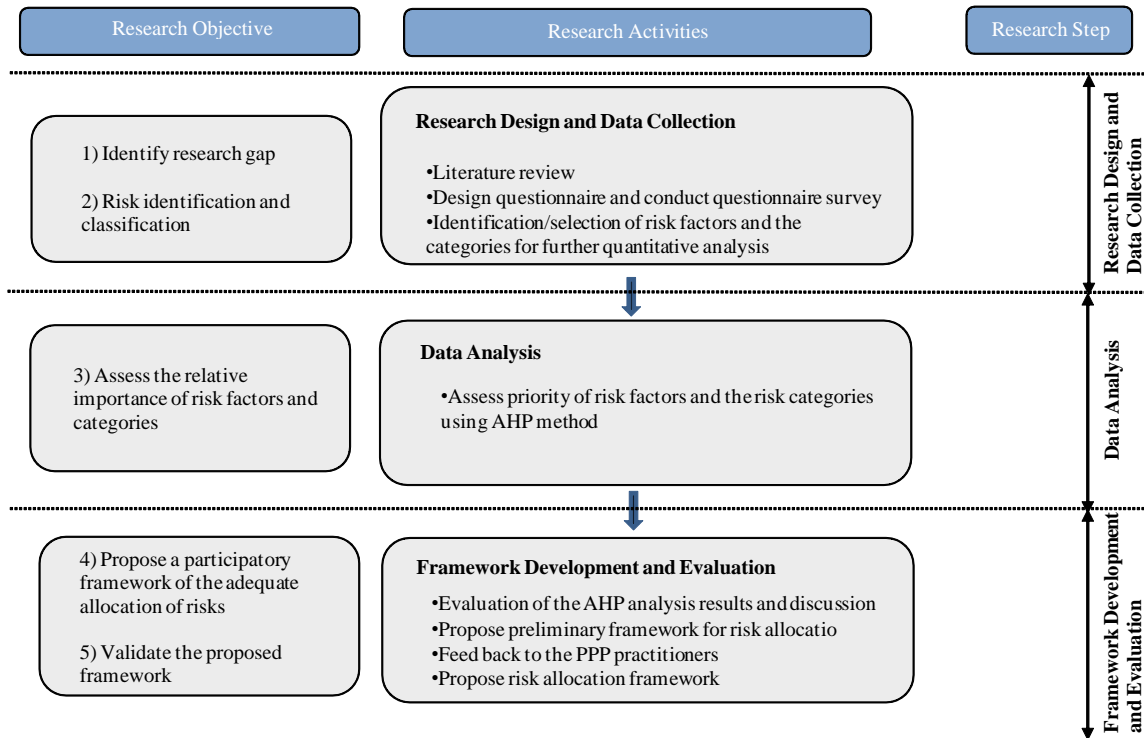
Figure 3.4.1 Overall Research Process

3.5 DETAILED RESEARCH DESIGN

According to Creswell (2009), the research design process involves inter-connections between philosophical assumptions (approach), strategies of inquiry and research methods adopted in a research. This research was conducted adopting quantitative strategy under the postpositivist epistemological position. In this section detailed research design is discussed, based on the philosophical approach, research strategy, research method discussed in the previous sections and the research objectives by the research step identified in the section 3.4 and according to Table 3.5.1 below.

Table 3.5.1 Research Procedure and Method by Research Objective

Research Step	Research Objective	Method
The 1st Step (Research design and data collection)	(1) Identify research gap, (2) Risk identification and classification	➢ Literature review ➢ Questionnaire survey to well experienced practitioners of PPP (preparation of input data for AHP)
The 2nd Step (data analysis)	(3) Assess the relative importance of risk factors and categories, in association with risk control/management capability of project practitioners	➢ Quantitative analysis using AHP
The 3rd Step (Framework development and evaluation)	(4) Propose a participatory framework of the adequate allocation of risks (5) Validate the proposed framework	➢ Evaluation of the AHP analysis results and discussion, ➢ Propose risk allocation framework ➢ Feed back to the PPP practitioners

3.5.1 Research Design and Data Collection – 1st Step

Research Objective (1): Identify research gap and appropriate way to address it

An extensive literature review was carried out for identifying the research gap. In the context of infrastructure, especially in water supply/sanitation sector, Sri Lanka has very limited experiences in the private sector involvement and there has been very little research on identification and management of risks associated in PPP project. Considering the above background, at first it was carried out to understand international practices of implementation of PPP infrastructure based on the extensive literature review, in order to discuss applicable PPP models, associated risk factors and the assessment in Sri Lanka and other countries.

These countries have different background respectively which may eventually affect the implementation of PPP infrastructure project, including geographical location, economic condition, government financial condition, experiences or history in PPP project, etc. It is useful in exploring the PPP models and the risk factors in Sri Lanka to understand how the difference or similarity of the country background affects the perspective of PPP project and perception to the risks involved.

The literature review covers the following areas.

1) Type of PPP models/structures applied for water supply/sanitation sector
2) Risk factors and the classification in implementing PPP based infrastructure projects, especially in water supply/sanitation sector
3) Infrastructure development policy under PPP in Sri Lanka
4) Samples and idea for questionnaire design for collecting information of ideas or perceptions of practitioners who have been involved in PPP water supply projects

5) Risk assessment methods - qualitative identification/classification and risk quantification methods

6) Risk allocation method – how the allocation method of the identified risks to the public and private sectors is discussed and what kind of quantitative indices are used in risk allocation

Research Objective (2): Risk identification and classification

In this research quantitative assessment of risks associated in PPP projects was attempted adopting AHP technique. AHP was introduced by Saaty, and it is a multi-criteria decision-making approach and a technique used to properly solve a problem in a complex, unanticipated and multi-criteria situation (Triantaphyllou and Mann, 1995). Prior to assessment of risks, it is necessary to identify and categorize all the risks. At first, the risks and the consequences will be listed based on generic risk lists formulated in other literatures such as list prepared by ADB as given in Table 3.5.2 below.

Table 3.5.2 Generic Risk Categories (ADB, 2009)

No.	Risk Category	No.	Risk Category
1	Commissioning risk	9	Latent defect risk
2	Construction risk	10	Operating risk (service under performance)
3	Demand risk	11	Performance risk
4	Design risk	12	Change in law risk
5	Environmental risk	13	Residual value risk
6	Financial risk	14	Technology obsolescence risk
7	Force majeure risk	15	Upgrade risk
8	Industrial relations risk		

Since the list of risks presented above is generic and illustrative in nature, it will be necessary to further examine the specific risks and categorise, considering the unique and specific conditions in Sri Lanka and in water supply/sanitation sector. Since infrastructure projects are normally implemented through multiple stage having its unique risk factors and successful criterion, it may be also beneficial to classify them from project life cycle perspectives.

Ameyaw and Chan (2015a) use the following categories of critical risk factors in PPP water supply projects for the evaluation and ranking of risk factors, as shown in Table 3.5.3.

Table 3.5.3 Classification of Critical Risk factor (Ameyaw and Chan, 2015a)

No.	Risk Category
1	Financial/commercial
2	Legal and socio-political
3	Technical

In total 22 risk factors are classified into the above three categories and used for the assessment and allocation study, applying fuzzy synthetic evaluation (FSE) method.

In this research the risk identification and classification were conducted referring to the relevant literatures, such as (Shuaib, Dahiru, and Ruya, 2015), (Tiendo, Likhitruangslip, Onishi, 2015) and (Chan and Cheung, 2014). As the result, a number of risk factors are identified and categorized through this literature review. In this research selection of the critical risk factors are further attempted out of the above identified risk factors through a questionnaire survey. The target group of the questionnaire survey is well experienced project practitioners in the public and private sectors, expecting the sufficient knowledge relevant to PPP infrastructure project. The sample size depends on the resources and time available as well as the study objectives (Mack et al., 2011). Considering this research is conducted adopting inductive research process under quantitative strategy, the sample data should be collected as much as possible, and the questionnaire sheets were eventually delivered to around 100 potential research participants by e-mail. It is apparent that the target group in this research is not easily accessible to researchers. However, once the researcher succeeds in contacting the first potential participant or informant, the participant with whom contact has already been made uses his/her social networks to refer the researcher to other people who could potentially participate in the research. In this research this sampling method known as snowball sampling process (Naderifar, Goli and Ghaljaie, 2017) was adopt.

3.5.2 Data Analysis – 2nd Step

Research Objective (3): Assess the relative importance of risk factors and categories

This practice is quantification of the judgements, ideas and perception of respondents (decision makers) on the risks obtained through the questionnaire survey. The risk factors and the categories which are selected in the previous step were quantitatively assessed, that is relative importance of risk factors and the categories were quantitatively expressed applying analytical hierarchy process (AHP). In parallel the relative importance of risk factors is examined in association with risk

control/management capability of project practitioner. In this practice, respondents were asked to conduct pair-wise comparisons between the categories and the risk factors within each category. In quantifying decision-maker's subjective idea or perception, a pairwise comparison is assumed to be able to reduce the respondent's ambiguity in answering the questions, or easy to judge in rating work, compared to judgment and answer using the rating method such as five points Likert Scale and the seven-point grading system. In order to clarify the difference in perception of the risks between the public and the private sectors, the questionnaire survey was made categorizing the respondents into the two groups.

The AHP method is explained in the following sections.

1)   General feature of the AHP

AHP is a scientific method developed by Thomas Saaty in 1970s (Alexander, 2012), based on the concept of operations research (OR), which is a rational and effective tool for dealing with decision-making in the complex social system. Jin and Zhang (2011) suggest that due to the uncertainty and incomplete nature of PPP projects, further research may integrate techniques such as fuzzy logic to design more intelligent models that are able to generate more accurate forecasts. The AHP is a technique that can incorporate the fuzzy nature of human's way of thinking/judgement into a mathematical model. The fundamental hierarchy structure in AHP developed by Saaty is shown in Figure 3.5.1 below.
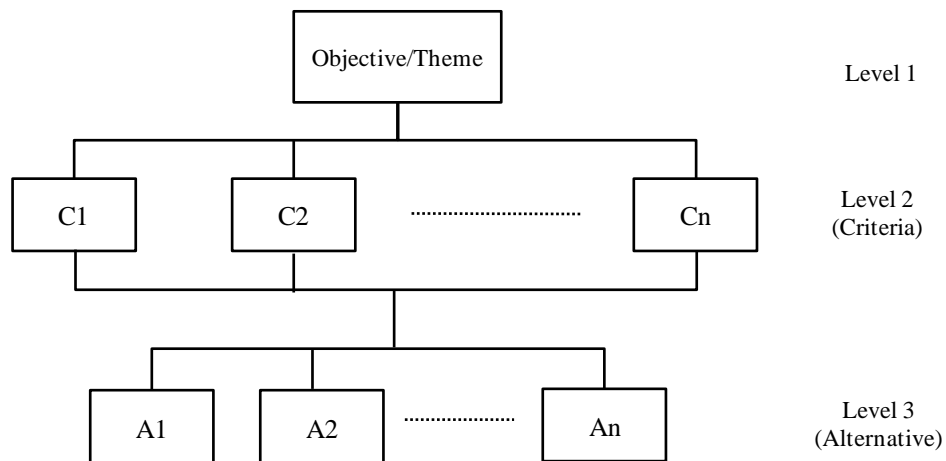
Source: Prepared by the researcher with reference to Saaty (2012)

Fig. 3.5.1 Fundamental Hierarchy Structure of AHP

49

The AHP assessment may require a large number of evaluations by the user, especially for many problems with many criteria and alternatives. It is therefore necessary to attempt minimising the criteria and alternatives to reduce unnecessary load of the evaluation task. In this research risk categories selected by the researcher are applied for the criteria at level 2 and risk factors which are categorized into the respective categories are applied for the alternatives at level 3. The objective of this process is to make overall ranking of the importance of the risk factors applied. In order to minimize the valuation task which will be conducted by the respondents, the six categories were selected by the researcher. Although there are many risk factors which are identified in many literatures, the research asks the respondents to choose a maximum five risks in each category considering the limit for keeping the enough consistency involved in the result of AHP.

2) How the AHP works

In identifying the risks associated with PPP projects, risk classification is very important because it reflects the purpose of risk management (Li and Zou, 2012). AHP technique is a powerful tool to give a solution to a multi-criteria decision – making subject which contains many uncertainties and complexity, it should, however, be recognized that the calculation result will be dependent of the risk structure to be formulated or assumed by researcher.

When one condition (i) is compared to the other condition (j), the pairwise comparison value is presented quantitatively as shown in Table 3.5.4 below.

Table 3.5.4 Pairwise Comparison Value

Pairwise Comparison Value (a_{ij})	Interpretation
1	i and j are equally important.
3	i is slightly more important than j.
5	i is more important than j.
7	i is strongly more important than j.
9	i is absolutely more important than j.

Detailed explanation of AHP method is provided in APPENDIX C.

3.5.3 Framework Development and Evaluation – 3rd Step

Research Objectives (4): Propose a participatory framework of the adequate allocation of risks

Based on the result of quantitative assessment of the risk factors, discussion is made so as to contribute to formulating a participatory framework of the adequate allocation of risks between the public and the private sectors, in implementing PPP infrastructure projects in water supply sector in the context of Sri Lanka.

The relative importance of risk factors is quantitatively assessed based on the experiential knowledge of the PPP practitioners of the public and private sectors, respectively. It is therefore presumed that the quantified importance of risk factors represents the practitioners' perceptions of the extent and the likelihood of those risks and their consequences. The extent of the relative importance is further considered to be related to the magnitude of risk control/management capability of a PPP party. For example, if a PPP practitioner feels difficult to deal with a risk and its consequences, the risk is of no small concern to him and he may judge the risk factor is very important compared to the other risks. As stated in the Chan and Cheung (2014) survey, the effective handling of risks is often related to the appropriate risk allocation between the public and private sectors.

In this research a generic risk allocation framework is discussed and proposed based on the relationship between the extent of relative importance of risks and the risk management capability of PPP parties, that is, how the respective risks associated in a PPP water supply project could be dealt with by respective PPP parties.

Research Objective (5): Validate the proposed framework

A proposed participatory framework of adequate risk allocation formulated based on the quantitative assessment of risk categories and risk factors is validated through interview or questionnaire survey again with all or some of the respondents who answered the questionnaire on risk identification and assessment (as output of AHP). The respondents are to be asked to choose either public sector or private sector which is best able to control and manage each risk to be identified in this research. The target respondents are selected from both the public and the private sectors for validating the framework to be acceptable for both sectors. Through this validation it is concluded which party will handle each risk better than other party. This result will contribute to formulating an adequate structure of PPP water supply project and the implementation contract between the public party and the private party. As a part of the validation, it can be presumed to

make a trial formulation of a simple structure of PPP based water supply project based on the participatory framework of adequate risk allocation.

3.6 ETHICAL ISSUES

Creswell (2014) mentions that researchers need to protect their research participants and ethical questions are apparent today in such issues as personal disclosure, authenticity and credibility of the research report, the role of researchers in cross-cultural contexts. Before the questionnaires, all the respondents were requested to read and understand the Participant Information and to indicate their agreement to participate in the research in written form. Besides, the University of the West of England has an ethical validation process which ensures that researchers conform to a reasonably accepted standard. The ethical code of the University ensures that there is no interference with participants' physical and psychological well-being, the research procedure is not likely to be stressful or distressing, the research materials are not sensitive, discriminatory or inappropriate, the research design is sufficiently well-grounded so that the potential participants' time is not wasted during the data collection; the research instruments used for this study were subjected to the requirements of the University's ethical research committee. Having addressed and satisfied all the criteria, the ethics committee granted permission for the field work to commence. A letter of authorization was obtained from the researcher's department and was presented to each participant, outlining the aim of the research and emphasizing that information provided would remain strictly confidential and be used only for the purpose of the research. Hence, the participants were reassured that the data gathered will be treated in a manner that will protect the confidentiality and anonymity of the companies involved in the study. All the questionnaire surveys commenced only after each participant agreed to participate.

In order to distribute the questionnaire, the researcher needs to have contact details of the potential respondents. At first, key individuals were identified from details available publically on projects and then ask them to pass on the questionnaire to their contacts. As the researcher needed to re-contact all or some of the respondents of the questionnaire for a series of two questionnaire surveys and for the validation/feedback purposes of the study results, a contact form (name and email address) was be included with the questionnaire. However, the contact form is made as a separate form in electronic file. A unique code is allocated to each contact detail of the respondents and the collected data sheet will be identified only by the code. The researcher does not store the

contact details associated with the unique code with the data sheets but file them separately for maintaining anonymity and confidentiality.

3.7 SUMMARY

This chapter explains the research philosophical approach, strategy and research design adopted in this research. The establishment of a research methodology is mainly focused in this chapter. The subject of research is to explore the way of risk allocation or share between the public and private sectors based on their preference or strength in managing risks in PPP projects. For this subject, a quantitative approach/method is applied attempting to quantify the human knowledge and perceptions. For this attempt, AHP technique that was used by researcher is explained in the detailed research design.

There is an explanation of the research method used for the purpose of this research and a justification for the choice of the quantitative research method. The choice of the research strategy is based on the nature of the research aim, objectives and data. A questionnaire survey was designed based on the literature review and conducted in the first step of the research. While in the second step of this research, data analysis was conducted applying quantitative method to the output from the questionnaire in the first step. Subsequently formulation of framework for risk allocation in implementation of PPP projects between the public and private sectors is proposed and the validation of the proposed framework is conducted based on the feedback from the research participant. Furthermore, an in-depth explanations and justifications on the applied data analysis technique and the questionnaire survey procedures are provided. Also, ethical concerns regarding data collection are emphasised highlighting the steps that were involved.

CHAPTER FOUR: 1st QUESTIONNAIRE SURVEY AND DISCUSSION OF FINDINGS

4.1 INTRODUCTION

In this chapter, answers to two questions obtained through the 1st questionnaire survey is presented. The first research question posed to address one of the research objectives is "What are the dominant risks perceived by project partners". The other research question is "What are the differences in risk perceptions between project practitioners by sector or organization/position they belong to". Discussions on the differences and similarities in risk perceptions by project practitioners between the public and private sectors are provided based on the results of the 1st questionnaire survey.

As a result of the literature reviews, a number of risk factors categorized into several risk categories were identified. All these risk factors and the categories are indicated in the 1st Questionnaire sheet and sent to Sri Lankan project practitioners who have engaged in infrastructure project, for collecting data of their perceptions to the risk factors and categories in terms of their control or management capability. The collected data was analysed and discussed to clarify the general trend of perceptions to the risks of both sectors, and any specific differences in the perception particular to the respective sectors. Furthermore, from the risk factors identified in this chapter, three risk factors in the respective seven categories, ranked highest three in terms of the number of respondents who chose them, were selected for the further analysis in the next chapter of this research.

4.2 QUESTIONNAIRE SURVEY RESULTS

4.2.1   Risk Categories and Risk Factors Used for the Questionnaire

Risk factors related to water supply projects are identified and examined for further analyses, through literature review specifically related to the water supply projects. Wibowo and Mohamed (2008) identify 39 key risks inherent to water supply projects in Indonesia and classify into six categories. In identification of risk factors in this research, these 39 risks and the categories are mainly used as the base, considering the similarity of the country situation in terms of the government policy for PPPs and the experience of PPPs. On the other hand, as Osei-Kyei,

Ameyaw, & Chan, (2017) state that future research should adopt a more locally focused interviews and case study analysis to unravel CSFs (Critical Success Factors) in managing operational PPPs, collection of locally focused data was considered. Thus, the data collection was made through the questionnaire survey to the experienced Sri Lankan project practitioners, including a risk category - Design and Procurement and the risk factors which cover the construction stage of a project were adopted referring the risk factors and the categories identified by Tiendo et al. (2015), in addition to the above mentioned 39 risks. Subsequently, the selected risk factors were examined in terms of the applicability and adequacy in discussing a PPP infrastructure project in water supply sector in Sri Lanka.

The risk categories and the risk factors adopted in this research are shown in Table 4.2.1.

Table 4.2.1 Risk Categories (C) and Risk Factors (R) Used for Questionnaire Survey

C1	Political risk		C2	Economic/commercial risk	
	R1	Nationalization/expropriation		R10	Inflation fluctuation
	R2	Non-availability of foreign exchange		R11	FX (Foreign Exchange) fluctuation
	R3	Restriction of FX exchangeability		R12	Interest rate fluctuation
	R4	Restriction of FX transferability	C4	Business risk	
	R5	Breach of contract by government		R17	Tariff setting uncertainty
	R6	Premature termination by government		R18	Premature termination by operator
	R7	General changes in legislation		R19	Breach of contract by operator
	R8	Discriminatory changes in legislation		R20	Unpaid bills by consumers
	R9	Specific changes in legislation		R21	Abuse of power by government officials
C3	Land and construction risk			R22	Failure in financial closure
	R13	Construction cost overrun		R23	Failure in refinancing
	R14	Land cost escalation		R24	Demand uncertainty
	R15	Construction time overrun		R25	Entry of new competitor
	R16	Protracted negotiation on land price	C6	Force majeure risk	
C5	Operation risk			R34	Natural disaster
	R26	Operation and maintenance cost escalation		R35	Man-made disaster
	R27	Equipment defect-caused interruption		R36	Declared war
	R28	Non-availability of raw water		R37	Riot

	R29	Environment protest-caused interruption		R38	Terrorism attack
	R30	Technical leakage during distribution		R39	Labor strike
	R31	Electricity blackout	C7	Design and procurement risk	
	R32	Water meter manipulation		R43	Improper design
	R33	Low quality of raw water		R44	Construction method/design change
C7	Design and procurement risk			R45	Site availability
	R40	Poor decision making process		R46	Supporting incentive of government risk
	R41	Lack of transparency in bidding		R47	Unfair process of selection of contractor
	R42	Poor or incomplete project evaluation		R48	Low capacity of Special Purpose Company (SPC)

4.2.2 Research Participants

To collect data on risk perceptions it was necessary to survey the relevant stakeholder groups in relation to the topic, targeting the population which includes department managers, project managers or engineers in the public and private sectors. Out of these stakeholders those who belong to any government organizations were categorized into public and those who belong to private companies and universities were categorized into private. Through the approach explained in the Chapter 3, 100 potential respondents were identified from government agencies and private organizations that are extensively involved in implementation of infrastructure projects on the basis of PPP and/or conventional method.

Out of the 100 potential respondents to whom questionnaires were sent, 60 valid and usable responses were returned. This consisted of 33 respondents of public sector and 27 of private sector. Considering the limited practice of PPP infrastructure projects in the water sector in Sri Lanka, as discussed in Chapter 3, Section 3.5.1, it is not easy to access to respondents who have appropriate background of the project experiences, 60 valid and usable responses from the target population is acceptable. Wibowo and Mohamed (2008) state that a total of 30 valid and usable responses from a response rate of around 20 % represent a low but acceptable sample. It is considered that the response rate of 60% resulted from a questionnaire design focusing on making a simple and clear questionnaire form, in order to avoid unnecessary burden to respondents. Given the limited population meeting the desired criteria, it can therefore be accepted that the views of the

respondents are suitable to represent the current local situation and problems of implementation of PPP based projects in water sector in Sri Lanka, providing validity to the survey results irrespective of the sample size.

The breakdown of the questionnaire participants who returned valid and usable response is as shown in the Table 4.2.2 below, together with their level of experience in terms of (1) years of experience in the construction industry or infrastructure development and (2) no. of PPP based projects which they have been involved in.

Table 4.2.2 Background of Questionnaire Participants

No.	Organization of Respondent	No. of Respondents	(1) years	(2) no.	No.	Organization of Respondent	No. of Respondents	(1) years	(2) no.
1	Ministry of Finance (PPP Unit)	4	1~10	5~30	6	Other Government Organizations	9	5~32	0~15
2	BOI (Board of Investment)	1	6	4	7	University researcher/staff	3	9~40	2~5
3	Bank of Ceylon	4	3~30	0~50	8	Construction Company	15	2~35	0~25
4	NWSDB (National Water Supply and Drainage Board)	4	5~34	0~1	9	Engineering Consulting Company	10	6~41	0~18
5	CECB (Central Engineering Consultancy Bureau)	8	4~22	3~15	10	Private Bank	2	1~5	0

4.2.3 Questionnaire Results

The purpose of the 1st Questionnaire survey is to select the risk factors by risk category for the further prioritization study of the selected risk factors. The questionnaire participants were asked to choose a maximum of five risk factors in each risk category which they consider to be least in their control. The 48 risk factors in seven categories are indicated and ranked within respective risk categories, based on the number of questionnaire participants who chose the risk factor. The questionnaire result is indicated in the Table 4.2.3 below. The full document of the 1st Questionnaire Survey sheet including the cover page, introduction and how to answer to the question is provided in Appendix B1.

Table 4.2.3 Questionnaire Result and Risk Factor Ranking by Category

Risk Category (C) and Risk Factor (R)			No. of Respondents who chose			Rank in terms of no. of respondents who chose
			Public N=33	Private N=27	Total N=60	
C1	Political risk		-	-	-	-
	R1	Nationalization/expropriation	14	13	27	4
	R2	Non-availability of foreign exchange	14	19	33	3
	R3	Restriction of FX exchangeability	11	11	22	8
	R4	Restriction of FX transferability	4	10	14	9
	R5	Breach of contract by government	22	12	34	2
	R6	Premature termination by government	17	9	26	5
	R7	General changes in legislation	20	18	38	1
	R8	Discriminatory changes in legislation	14	9	23	6
	R9	Specific changes in legislation	14	9	23	6
C2	Economic/commercial risk		-	-	-	-
	R10	Inflation fluctuation	25	20	45	2
	R11	FX fluctuation	19	16	35	3
	R12	Interest rate fluctuation	23	24	47	1
C3	Land and construction risk		-	-	-	-
	R13	Construction cost overrun	26	17	43	1
	R14	Land cost escalation	15	13	28	3
	R15	Construction time overrun	25	16	41	2
	R16	Protracted negotiation on land price	13	6	19	4
C4	Business risk		-	-	-	-
	R17	Tariff setting uncertainty	22	14	36	1
	R18	Premature termination by operator	13	4	17	7
	R19	Breach of contract by operator	12	12	24	4
	R20	Unpaid bills by consumers	16	14	30	3
	R21	Abuse of power by government officials	14	19	33	2
	R22	Failure in financial closure	9	6	15	8
	R23	Failure in refinancing	6	6	12	9
	R24	Demand uncertainty	13	10	23	5
	R25	Entry of new competitor	16	7	23	5
C5	Operation risk		-	-	-	-
	R26	Operation and maintenance cost escalation	27	18	45	1
	R27	Equipment defect-caused interruption	16	16	32	3
	R28	Non-availability of raw water	15	10	25	5

	R29	Environment protest-caused interruption	20	20	40	2
	R30	Technical leakage during distribution	11	10	21	6
	R31	Electricity blackout	12	8	20	7
	R32	Water meter manipulation	12	7	19	8
	R33	Low quality of raw water	15	11	26	4
C6	Force majeure risk		-	-	-	-
	R34	Natural disaster	28	21	49	1
	R35	Man-made disaster	17	14	31	3
	R36	Declared war	6	2	8	6
	R37	Riot	10	9	19	4
	R38	Terrorism attack	10	3	13	5
	R39	Labor strike	26	18	44	2
C7	Design and procurement risk		-	-	-	-
	R40	Poor decision-making process	27	23	50	1
	R41	Lack of transparency in bidding	20	9	29	3
	R42	Poor or incomplete project evaluation	21	16	37	2
	R43	Improper design	16	10	26	5
	R44	Construction method/design change	12	10	22	6
	R45	Site availability	11	6	17	7
	R46	Supporting incentive of government risk	11	5	16	8
	R47	Unfair process of selection of contractor	15	14	29	3
	R48	Low capacity of Special Purpose Company (SPC)	8	8	16	8

It is found in Table 4.2.3 that there are several high rank risks (chosen by the majority of respondents) that include risks in the categories of economic/financial, operational, force majeure and design/procurement. This survey result is considered to justify inclusion of the category of Design and Procurement in addition to the risk categories identified by Wibowo and Mohamed (2008).

4.3 ANALYSIS OF DATA COLLECTED

4.3.1 Further Classification of the Collected Data

In terms of number of the respondents who chose a risk factor, the survey result indicated in the Table 4.2.3 is further classified into the following three cases. This table clearly shows the

difference or similarity between both sectors in the number of respondents who chose the risk factor. It further implies the features of perception of the respective sectors to the risk factors.

Case 1: Risk factor chosen by similar number of the respondents in both public and private sectors

Case 2: Risk factor chosen by considerably higher number of the public sector respondents than that of the private sector respondents

Case 3: Risk factor chosen by considerably higher number of the private sector respondents than that of the public sector respondents

The table rearranged based on the above Case 1 to Case 3 is given in Table 4.3.1.

Table 4.3.1 Classification of Risk Factors by Number of Respondents

Risk Category (C) and Risk Factor (R)			No. of Person who chose			Case 1	Case 2	Case 3
			Public N=33	Private N=27	Total N=60			
C1	Political risk		-	-	-	-	-	-
	R1	Nationalization/expropriation	14	13	27	✓		
	R2	Non-availability of foreign exchange	14	19	33	✓		
	R3	Restriction of FX exchangeability	11	11	22	✓		
	R4	Restriction of FX transferability	4	10	14			✓
	R5	Breach of contract by government	22	12	34		✓	
	R6	Premature termination by government	17	9	26		✓	
	R7	General changes in legislation	20	18	38	✓		
	R8	Discriminatory changes in legislation	14	9	23	✓		
	R9	Specific changes in legislation	14	9	23	✓		
C2	Economic/commercial risk		-	-	-	-	-	-
	R10	Inflation fluctuation	25	20	45	✓		
	R11	FX fluctuation	19	16	35	✓		
	R12	Interest rate fluctuation	23	24	47	✓		
C3	Land and construction risk		-	-	-	-	-	-
	R13	Construction cost overrun	26	17	43	✓		
	R14	Land cost escalation	15	13	28	✓		
	R15	Construction time overrun	25	16	41	✓		
	R16	Protracted negotiation on land price	13	6	19		✓	
C4	Business risk		-	-	-	-	-	-
	R17	Tariff setting uncertainty	22	14	36	✓		
	R18	Premature termination by operator	13	4	17		✓	

	R19	Breach of contract by operator	12	12	24	✓		
	R20	Unpaid bills by consumers	16	14	30	✓		
	R21	Abuse of power by government officials	14	19	33	✓		
	R22	Failure in financial closure	9	6	15	✓		
	R23	Failure in refinancing	6	6	12	✓		
	R24	Demand uncertainty	13	10	23	✓		
	R25	Entry of new competitor	16	7	23		✓	
C5	Operation risk		-	-	-	-	-	-
	R26	Operation and maintenance cost escalation	27	18	45	✓		
	R27	Equipment defect-caused interruption	16	16	32	✓		
	R28	Non-availability of raw water	15	10	25	✓		
	R29	Environment protest-caused interruption	20	20	40	✓		
	R30	Technical leakage during distribution	11	10	21	✓		
	R31	Electricity blackout	12	8	20	✓		
	R32	Water meter manipulation	12	7	19	✓		
	R33	Low quality of raw water	15	11	26	✓		
C6	Force majeure risk		-	-	-	-	-	-
	R34	Natural disaster	28	21	49	✓		
	R35	Man-made disaster	17	14	31	✓		
	R36	Declared war	6	2	8	✓		
	R37	Riot	10	9	19	✓		
	R38	Terrorism attack	10	3	13		✓	
	R39	Labor strike	26	18	44	✓		
C7	Design and procurement risk		-	-	-	-	-	-
	R40	Poor decision-making process	27	23	50	✓		
	R41	Lack of transparency in bidding	20	9	29		✓	
	R42	Poor or incomplete project evaluation	21	16	37	✓		
	R43	Improper design	16	10	26	✓		
	R44	Construction method/design change	12	10	22	✓		
	R45	Site availability	11	6	17		✓	
	R46	Supporting incentive of government risk	11	5	16		✓	
	R47	Unfair process of selection of contractor	15	14	29	✓		
	R48	Low capacity of Special Purpose Company (SPC)	8	8	16	✓		

Based on the above Table 4.3.1, discussions on findings from the 1st Questionnaire Survey are provided in the subsequent section.

4.3.2 Assessment on Perceptions to Risks

(1) Similarity in Perception to Risk Factors between Both Sectors

According to the above Table 4.3.1, out of 48 risk factors 38 were chosen by both public and private sectors respondents in similar numbers. Irrespective of the sectors and organizations that the respondents belong to, and of the positions of the respondents, perception of the difficulty in controlling these 38 risk factors is similarly distributed among the respondents. This result may imply that there is a variety in perception of the project practitioners to the risk allocation even in the same sector and a clear perception to allocation of those risks is not established. This finding would be an important factor in considering allocation or share of the risks between the public and private sectors in terms of necessity for clear recommendations on a risk allocation framework based on any justification. The feedback questionnaire survey to the research participants was conducted to validate the research outcomes, as explained in the Chapter 6. The survey result also supports the above findings.

Furthermore, this research result indicates that while there are several risk factors that are allocated to the public sector which is the best party to manage them in previous research on perceived or preferred risk allocation between public and private sectors in PPP projects, a number of project practitioners in the public sector of Sri Lanka consider the same risk factors are least in their control.

(2) Difference in Perception to Risk Factors between Both Sectors

In general, the respondents in both sectors identified same risk factors. However, there are several risk factors where there is large difference between the public sector and the private sector. Compared to the respondents in the private sector, the respondents in the public sector selected the nine risk factors given below more than twice as frequently.

- C1/R5: Breach of contract by government,
- C1/R6: Premature termination by government,
- C3/R16: Protracted negotiation on land price,

- C4/R18:   Premature termination by operator,

- C4/R25:   Entry of new competitor,

- C6/R38:   Terrorism attack,

- C7/R41:   Lack of transparency in bidding,

- C7/R45:   Site availability,

- C7/R46:   Supporting incentive of government risk

When discussing the allocation of the above risk factors except the R18 and R25, the sector which is better or easier at dealing with these risks, for the whole or major part of the respective risks is considered to be the public sector. Wibowo and Mohamed (2008) allocates the five risk factors including R5, R6, R16, R38 and R45 to the public sector, which is the best party to retain the risks, and R18 and R25 to the private sector. Ke *et al.* (2010) indicates risks related to land availability and the cost (R16 and R45) and contractual risks (R5 and R6) as risk to be preferably allocated to the Public. It is considered apparent that R41 and R46 are risks that should be managed wholly under government's responsibility. There is, therefore, an apparent contradiction in the perceived control of risk by those working in the public sector since they rank the risk factors as out of their control. This survey result might imply that although government as a whole might be able to manage the above seven risks, the individual within the government feels the management functions or systems of the government are disempowering. On the other hand, the reason why many respondents in the public sector chose the risks R18 and R25 is assumed that they simply consider these risks cannot be easily managed by the public sector.

A single risk factor was selected by more than twice as many of the private sector respondents compared to respondents in the public sector namely Restriction of FX transferability (R4). R4 is a risk factor categorized into the political risk, and Wibowo and Mohamed (2008) identifies the private sector as best party to retain this risk. Exchange rates of foreign currency are vulnerable to micro and macro environmental conditions and the volatility levels are high. If any project is fully or partly funded by the FX inflow and outflow, the high volatility will have a direct correlation with the income and the cost of the project. This high volatility cannot be purely eliminated but can be managed by entering into financial tools that are established based on FX transferability.

However, the transferability is controlled by government regulatory framework Therefore, restriction of the FX transferability is a difficult factor for the project operator (the private sector) to control or manage. This is considered the reason why many private respondents chose Restriction of FX transferability.

4.3.3 Risk Factors Selected for the 2nd Questionnaire Survey

In the 2nd Questionnaire Survey, the respondents are asked to make pairwise comparison for AHP analysis using the risk factors by risk categories selected through the 1st Questionnaire Survey. In selecting the risk factors for the pairwise comparison by respondents, the careful setting of assessment criteria and categories was made not to unnecessarily increase the workload to them and to obtain useful assessment result by minimizing the inconsistency which may be involved in the pairwise comparison to be conducted by respondents. Based on the above consideration, the three highest rank risk factors in respective seven risk categories are selected as shown in the Table 4.3.2. As discussing in the previous section 4.3.2, it is considered that there is a variety in perception of the practitioners to the risk factors even in the same sector, therefore the further analysis adopting only the three highest rank risk factors may not cover the perceptions or ideas of the respondents which chose many other lower ranked risk factors, in other words it might be difficult to clarify any trend of perception to the risk factors particular to the public sector or the private sector. However, in this research the three highest rank risk factors were adopted focussing on looking into the analysis result applying AHP.

Table 4.3.2 Risk Factors Selected for the 2nd Questionnaire Survey

Risk Category (C) and Risk Factor (R)			No. of respondents who chose			Rank in terms of number of respondents who chose
			Public N=33	Private N=27	Total N=60	
C1	Political risk		-	-	-	-
	R2	Non-availability of foreign exchange	14	19	33	3
	R5	Breach of contract by government	22	12	34	2
	R7	General changes in legislation	20	18	38	1
C2	Economic/commercial risk		-	-	-	-
	R10	Inflation fluctuation	25	20	45	2
	R11	FX fluctuation	19	16	35	3
	R12	Interest rate fluctuation	23	24	47	1

C3		Land and construction risk	-	-	-	-
	R13	Construction cost overrun	26	17	43	1
	R14	Land cost escalation	15	13	28	3
	R15	Construction time overrun	25	16	41	2
C4		Business risk	-	-	-	-
	R17	Tariff setting uncertainty	22	14	36	1
	R20	Unpaid bills by consumers	16	14	30	3
	R21	Abuse of power by government officials	14	19	33	2
C5		Operation risk	-	-	-	-
	R26	Operation and maintenance cost escalation	27	18	45	1
	R27	Equipment defect-caused interruption	16	16	32	3
	R29	Environment protest-caused interruption	20	20	40	2
C6		Force majeure risk	-	-	-	-
	R34	Natural disaster	28	21	49	1
	R35	Man-made disaster	17	14	31	3
	R39	Labor strike	26	18	44	2
C7		Design and procurement risk	-	-	-	-
	R40	Poor decision making process	27	23	50	1
	R41	Lack of transparency in bidding	20	9	29	3
	R42	Poor or incomplete project evaluation	21	16	37	2

4.4 SUMMARY

One research question that is posed to address the research objective is What are the dominant risks perceived by project partners. In this chapter, the answer to this question obtained through the 1st Questionnaire Survey is presented. In addition, adequate risk factors by risk category are selected for the 2nd Questionnaire Survey.

It is important to explore the difference or similarity in risk perception between the public sector and the private sector in order to address to formulation of a framework for adequate risk allocation between both sectors. For this purpose, a questionnaire survey was designed based on the literature review and conducted in this research in order to select appropriate risk factors which were considered to be important by higher number of the well experienced practitioners of PPP based infrastructure projects in Sri Lanka. As explained in the Section 4.2.1 of this Chapter, in this research locally focused data is considered to have been collected through the questionnaire

survey. The questionnaire survey result shows that in general the respondents of both sectors identified the same risk factor in terms of risk which is least in their control. On the other hand, there are several risk factors which show large difference in numbers of the respondents between both sectors who chose them. In this chapter some considerations on these survey results are provided. These considerations will be a base to further evaluate the perceptions of the project practitioners in both sectors to the relative importance of risks in the subsequent chapter. These findings indicate an implication to the further data analysis to be conducted applying quantitative method in the next step.

CHAPTER FIVE: 2nd QUESTIONNAIRE SURVEY AND DISCUSSION OF FINDINGS

5.1 INTRODUCTION

In the Chapter 4, dominant risk factors perceived by project practitioners were explored through analysis for the 1st questionnaire survey results. Consequently, 21 risk factors in total, that consist of three risk factors in each of seven risk categories, were identified as dominant risk factors and used for the 2nd questionnaire survey of which the results are discussed in this chapter. In the previous chapter the differences and similarities in risk perception by the project practitioners were discussed between the public and private sectors using quantitative survey data, while in this chapter the differences and similarities in risk perceptions amongst project practitioners by sector or organization/position they belong to are explored more specifically from quantitative aspect.

In order to measure the difference or similarity in risk perceptions by project practitioner, relative importance of a risk factor is introduced as an index. A relative importance of risk factors is presented in a value between 0 and 1 by applying AHP method. In the 2nd questionnaire survey the research participants are asked to carry out a pairwise comparison amongst Risk Categories and amongst Risk Factors selected through the 1st questionnaire survey. In this chapter discussion on the questionnaire results and the findings are conducted based on the quantified relative importance of the risk categories and the risk factors.

5.2 QUESTIONNAIRE SURVEY RESULTS

5.2.1 Data Collection Through The 2nd Questionnaire Survey

A questionnaire survey sheet was designed intending to collect numerical data of relative importance between two risk categories and between two risk factors through pairwise comparison to be conducted by respondents.

The full document of the 2nd Questionnaire Survey sheet including the cover page, introduction and how to answer to the question is provided in Appendix B2.

5.2.2 Research Participants

The 2nd questionnaire was sent to the 60 respondents from which valid and usable responses for the 1st questionnaire were returned, with a cover letter explaining the survey purpose, background and significance as explained in the previous section 4.2.2. In this questionnaire, it is reiterated that confidentiality and anonymity of the responses would be strictly maintained. Responses to the 2nd questionnaire were also returned from the same 60 participants consisting of 33 respondents of public sector and 27 of private sector. In this questionnaire survey 100% of response rate was achieved. Many Sri Lankan project practitioners are considered to be interested in this research and to expect the outcomes. The background information of individual respondent that were provided by the respondents in the answer to the 1st questionnaire as listed in Table 4.2.2 were used for analysing the participants' answers in relation to their backgrounds.

5.2.3   Questionnaire Results

As a sample, a questionnaire sheet for Risk Categories that was answered by a research participant in the public sector is shown in Table 5.2.1 below. The research participants are asked to select one space on each row and mark with a tick ☑ based on their comparison of relative importance between Factor (A) and Factor (B).

Table 5.2.1 The 2nd Questionnaire Survey Sheet (Risk Categories)

(A)		A is dominant.	A is strongly more important than B.	A is more important than B.	A is slightly more important than B.	A and B are equally important.	B is slightly more important than A.	B is more important than A.	B is strongly more important than A.	B is dominant.	(B)	
Category No.	Risk Category	9	7	5	3	1	3	5	7	9	Category No.	Risk Category
C1	Political Risk					✓					C2	Economic/Commercial Risk
C1	Political Risk				✓						C3	Land and Construction Risk
C1	Political Risk				✓						C4	Business Risk
C1	Political Risk					✓					C5	Operation Risk
C1	Political Risk			✓							C6	Force Majeure Risk
C1	Political Risk			✓							C7	Design and Procurement Risk
C2	Economic/Commercial Risk				✓						C3	Land and Construction Risk
C2	Economic/Commercial Risk					✓					C4	Business Risk
C2	Economic/Commercial Risk				✓						C5	Operation Risk
C2	Economic/Commercial Risk					✓					C6	Force Majeure Risk
C2	Economic/Commercial Risk				✓						C7	Design and Procurement Risk
C3	Land and Construction Risk						✓				C4	Business Risk
C3	Land and Construction Risk				✓						C5	Operation Risk
C3	Land and Construction Risk						✓				C6	Force Majeure Risk
C3	Land and Construction Risk				✓						C7	Design and Procurement Risk

C4	Business Risk				✓						C5	Operation Risk
C4	Business Risk					✓					C6	Force Majeure Risk
C4	Business Risk				✓						C7	Design and Procurement Risk
C5	Operation Risk					✓					C6	Force Majeure Risk
C5	Operation Risk					✓					C7	Design and Procurement Risk
C6	Force Majeure Risk				✓						C7	Design and Procurement Risk

In order to calculate the relative importance (weight in AHP) of risk categories C1 to C7, a pairwise comparison matrix indicated in Table 5.2.2 was made using the data collected in the questionnaire sheet. The research participants are asked to carry out pairwise comparisons to get half of the pairwise comparison values in the matrix. The other half of the pairwise comparison values were calculated as reciprocal number of the pairwise comparison values selected by the respondents in the questionnaire.

Table 5.2.2 Pairwise Comparison Matrix of Risk Categories

	C1	C2	C3	C4	C5	C6	C7
C1	1	1	3	3	1	5	5
C2	1	1	3	1	3	1	3
C3	1/3	1/3	1	1/3	3	1/3	3
C4	1/3	1	3	1	3	1	3
C5	1	1/3	1/3	1/3	1	1	1
C6	1/5	1	3	1	1	1	3
C7	1/5	1/3	1/3	1/3	1	1/3	1

Note: ▨ pairwise comparison values selected by respondents in the questionnaire.

☐ pairwise comparison values calculated as reciprocal number to the values selected by respondents in the questionnaire

The above pairwise comparison matrices of the seven risk categories were made using answers from all the questionnaire respondents, respectively. Likewise, pairwise comparison matrices of the three risk factors by risk category were made based on the answers from all the questionnaire respondents. These pairwise comparison matrices of the risk categories and risk factors are provided in Appendix D1 and Appendix D2, respectively.

5.3 FINDINGS OF QUESTIONNAIRE SURVEY

5.3.1   Relative Importance of Risk Categories and Risk Factors

In this section, based on the calculation results of relative importance (weight) for the seven risk categories and 21 risk factors consisting of three risk factors in each of the seven risk categories, discussions are made as provided below.

(1)   Consistency of Pairwise Comparison Matrix

According to Saaty (2012) usually people cannot be so certain of their judgments that they would insist on forcing consistency in the pairwise comparison matrix. Saaty (2012) further states that we may not be perfectly consistent, but that is the way we tend to work, and if there is enough consistency to maintain coherence among the objects of our experience, the consistency need not be perfect. Based on this idea, Saaty establishes a range of consistency between tolerable inconsistency and perfect consistency where all knowledge must be admitted. In this research consistency of all the research participants' judgements (pairwise comparison matrices) were checked for screening the matrices whose consistency is out of the tolerable range.

If the degree of inconsistency of a pairwise comparison matrix is larger than 0.1 that is the limit of tolerable inconsistency according to Saaty (2012), reliability of the pairwise comparison matrix is considered insufficient. Therefore, in this research the reliability of pairwise comparison matrix was verified using consistency index (C.I.). Pairwise comparison matrices that satisfy allowable condition of C.I. were adopted for further analysis and discussion. Pairwise comparison matrices of risk category and risk factor with consistency indices for all research participants are provided in Appendix D1 and Appendix D2, respectively.

(2)   Relative Importance Estimated for Risk Categories

Pairwise comparison results were obtained from 33 respondents in the public sector and 27 respondents in the private sector, respectively. As the result of consistency test for the 60 pairwise comparison matrices about seven risk categories, out of these pairwise comparison matrices, 14 matrices of the public sector respondents and 11 matrices of the private sector respondents turned out to be in the tolerable range of the consistency. Therefore, further discussions are made using the relative importance calculated based on these matrices of 25 research participants. The calculation results on the relative importance of risk categories are given in Table 5.3.1 and Table 5.3.2 below, respectively.

| Respondents Code | Risk Category (C) | | | | | | | Total of Relative Importance Values |
| | C1 | C2 | C3 | C4 | C5 | C6 | C7 | |
	Political Risk	Economic/ commercial risk	Land and construction risk	Business risk	Operation risk	Force majeure risk	Design and procurement risk	
Q1PU1	0.271	0.200	0.091	0.171	0.078	0.136	0.053	1.00
Q1PU2	0.297	0.259	0.080	0.129	0.118	0.059	0.059	1.00
Q1PU3	0.472	0.135	0.080	0.069	0.080	0.084	0.080	1.00
Q1PU5	0.102	0.303	0.051	0.224	0.164	0.075	0.081	1.00
Q1PU7	0.045	0.072	0.069	0.206	0.116	0.246	0.246	1.00
Q1PU9	0.271	0.200	0.091	0.171	0.078	0.136	0.053	1.00
Q1PU11	0.359	0.266	0.046	0.183	0.042	0.062	0.041	1.00
Q1PU14	0.577	0.112	0.062	0.062	0.062	0.070	0.055	1.00
Q1PU19	0.086	0.071	0.128	0.188	0.188	0.152	0.188	1.00
Q1PU21	0.143	0.143	0.143	0.143	0.143	0.143	0.143	1.00
Q1PU23	0.548	0.061	0.214	0.044	0.044	0.044	0.044	1.00
Q1PU24	0.548	0.061	0.214	0.044	0.044	0.044	0.044	1.00
Q1PU30	0.112	0.071	0.354	0.128	0.152	0.128	0.056	1.00
Q1PU31	0.143	0.143	0.143	0.143	0.143	0.143	0.143	1.00
Average	0.284	0.150	0.126	0.136	0.104	0.109	0.092	1.00

Note: Respondents Code is allocated by the researcher to each questionnaire respondent in order to secure their anonymity, and for example, Q1PU1 indicates Respondent No.1 in the public sector who answered to the 1st Questionnaire. The same codes were used in the 2nd Questionnaire.

Table 5.3.2 Estimated Value of Relative Importance for Seven Risk Categories
(Private Sector Respondents)

| Respondents Code | Risk Category (C) | | | | | | | Total of Relative Importance Values |
| | C1 | C2 | C3 | C4 | C5 | C6 | C7 | |
	Political Risk	Economic/ commercial risk	Land and construction risk	Business risk	Operation risk	Force majeure risk	Design and procurement risk	
Q1PV2	0.352	0.139	0.082	0.065	0.052	0.030	0.281	1.00
Q1PV8	0.079	0.482	0.071	0.096	0.104	0.071	0.096	1.00
Q1PV11	0.271	0.200	0.091	0.171	0.078	0.136	0.053	1.00
Q1PV12	0.317	0.126	0.100	0.161	0.148	0.073	0.073	1.00
Q1PV16	0.548	0.061	0.214	0.044	0.044	0.044	0.044	1.00
Q1PV17	0.355	0.089	0.176	0.052	0.044	0.241	0.041	1.00
Q1PV22	0.548	0.061	0.214	0.044	0.044	0.044	0.044	1.00
Q1PV23	0.119	0.119	0.416	0.087	0.087	0.087	0.087	1.00
Q1PV24	0.613	0.068	0.068	0.054	0.054	0.065	0.079	1.00
Q1PV26	0.147	0.281	0.114	0.114	0.114	0.114	0.114	1.00
Q1PV27	0.213	0.135	0.097	0.249	0.169	0.039	0.097	1.00
Average	0.324	0.160	0.149	0.103	0.085	0.086	0.092	1.00

Note: Respondents Code is allocated by the researcher to each questionnaire respondent in order to secure their anonymity, and for example, Q1PV1 indicates Respondent No.1 in the private sector who answered to the 1st Questionnaire. The same codes were used in the 2nd Questionnaire.

In Table 5.3.1, the values in a row show degree of relative importance for each risk category based on judgment of each respondent and total of the relative importance values of the seven risk categories is always 1.00. For example, a respondent, Q1PU1 perceives that risk category C1 is the most important of the seven risk categories and the second most important one is risk category C2. In case of Q1PU14 the respondent's perception is that C1 is the most important category with the degree of importance of 0.577 followed by the second most important category C2 with the degree of importance of 0.112 and the relative importance of the other five categories are more or less same and only one-tenth of C1, or half compared to C2.

In Table 5.3.2, the values in a row give degree of relative importance for each risk category judged by respondent. The respondents Q1PV16 and Q1PV22 indicate the same relative importance for the seven risk categories that C1 is the most important category with the degree of importance of 0.548 followed by the second most important category C3 with the degree of importance of 0.214, and these two respondents seem to perceive that the other five categories are not very important. This perception to the seven risk categories is same as those of the respondents Q1PU23 and Q1PU24 in the public sector. In case of Q1PV24, it is apparent that this respondent perceives C1 is considerably important risk category and the other six are of no importance.

The above results are shown in graphs in Figure 5.3.1 and Figure 5.3.2 so as to visually understand the degree of relative importance judged by the respondents.
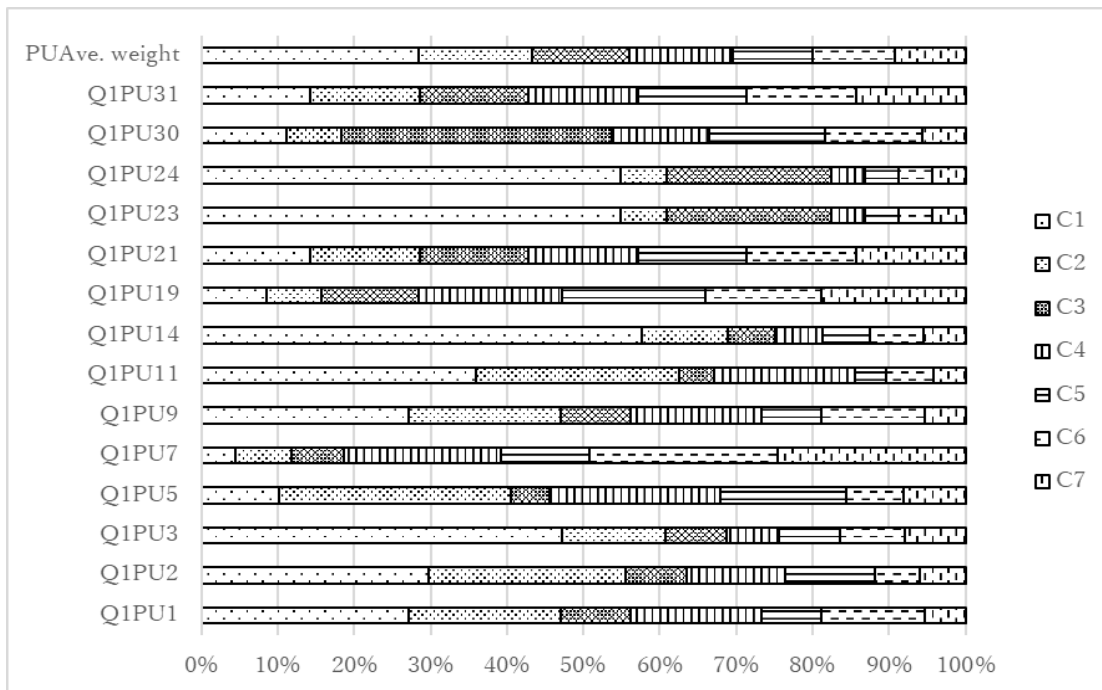
Figure 5.3.1 Estimated Relative Importance for Seven Risk Categories
(Public Sector Respondents)
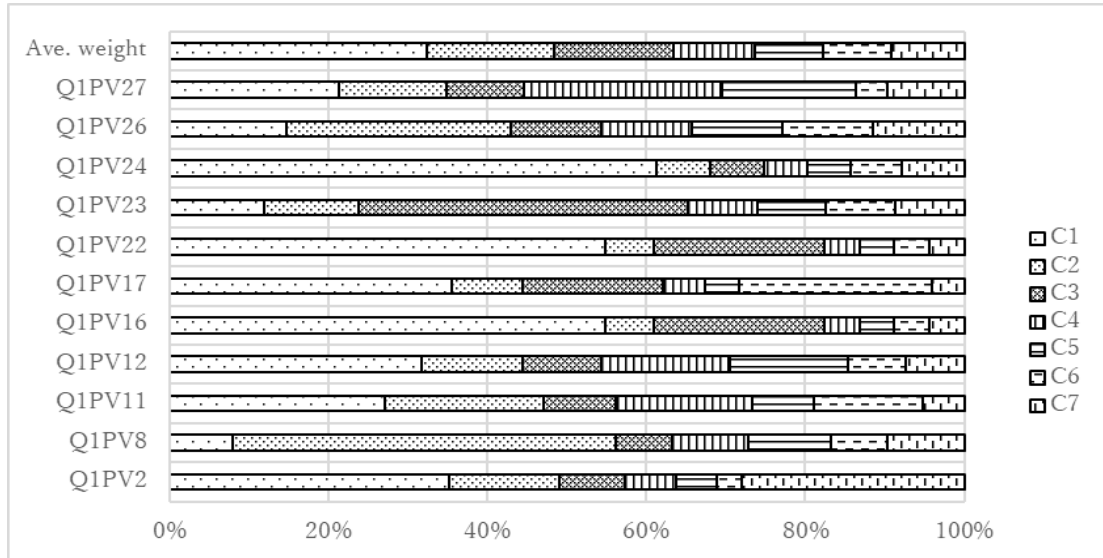
Figure 5.3.2 Estimated Relative Importance for Seven Risk Categories
(Private Sector Respondents)

From the above two figures, it can be read that how important the research participants consider each of the seven risk categories. Regarding the relative importance for the seven risk categories, any trend particular to the public sector or private sector is not observed. Instead, both Figures above show that there are many different perceptions to the same risk categories by project practitioner even in the same sector. Both in the public sector and private sector several respondents give the highest relative importance to the risk category C1 - Political risk, while there is one respondent in the public sector who gives the lowest importance to C1 and one respondent in the private sector who gives the fourth highest importance to C1 out of seven risk factors. Average of relative importance that was given to each risk category by the respondents in the public and private sectors are calculated in Tables 5.3.1 and 5.3.2, and those are indicated in Figure 5.3.3.
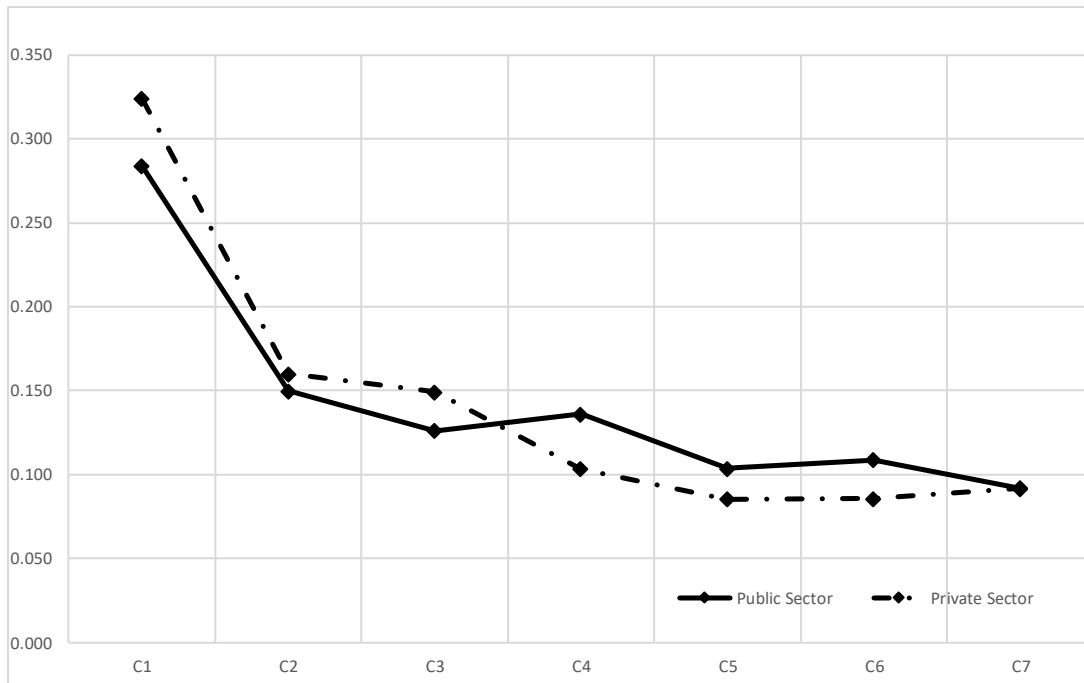
Figure 5.3.3 Average of Relative Importance for Seven Risk Categories

The graphs in Figure 5.3.3 indicate average values of relative importance to each of the seven risk categories. These two graphs for the public sector and the private sector show a similar trend. As observed in Figures 5.3.1 and 5.3.2, there is large extent of individual difference in perception to a risk category by respondent even in the same sector, however in terms of average value, that is considered to represent a feature of each sector, it seems that there is no significant difference in degree of relative importance to each risk category between the public sector and private sector. This is considered to result from the following features that are commonly observed in both sectors.

➢ More than 60% of the respondents judged that Risk Category C1 (political risk) is the most important category giving comparatively higher value of relative importance (around 0.30 to 0.55 out of 1.00 in total of the seven categories).

➢ More than half of respondent's rank Risk Category C2 (economic/commercial risk) to comparatively high positions, 2nd place or 3rd place

➢ For the Risk Categories C3 (land and construction risk) and C4 (business risk), some respondents rank these categories to comparatively high positions, while similar number of respondents rank them to lower than 3rd position. The respondents' judgments are at variance

even in the same sector.

➢ For the Risk Categories C5 (operation risk risk), C6 (force majeure) and C7 (design and procurement risk), the number of respondents who ranked these categories to 4th to 7th positions are equal or larger than those who ranked to 1st to 3rd positions. In addition, many respondents give relative importance value less than 0.10 to these categories.

In order to further explore the trend of degree of relative importance judged by respondents in each sector, the estimated values of relative importance given in Tables 5.3.1 and 5.3.2 were indicated in the rank order in Table 5.3.3 and Table 5.3.4, respectively. In addition, the number of respondents who chose a rank (1st rank to 7th rank) for each Risk Category is indicated in the same tables.

Table 5.3.3 Relative Importance for Seven Risk Categories in Ranking
(Public Sector Respondents)

Respondents Code	Risk Category (C)						
	C1	C2	C3	C4	C5	C6	C7
	Political Risk	Economic/ commercial risk	Land and construction risk	Business risk	Operation risk	Force majeure risk	Design and procurement risk
Q1PU1	1	2	5	3	6	4	7
Q1PU2	1	2	5	3	4	6	6
Q1PU3	1	2	4	7	4	3	4
Q1PU5	4	1	7	2	3	6	5
Q1PU7	7	5	6	3	4	1	1
Q1PU9	1	2	5	3	6	4	7
Q1PU11	1	2	5	3	6	4	7
Q1PU14	1	2	4	4	4	3	7
Q1PU19	6	7	5	1	1	4	1
Q1PU21	1	1	1	1	1	1	1
Q1PU23	1	3	2	4	4	4	4
Q1PU24	1	3	2	4	4	4	4
Q1PU30	5	6	1	3	2	3	7

Q1PU31	1	1	1	1	1	1	1
Average	1	2	4	3	6	5	7
Note:	Average above is ranking for the average of relative importance values in Table 5.3.1						
Rank	No. of respondent who chose the rank for a risk category (14 respondents)						
1	10	3	3	3	3	3	4
2	0	6	2	1	1	0	0
3	0	2	0	6	1	3	0
4	1	0	2	3	6	6	3
5	1	1	5	0	0	0	1
6	1	1	1	0	3	2	1
7	1	1	1	1	0	0	5
Mode	1	2	5	3	4	4	7

Table 5.3.4 Relative Importance for Seven Risk Categories in Ranking
(Private Sector Respondents)

Respondents Code Risk Category (C)							
	C1	C2	C3	C4	C5	C6	C7
	Political Risk	Economic/ commercial risk	Land and construction risk	Business risk	Operation risk	Force majeure risk	Design and procurement risk
Q1PV2	1	3	4	5	6	7	2
Q1PV8	5	1	6	3	2	6	3
Q1PV11	1	2	5	3	6	4	7
Q1PV12	1	4	5	2	3	6	6
Q1PV16	1	3	2	4	4	4	4
Q1PV17	1	4	3	5	6	2	7
Q1PV22	1	3	2	4	4	4	4
Q1PV23	2	2	1	4	4	4	4
Q1PV24	1	3	3	6	6	5	2

Q1PV26	2	1	3	3	3	3	3
Q1PV27	2	4	5	1	3	7	5
Average	1	2	3	4	7	6	5
Note:	Average above is ranking for the average of relative importance values in Table 6.4.2.						
Rank	No. of respondent who chose the rank for a risk category (11 respondents)						
1	7	2	1	1	0	0	0
2	3	2	2	1	1	1	2
3	0	4	3	3	3	1	2
4	0	3	1	3	3	4	3
5	1	0	3	2	0	1	1
6	0	0	1	1	4	2	1
7	0	0	0	0	0	2	2
Mode	1	3	3, 5	3, 4	6	4	4

From the above Tables 5.3.3 and 5.3.4, the followings are observed.

1) 71% of the respondents in the public sector and 64% of the respondents in the private sector perceived Risk Category C1(Political risk) as the most important risk category.

2) The respondents who chose C1 as the most important risk category or the 2nd most important risk category are 71% in the public sector and 91% in the private sector.

3) From the above 1) and 2), it seems to be a common recognition that C1 is a considerably important risk category out of the seven categories for major part of the respondents in both sectors.

4) On the other hand, four respondents in the public sector ranked C1 to 4th, 5th, 6th and 7th, respectively.

5) Similarly, in the private sector one respondent ranked C1 to 5th (comparatively lower ranking).

6) In terms of mode of ranking to the risk categories, it is clearly observed in the public sector that C1, C2 and C4 were ranked to 1st position, 2nd position and 3rd position, respectively.

7) In case of C3, C5, C6 and C7 in the public sector, a clear trend of priority ranking is

not observed and degree to variance in perception to the risk categories by respondent is large. Some respondents ranked these risk categories to the 1st position, while some other respondents ranked them to lower positions (5th to 7th positions). On the whole, the respondents more than approximately 60% of the public sector ranked these risk categories to medium to low positions (4th to 7th positions).

8) Especially, in case of C7(Design and procurement risk) four respondents in the public sector ranked it to the 1st position, while five respondents in the same sector ranked it to the 7th position.

9) In the private sector, degree to variance in perception of relative importance to the risk categories is larger than that of the public sector, except the perception to risk category C1.

10) It is observed that major number of the private sector respondents ranked C1 and C2 to higher positions (1st to 3rd positions), and ranked C5, C6 and C7 to medium to low positions (4th to 7th positions). For the risk categories C3 and C4, degree to variance in perception to the risk categories by the private sector respondent is large.

(3)   Relative Importance Estimated for Risk Factors

In a similar manner to the risk categories, 60 research participants which consist of 33 participants in the public sector and 27 participants in the private sector were asked to conduct pairwise comparison about the risk factors. In case of the risk factor, three risk factors were identified for each of seven risk categories, and thus the research participants were asked to carry out a pairwise comparison about three risk factors by risk category. As the result, seven pairwise comparison matrices were obtained from each of the research participants.

However, as explained in the previous section 5.3.1 (1), out of the above pairwise comparison matrices about the risk factors only pairwise comparison matrices whose consistency are within tolerable range were used for further analysis. The pairwise comparison matrices that satisfied consistency are as given in Tables 5.3.5 and 5.3.6.

Table 5.3.5 Consistency of Pairwise Comparison Matrix by Respondent
(Public Sector Respondents)

Respondent Code	Consistency of Pairwise Comparison Matrix							
	7 Risk categories	3 Risk factors in C1	3 Risk factors in C2	3 Risk factors in C3	3 Risk factors in C4	3 Risk factors in C5	3 Risk factors in C6	3 Risk factors in C7
Q1PU1	✓	✓	✓	✓	✓	✓	✓	✓
Q1PU2	✓	✓	✓	✓	✓	✓	✓	✓
Q1PU3	✓	✓	✓	✓	✓	✓	✓	✓
Q1PU5	✓	✓	✓	✓	✓	✓	✓	✓
Q1PU7	✓	✓	✓	✓	✓	✓	✓	✓
Q1PU9	✓	✓	✓	✓	✓	✓	✓	✓
Q1PU11	✓	✓	✓	✓	✓	✓	✓	✓
Q1PU14	✓	✓	✓	✓	✓	✓	✓	✓
Q1PU19	✓	✓	✓	✓	✓	✓	✓	✓
Q1PU21	✓	✓	✓	✓	✓	✓	✓	✓
Q1PU23	✓	✓	✓	✓	✓	✓	✓	✓
Q1PU24	✓	✓	✓	✓	✓	✓	✓	✓
Q1PU30	✓	✓	✓	✓	✓	✓	✓	✓
Q1PU31	✓	x	✓	✓	✓	x	✓	x

Note: ✓ - Matrix satisfies consistency
x - Matrix does not satisfy consistency

Table 5.3.6 Consistency of Pairwise Comparison Matrix by Respondent
(Private Sector Respondents)

Respondent Code	Consistency of Pairwise Comparison Matrix							
	7 Risk categories	3 Risk factors in C1	3 Risk factors in C2	3 Risk factors in C3	3 Risk factors in C4	3 Risk factors in C5	3 Risk factors in C6	3 Risk factors in C7
Q1PV2	✓	✓	✓	✓	✓	✓	✓	✓
Q1PV8	✓	✓	✓	✓	✓	✓	✓	✓
Q1PV11	✓	✓	✓	✓	✓	✓	✓	✓
Q1PV12	✓	✓	✓	✓	✓	✓	✓	✓
Q1PV16	✓	✓	✓	✓	✓	✓	✓	✓
Q1PV17	✓	✓	✓	✓	✓	✓	✓	✓
Q1PV22	✓	✓	✓	✓	✓	✓	✓	✓
Q1PV23	✓	✓	✓	✓	✓	✓	✓	✓
Q1PV24	✓	✓	✓	✓	✓	✓	✓	✓
Q1PV26	✓	✓	✓	✓	✓	✓	✓	✓
Q1PV27	✓	✓	✓	✓	✓	✓	✓	✓

Note: ✓ - Matrix satisfies consistency
x - Matrix does not satisfy consistency

As shown in the above Tables 5.3.5 and 5.3.6, the pairwise comparison matrices about risk categories of 14 public sector respondents and 11 private sector respondents were used for discussion on the relative importance of risk categories. Subsequently, in discussing the relative importance of risk factors, overall priority of the 21 risk factors was calculated by synthesizing the relative importance of risk categories and risk factors. However, as one public respondent (Q1PU31) gave three pairwise comparison matrices about risk factors that do not satisfy consistency, overall priority of the 21 risk factors could not be calculated, and thus the questionnaire result from this respondent was excluded from the discussion on the relative importance of risk factor.

The calculation results on the relative importance of risk factors are given in Table 5.3.7 and Table 5.3.8. Furthermore, the above results are shown in graphs in Figure 5.3.4 and Figure 5.3.5 so as to visually understand the degree of relative importance judged by the respondents. Average of relative importance that was given to each risk factor by the respondents in the public and private sectors are calculated in Tables 5.3.7 and 5.3.8, and those are indicated in Figure 5.3.6.

Table 5.3.7 Synthesized Value of Relative Importance for Risk Factors
(Public Sector Respondents)

Respondent Code	C1: Political risk			C2: Economic/commercial risk			C3: Land and construction risk			C4: Business risk			C5: Operation risk			C6: Force majeure risk			C7: Design and procurement risk			Total
	R2	R5	R7	R10	R11	R12	R13	R14	R15	R17	R20	R21	R26	R27	R29	R34	R35	R39	R40	R41	R42	
	Non-availability of foreign exchanfe	Breach of contract by government	General changes in legislation	Inflation fluctuation	FX fluctuation	Interest rate fluctuation	Construction cost overrun	Land cost escalation	Construction time overrun	Tarrif setting uncertainty	Unpaid bills by consumers	Abuse of power by government officials	Operation and maintenance cost escalation	Equipment defect-caused interruption	Emvironment protest-caused interruption	Natural disater	Man-made disaster	Labor strike	Poor decision making process	Lack of transparency in bidding	Poor or incomplete project evaluation	
Q1PU1	0.121	0.094	0.056	0.029	0.086	0.086	0.032	0.041	0.019	0.019	0.028	0.124	0.035	0.016	0.027	0.032	0.020	0.084	0.024	0.018	0.011	1.00
Q1PU2	0.225	0.023	0.049	0.024	0.191	0.043	0.036	0.007	0.036	0.012	0.022	0.095	0.039	0.039	0.039	0.006	0.044	0.010	0.020	0.020	0.020	1.00
Q1PU3	0.057	0.379	0.036	0.045	0.045	0.045	0.064	0.006	0.010	0.007	0.004	0.058	0.020	0.055	0.005	0.017	0.017	0.050	0.060	0.009	0.011	1.00
Q1PU5	0.077	0.008	0.017	0.048	0.227	0.028	0.031	0.012	0.007	0.096	0.032	0.096	0.070	0.023	0.070	0.054	0.008	0.012	0.035	0.035	0.012	1.00
Q1PU7	0.031	0.005	0.009	0.010	0.014	0.047	0.047	0.008	0.014	0.069	0.069	0.069	0.076	0.023	0.017	0.028	0.040	0.179	0.112	0.022	0.112	1.00
Q1PU9	0.167	0.040	0.064	0.150	0.016	0.034	0.073	0.012	0.006	0.108	0.043	0.020	0.058	0.013	0.007	0.109	0.017	0.009	0.041	0.007	0.005	1.00
Q1PU11	0.269	0.061	0.029	0.127	0.018	0.122	0.022	0.002	0.022	0.012	0.044	0.127	0.006	0.006	0.030	0.028	0.013	0.022	0.019	0.019	0.003	1.00
Q1PU14	0.072	0.470	0.035	0.037	0.037	0.037	0.038	0.009	0.015	0.008	0.005	0.049	0.006	0.050	0.006	0.008	0.008	0.054	0.026	0.004	0.026	1.00
Q1PU19	0.029	0.029	0.029	0.030	0.030	0.010	0.055	0.018	0.055	0.081	0.027	0.081	0.063	0.063	0.063	0.091	0.030	0.030	0.063	0.063	0.063	1.00
Q1PU21	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.024	0.109	0.010	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	1.00
Q1PU23	0.448	0.050	0.050	0.021	0.013	0.027	0.181	0.022	0.012	0.015	0.015	0.015	0.037	0.002	0.004	0.036	0.004	0.004	0.015	0.015	0.015	1.00
Q1PU24	0.448	0.050	0.050	0.020	0.020	0.020	0.181	0.022	0.012	0.015	0.015	0.015	0.015	0.015	0.015	0.036	0.004	0.004	0.015	0.015	0.015	1.00
Q1PU30	0.014	0.009	0.089	0.024	0.024	0.024	0.123	0.074	0.158	0.021	0.019	0.088	0.025	0.023	0.104	0.014	0.021	0.093	0.019	0.019	0.019	1.00
Average	0.154	0.097	0.043	0.047	0.059	0.044	0.072	0.022	0.032	0.037	0.033	0.065	0.038	0.029	0.033	0.039	0.021	0.046	0.038	0.022	0.028	1.00

Note: Respondents Code is allocated by the researcher to each questionnaire respondent in order to secure their anonymity, and for example, Q1PU1 indicates Respondent No.1 in the public sector who answered to the 1st Questionnaire. The same codes were used in the 2nd Questionnaire.

Table 5.3.8 Synthesized Value of Relative Importance for Risk Factors
(Private Sector Respondents)

Respondent Code	C1: Political risk			C2:Economic/commercial risk			C3:Land and construction risk			C4: Business risk			C5: Operation risk			C6: Force majeure risk			C7: Design and procurement risk			Total
	R2	R5	R7	R10	R11	R12	R13	R14	R15	R17	R20	R21	R26	R27	R29	R34	R35	R39	R40	R41	R42	
	Non-availability of foreign exchanfe	Breach of contract by government	General changes in legislation	Inflation fluctuation	FX fluctuation	Interest rate fluctuation	Construction cost overrun	Land cost escalation	Construction time overrun	Tarrif setting uncertainty	Unpaid bills by consumers	Abuse of power by government officials	Operation and maintenance cost escalation	Equipment defect-caused interruption	Emvironment protest-caused interruption	Natural disater	Man-made disaster	Labor strike	Poor decision making process	Lack of transparency in bidding	Poor or incomplete project evaluation	
Q1PV2	0.161	0.152	0.039	0.020	0.099	0.020	0.008	0.006	0.068	0.030	0.004	0.030	0.006	0.012	0.034	0.003	0.005	0.023	0.098	0.125	0.058	1.00
Q1PV8	0.060	0.010	0.009	0.033	0.368	0.080	0.032	0.032	0.006	0.071	0.016	0.009	0.013	0.008	0.083	0.012	0.006	0.053	0.015	0.011	0.070	1.00
Q1PV11	0.121	0.094	0.056	0.029	0.086	0.086	0.032	0.041	0.019	0.019	0.028	0.124	0.035	0.016	0.027	0.032	0.020	0.084	0.024	0.018	0.011	1.00
Q1PV12	0.240	0.025	0.052	0.012	0.084	0.031	0.043	0.011	0.046	0.015	0.027	0.119	0.049	0.049	0.049	0.007	0.049	0.018	0.024	0.024	0.024	1.00
Q1PV16	0.463	0.030	0.056	0.020	0.020	0.020	0.071	0.071	0.071	0.015	0.015	0.015	0.015	0.015	0.015	0.037	0.004	0.002	0.015	0.015	0.015	1.00
Q1PV17	0.033	0.262	0.059	0.038	0.013	0.038	0.120	0.029	0.026	0.005	0.007	0.040	0.007	0.004	0.033	0.172	0.034	0.034	0.007	0.028	0.006	1.00
Q1PV22	0.448	0.050	0.050	0.020	0.020	0.020	0.071	0.071	0.071	0.015	0.015	0.015	0.021	0.003	0.020	0.037	0.004	0.002	0.037	0.004	0.002	1.00
Q1PV23	0.053	0.041	0.025	0.053	0.041	0.025	0.061	0.099	0.256	0.073	0.005	0.009	0.009	0.070	0.008	0.071	0.008	0.008	0.073	0.005	0.009	1.00
Q1PV24	0.033	0.063	0.517	0.023	0.023	0.023	0.057	0.007	0.004	0.018	0.018	0.018	0.005	0.005	0.044	0.053	0.006	0.006	0.026	0.026	0.026	1.00
Q1PV26	0.119	0.010	0.018	0.026	0.208	0.047	0.052	0.010	0.052	0.011	0.019	0.084	0.038	0.038	0.038	0.011	0.084	0.019	0.038	0.038	0.038	1.00
Q1PV27	0.024	0.024	0.166	0.009	0.033	0.093	0.016	0.009	0.072	0.028	0.028	0.194	0.104	0.040	0.025	0.005	0.003	0.031	0.042	0.042	0.014	1.00
Average	0.160	0.069	0.095	0.026	0.090	0.044	0.051	0.035	0.063	0.027	0.016	0.060	0.027	0.024	0.034	0.040	0.020	0.025	0.036	0.031	0.025	1.00

Note: Respondents Code is allocated by the researcher to each questionnaire respondent in order to secure their anonymity, and for example, Q1PV1 indicates Respondent No.1 in the private sector who answered to the 1st Questionnaire. The same codes were used in the 2nd Questionnaire.
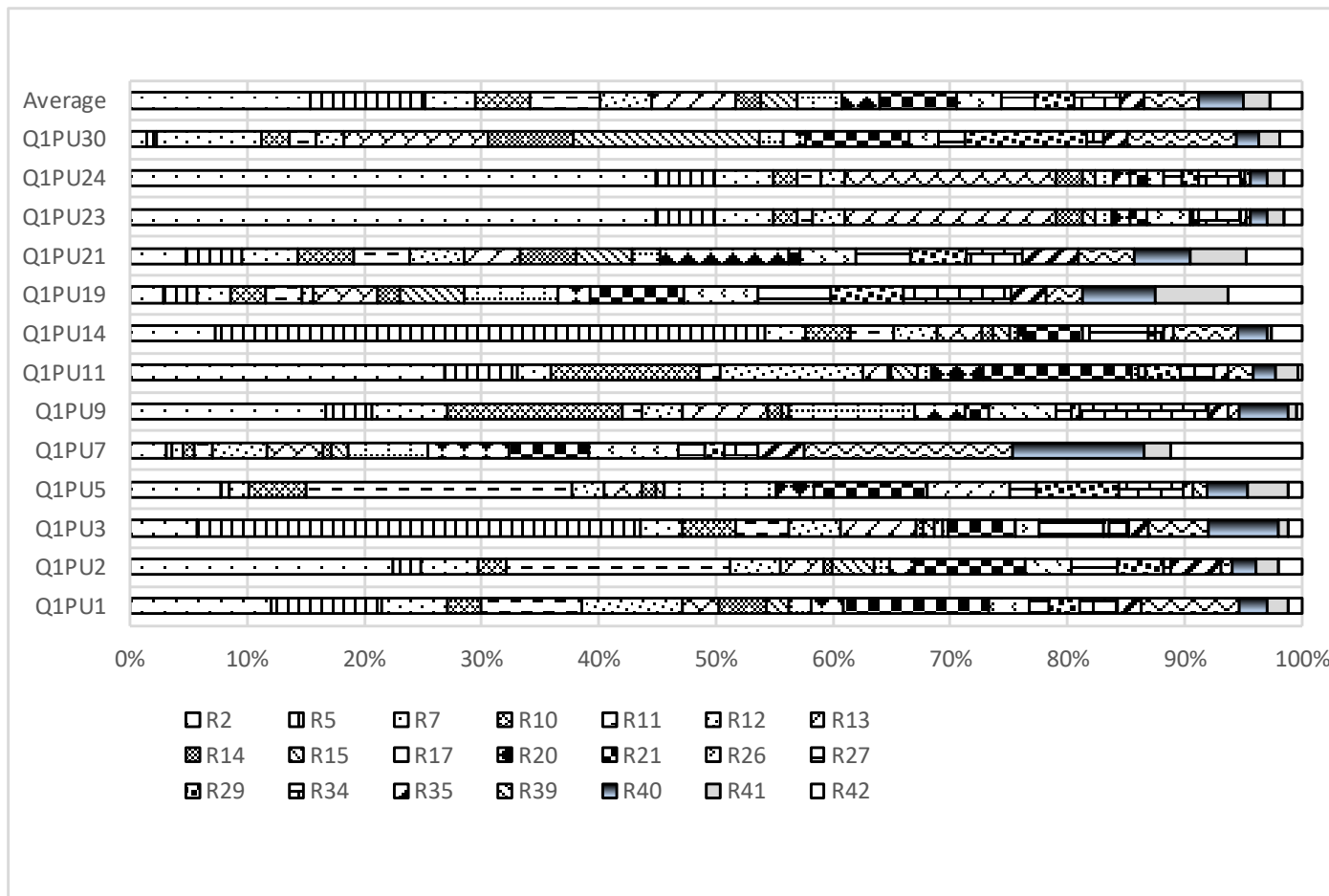
Figure 5.3.4 Synthesized Relative Importance for Risk Factors
(Public Sector Respondents)
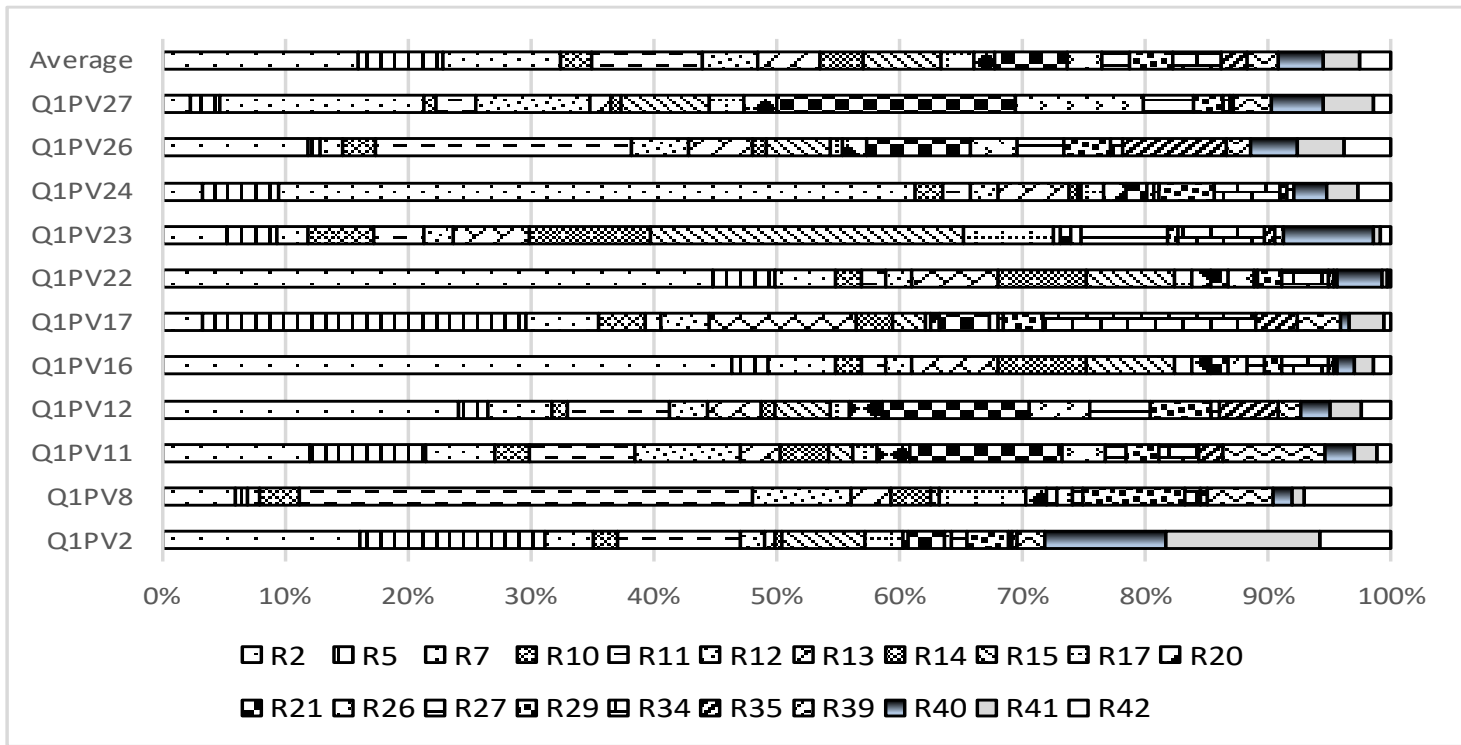
Figure 5.3.5 Synthesized Relative Importance for Risk Factors
(Private Sector Respondents)

The values in a row of the above Tables 5.3.7 and 5.3.8 show degree of relative importance for each risk factor based on judgment of each respondent and total of the relative importance values for the 21 risk factors is always 1.00.

From the above Figures 5.3.4 and 5.3.5, it can be read that how important the research participants consider each of the 21 risk factors. Regarding the relative importance for the 21 risk factors, similar to that of the risk category, any trend particular to the public sector or private sector is not observed. Instead, both Figures show that there is a variety in perception to the same risk factor by project practitioner even in the same sector. In the public sector five out of 13 respondents give the highest relative importance to the risk factor R2 – Non-availability of foreign exchange and the second highest relative importance to the risk factor R13 – Construction cost overrun, while there are two respondents who give the 16th and 19th importance to R2, respectively and four respondents who give the 10th importance to R13. In the private sector four out of 11 respondents give the highest relative importance to the risk factor R2 and large variance of the ranking by respondent is observed for other risk factors.

The above discussion results are illustrated in the graphs of Figure 5.3.6, which indicate average values of relative importance to each of risk factors.
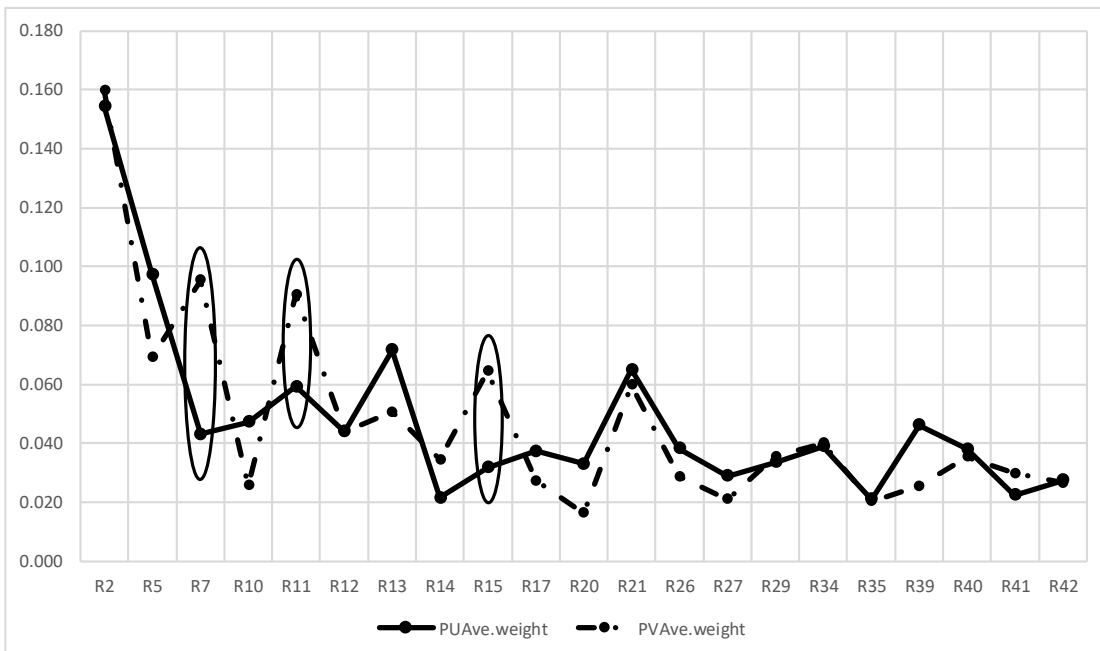
Figure 5.3.6 Average of Relative Importance for 21 Risk Factors

87

These two graphs for the public sector and the private sector show a similar trend and any prominent features particular to the public sector or private sector are not observed. This is considered to result from the following features that are commonly observed in both sectors.

➢ Five out of 13 respondents in the public sector and four out of 11 respondents in the private sector judged that Risk Factor R2 (non availability of foreign exchange) in the risk category C1(political risk) is the most important risk factor.

➢ The above respondents give considerably high value of relative importance (around 0.16 to 0.46 out of 1.00 in total of 21 risk factors) to R2.

➢ Comparatively high values of relative importance are observed in two risk factors including R5(breach of contract by government) and R7(general changes in legislation) categorized in the risk category C1.

➢ To the contrary, there observed a few respondents who gave considerably low relative importance to R2 in both public and private sectors.

➢ Almost all respondents judged that the relative importance of R17 to R42 (12 risk factors categorized in four risk categories C4 – business risk, C5 – operation risk, C6 – force majeure risk and C7 – design and procurement risk) was considerably low, and the relative importance values calculated for most of the 12 risk factors are less than 0.05.

On the other hand, as observed in Figures 5.3.4 and 5.3.5, there is a large extent of difference in perception to the risk factors by respondent even in the same sector. Although two graphs in Figure 5.3.6 show similar trend, there observed a large difference in relative importance between the two sectors in some specific risk factors as indicated in the Figure 5.3.6 as well (risk factors marked with an oval). Especially, the difference in average relative importance of the risk factors R7, R11 and R15 between both sectors is comparatively large. From the above findings, it can be concluded that although there is a variety of judgment/perception to the relative importance of 21 risk factors even in the same sector, the general trend, that is presented in average relative importance to the risk factors in Figure 5.3.6, is considerably similar between both sectors.

5.3.2   Approach to Adequate Risk Allocation Between the Two Sectors

In the previous Section 5.3.1, relative importance to the seven risk categories and the 21 risk factors were estimated for the 13 research participants in the public sector and the 11 research participants

in the private sector, and further the averages of relative importance were calculated for both sectors, as presented in Figures 5.3.3 and 5.3.6, respectively. When these averages of the relative importance are indicated in a different way as shown below in Figures 5.3.7 and 5.3.8, difference in perceptions to the major risks associated in PPP based infrastructure projects between the public sector and the private sector can be presented more clearly in terms of the relative importance.
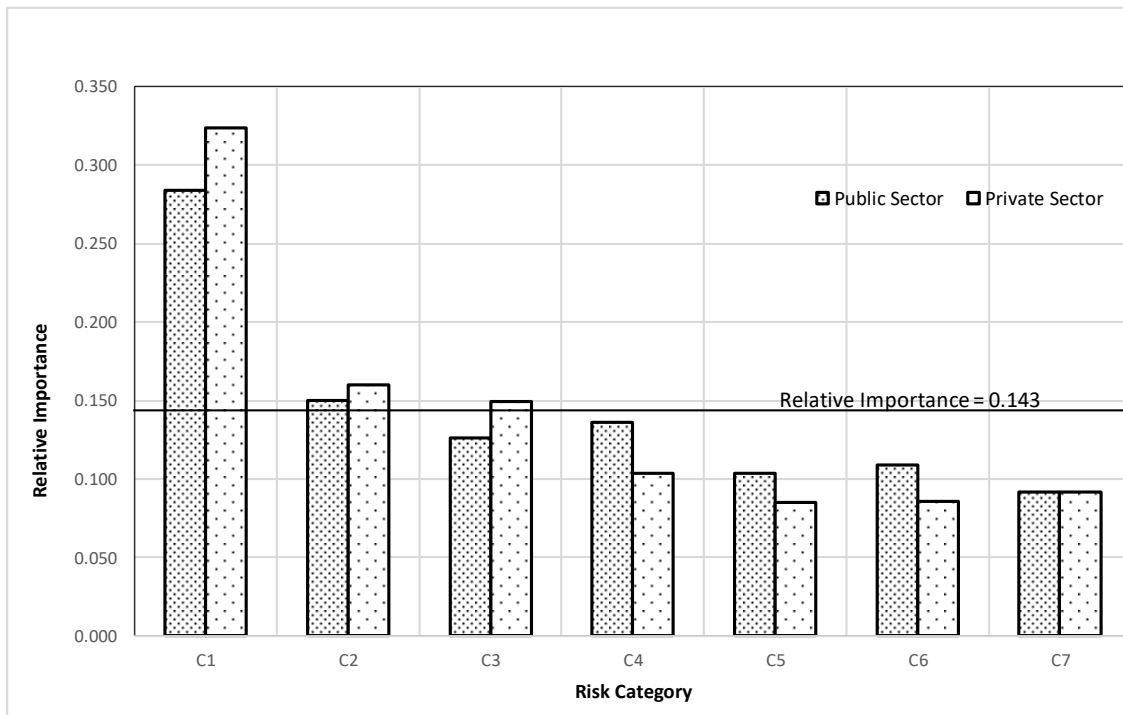
Note:
  *   Total of relative importance C1 to C7 is always 1.00 and if importance of all seven risk categories are judged exactly equal, the relative importance is calculated at 0.143 (= 1.00/7) for all categories.

Figure 5.3.7 Perception to Risk Category by Sector
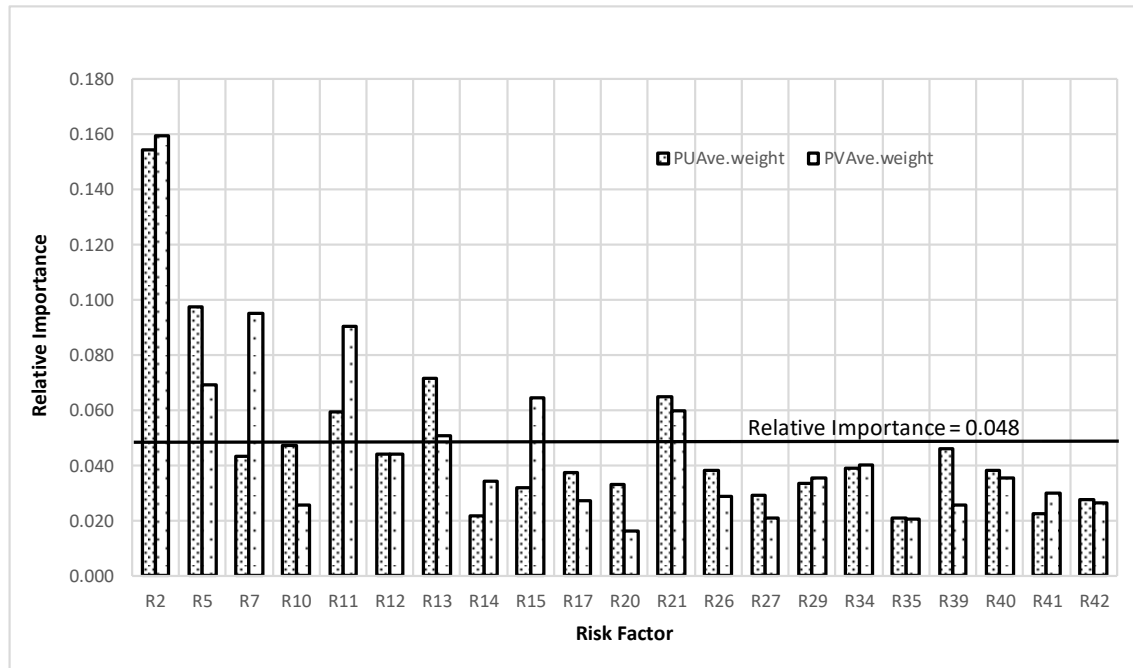
Note:
*   Total of relative importance R2 to R42 is always 1.00 and if importance of all 21 risk factors are judged exactly equal, the relative importance is calculated at 0.048 (= 1.00 / 21) for all factors.

Figure 5.3.8 Perception to Risk Factor by Sector

(1)   Assumed Interpretation on the Degree of Relative Importance of Risks

In the 1st Questionnaire survey of this research the research participants (project practitioners) were asked to choose a maximum of five risk factors that they consider to be least in their control. This is the base in discussing the degree of relative importance of risks in this research. The relative importance was estimated based on the result of a pairwise comparison between two risk categories or factors conducted by the same research participants in the 2nd Questionnaire survey. When a research participant conducted a pairwise comparison between two risk categories or factors, what is the base that he/she considers the risk is more important than the other one. It is assumed in this research that when a project practitioner considers more difficult to control or manage a risk, he/she recognizes the risk is more important. On the contrary, when a project practitioner considers the sector or organization that he/she belongs to has enough capability to control or manage the risk factor, the practitioner recognizes importance of the risk factor is lower.

Based on this, it can be eventually assumed that the party that indicates lower relative importance value is a better party to control/manage the risk.

90

(2)   Discussions on the Relative Importance by Risk Category and Factor

In comparison of the relative importance between both sectors, which were estimated for the risk category and the risk factor, and presented in Figures 5.3.7 and 5.3.8, respectively, the following discussions and considerations were made.

Risk Categories

1) It is a common perception for both public and private sectors that risk category C1 (political risk) is predominantly important compared to the other five. The relative importance of the private sector is higher than that of the public sector, that is, management capability of the public sector for C1 is considered generally higher than that of the private sector. It can be assumed apparently that C1 is the risk category of which the whole should be managed under government's responsibility. However, many research participants in the public sector give high priority to the political risk. This analysis result, as mentioned in the previous Section 5.3.2, might imply that although government as a whole might be able to manage the political risks, many individuals within the government feel the management functions or systems of the government are disempowering.

2) To the risk categories C2 (economic/commercial risk) and C3 (land and construction risk), the average degree of relative importance is given by both sectors. The relative importance of the private sector is slightly higher than that of the public sector. This result may imply that major part of the risks in the categories C2 and C3 are expected to be taken and managed by the public sector. Especially, C3 is considered to be specifically associated with the construction stage of project. The main actor in the construction stage is private operator and the project manager. Applying their project management skills is one of the major reasons why the public sector intends to introduce PPP infrastructure project. However, in terms of relative importance value of the risk category, the analysis result shows that the public sector is better party to take this risk category. Implication of this result is considered that even in the construction stage of project, there are still some key risks in this category that are difficult for the private operator to control and that the public sector needs to take. As mentioned in the subsequent section for the Risk Factor 9) R15 – construction time overrun, further assessment for the risk allocation is suggested to identify better party to take each component, based on a list of the specific components that cause the risk.

3) To the risk categories C4 (business risk) and C5 (operation risk) and C6 (force majeure risk), the relative importance less than average is given by both sectors, and the relative importance of the public sector is higher than that of the private sector for these three risk categories. This result is considered to indicate that both sectors recognize the private sector is better party to retain and manage these risks.

4) In case of the risk category C7 (design and procurement risk), a low relative importance is shown by both sectors. However, the relative importance values of both sectors are same and the risk management in this category should be shared between both sectors.

<u>Risk Factors</u>

1) Risk Factor R2: Non-availability of foreign exchange (FX)

A slightly higher relative importance of the private sector than that of the public sector is given to R2. It is unavoidable in implementing water supply projects in a developing country to procure many industrial products and technology required for construction of the facilities/plants from foreign countries. For this procurement, availability of foreign exchange is a fundamental condition. Furthermore, exchange rates of foreign currency are vulnerable to micro and macro environment conditions and the volatility levels are high. If any project is fully or partly funded by the FX inflow and outflow, the high volatility will have a direct correlation with the income and the cost of the project. This high volatility cannot be purely eliminated but can be managed by entering into financial tools. However, the financial tools are controlled by government regulatory framework, and therefore foreign exchange is a difficult factor for the private sector to control or manage. This is considered the reason why much higher relative importance than other risk factors are given to R2 by the private sector. On the other hand, considerably high relative importance is also given to R2 by the public sector. From this result it might be considered that many individuals within the government feel the management functions or systems of the government are disempowering.

2) Risk Factor R5: Breach of contract by government

It is apparent that the public sector is the best party to control and manage this risk factor, nevertheless the public sector gives considerably higher relative importance than that of the private sector, that is, they consider this risk factor is least in their control for successful implementation

of a PPP infrastructure project in water supply sector. This result might also be considered that many individuals within the government feel the management functions or systems of the government are disempowering.

3) Risk Factor R7: General changes in legislation

Much higher relative importance of the private sector than that of the public sector is given to R7. Establishment and the change in legislation is a government matter and the public sector is the only one party to control and manage this risk factor. This is considered the reason why much higher relative importance of the private sector than that of the public sector is given to R7, that is, the research participants in the private sector recognize this risk factor is least in their control for successful implementation of a PPP infrastructure project in water supply sector. Many research participants in the public sector give relative importance lower than the average and this result is considered that they recognize the public sector is the party to control and manage this risk factor.

4) Risk Factor R10: Inflation fluctuation

Relative importance judged by the research participants in both sectors is lower than the average and it is presumed they consider this risk factor as less important. However, the relative importance of the public sector is nearly two times higher than that of the private sector. As mentioned in the subsequent section 6), the government (the central bank) attempts to control inflation by adjusting the interest rate as a financial policy. Therefore, the public sector is considered to be the best party to control this risk factor. The analysis result might imply that despite the government as a whole might be able to manage this risk, many individuals within the government feel the management functions or systems of the government are disempowering.

5) Risk Factor R11: Foreign exchange (FX) fluctuation

Relative importance judged by the research participants in both sectors is higher than the average, and especially relative importance of the private sector is considerably higher than that of the public sector. Exchange rates of foreign currency are vulnerable to micro and macro environment conditions and the volatility levels are high. If any project is fully or partly funded by the FX inflow and outflow, the high volatility will have a direct correlation with the income and the cost of the project. This high volatility cannot be purely eliminated but can be managed by entering into financial tools. However, the financial tools are controlled by government regulatory

framework. Therefore, FX fluctuation is a difficult factor for the private sector to control or manage and the public sector is the best party to control this risk factor.

6) Risk Factor R12: Interest rate fluctuation

Relative importance judged by the research participants in both sectors is lower than the average and they are considered to recognize this risk factor is not very important. Relative importance of both sectors indicates a same value. It is assumed that most of the research participants in both sectors perceive adjustment of the interest rate is a popular method for executing financial policies in order to control inflation. If any project is fully or partly funded by loan, the interest rate fluctuation will have a direct correlation with the income and the cost of the project. As discussed above, the interest rates are adjusted by government financial policies, especially for control of the inflation rate. Therefore, the public sector is the best party to take interest fluctuation risk.

7) Risk Factor R13: Construction cost overrun

Relative importance judged by the research participants in the public sector is higher than the average and that of the private sector is almost same as the average. The private sector has management know-how of construction work in a project implementation, and thus they are expected to be involved in the design, construction and operation in PPP based infrastructure projects. From this analysis result of the relative importance, it is presumed that most of the research participants in the public sector perceive this risk is least in their control. Therefore, the private sector is the best party to control and manage the construction cost overrun risk.

8) Risk Factor R14: Land cost escalation

Relative importance judged by the research participants in both sectors is considerably lower than the average and it is presumed they consider this risk factor as less important. However, the relative importance of the private sector is higher than that of the public sector. This result may imply that the private sector participants expect or recognize the public sector is the party which can control this risk factor. Land cost is an important part of a project cost and land acquisition in a conventional infrastructure development project is a prerequisite for commencement of the construction of project components. Therefore, in PPP based infrastructure project as well, unlike direct construction cost of the project, government's proactive involvement would make it easier to proceed the land acquisition controlling the land price escalation even if the private sector

invests in land acquisition. From this analysis result of the relative importance, it is presumed that most of the research participants in the private sector perceive this risk is least in their control. Therefore, the public sector is the best party to control the land cost escalation risk.

9) Risk Factor R15: Construction time overrun

Relative importance judged by the research participants in the private sector is higher than the average and considerably higher than that of the public sector. In PPP based project, the private sector is presumed to be usually involved as a project operator that manages the substantial implementation of a project, including design, construction, operation and maintenance. It can be, therefore presumed that a project operator is in a position that can control/manage the progress (time) of construction. However, this analysis result of relative importance indicates that the private sector practitioners consider this risk factor is least in their control. This may imply that there are some processes in construction stage which government's involvement is required for settlement of issues or management of risks, such as project land acquisition and handing over of the land to the operator, environmental impact issues, resettlement and compensation issues and so on. While private operator has sufficient project management skills in project construction stage, project progress in construction stage is often delayed by the above-mentioned issues or risks that are least in control of the private sector. Therefore, the public sector's involvement and taking those risks is indispensable even in the project construction stage. Based on this discussion, this risk factor may be better to share between both sectors, depending on their capabilities to control them. For a risk factor for which a share risk responsibility is suggested in the risk allocation framework, it is further suggested to prepare a list of the specific components that cause the risk and identify the better party to take each component.

10) Risk Factor R17: Tariff setting uncertainty

Relative importance judged by the research participants in both sectors is considerably lower than the average and it is presumed they consider this risk factor as less important. However, the relative importance of the public sector is higher than that of the private sector. This risk is categorized into business risk and the private sector has know-how of tariff setting. From this analysis result of the relative importance, it is assumed that the research participants in both sectors perceive the private sector is the best party to manage the tariff setting uncertainty. However, since the water

tariff in public water supply can not necessarily be determined only from the aspects of cost and benefit, the public sector should intervene in permission and authorization of tariff setting.

11) Risk Factor R20: Unpaid bill by consumers

Relative importance judged by the research participants in both sectors is much lower than the average and it is presumed they consider this risk factor as less important. However, the relative importance of the public sector is considerably higher than that of the private sector. This risk is categorized into business risk and will realize in the project operation. It is, therefore presumed that the private sector has the know-how to deal with this risk. From this analysis result of the relative importance, it is said that the research participants in the public sector perceive this risk is least in their control, while the private sector is the best party to manage this risk factor.

12) Risk Factor R21: Abuse of power by government officials

Relative importance judged by the research participants in both sectors is higher than the average and the relative importance of the public sector is slightly higher than that of the private sector. It is apparent that this risk is least in control of the private sector and should be controlled by the public sector. However, according to this analysis result, the public sector participants also perceive this risk is least in their control. This analysis result might imply that although government as a whole might be able to manage the political risks, many individuals within the government feel the management functions or systems of the government are disempowering.

13) Risk Factor R26: Operation and maintenance cost escalation

Relative importance judged by the research participants in both sectors is lower than the average and it is presumed they consider this risk factor as less important. However, the relative importance of the public sector is higher than that of the private sector. This risk is specifically associated with operation and maintenance of facilities/plants constructed in a project. In PPP based infrastructure project the operation and maintenance are to be undertaken by the private sector to be involved in the project as project operator. Well-experienced project operator has know-how of operation and maintenance including how to deal with this risk factor. From this analysis result of the relative importance, it is assumed that the research participants in both sectors perceive the private sector is the best party to manage this risk.

14) Risk Factor R27: Equipment defect-caused interruption

Relative importance judged by the research participants in both sectors is lower than the average and it is presumed they consider this risk factor as less important. However, the relative importance of the public sector is higher than that of the private sector. This risk is specifically associated with operation and maintenance of facilities/plants constructed in a project. In PPP based infrastructure project the operation and maintenance are to be undertaken by the private sector to be involved in the project as project operator. Well-experienced project operator has know-how of operation and maintenance including how to deal with this risk factor. From this analysis result of the relative importance, it is assumed that the research participants in both sectors perceive the private sector is the best party to manage this risk.

15) Risk Factor R29: Environment protest-caused interruption

Relative importance judged by the research participants in both sectors is lower than the average and it is presumed they consider this risk factor as less important. However, the relative importance of the private sector is slightly higher than that of the public sector. The risk factors R26 and R27 mentioned above are specifically associated with the operation and maintenance that are internal activities of the project, while this risk R29 is considered to be associated with issues outside the project. Environmental issues often become a social problem, and thus the private sector is considered to expect the public sector's involvement in solution of this problem. Once this risk is realized, the government's involvement will be required for settlement of environment protests by outsiders due to infrastructure projects. From this analysis result of the relative importance, this risk factor may be better to share between both sectors, depending on their capabilities to control it.

16) Risk Factor R34: Natural disaster

Relative importance judged by the research participants in both sectors is lower than the average and it is presumed they consider this risk factor as less important. The relative importance of both sectors are almost same. Both sectors are considered to have a similar perception to this risk, that is, although impacts of natural disasters to a project are large, there is a limit in the control and management. From this analysis result of the relative importance, this risk factor may be better to share between both sectors, depending on their capabilities to control it.

17) Risk Factor R35: Man-made disaster

Relative importance judged by the research participants in both sectors is considerably lower than the average and it is presumed they consider this risk factor as less important. The relative importance of both sectors are almost same. This risk is considered to be controlled and managed by the private sector that is a project operator, however there might be some cases that the public sector involvement is required for settlement of problems due to this risk factor. From this analysis result of the relative importance, this risk factor may be better to share between both sectors, depending on their capabilities to control it.

18) Risk Factor R39: Labor strike

Relative importance judged by the research participants in both sectors is lower than the average and it is presumed they consider this risk factor as less important. However, the relative importance of the public sector is considerably higher than that of the private sector. This risk is considered specifically associated with operation and management in implementing a project. In PPP based infrastructure project the project operation and management are to be undertaken by the private sector to be involved in the project as project operator. Well-experienced project operator has know-how of the project operation and management including how to deal with this risk factor. From this analysis result of the relative importance, it is assumed that the private sector is the best party to manage this risk and the research participants in the public sector expect the private sector to manage this risk.

19) Risk Factor R40: Poor decision making process

Relative importance judged by the research participants in both sectors is lower than the average and it is presumed they consider this risk factor as less important. The relative importance of both sectors are almost same. This risk is categorized into Design and Procurement Risk (C7). Although importance of this risk category is relatively esteemed low by the research participants in both sectors, there should be many opportunities when decision makings by both parties are required through the design and procurement stage in project implementation. From this analysis result of the relative importance, this risk factor may be better to share between both sectors, depending on their capabilities to control it.

20) Risk Factor R41: Lack of transparency in bidding

Relative importance judged by the research participants in both sectors is lower than the average and it is presumed they consider this risk factor as less important. However, the relative importance of the private sector is slightly higher than that of the public sector. This result is considered to indicate this risk is least in control of the private sector and they may expect the public sector to control it. Lack of transparency in bidding may be caused by improper intervention of a project owner (the public sector) to the project operation. From this analysis result of the relative importance, the public sector might be the best party to manage this risk.

21) Risk Factor R42: Poor or incomplete project evaluation

Relative importance judged by the research participants in both sectors is lower than the average and it is presumed they consider this risk factor as less important. The relative importance of both sectors are almost same. Although importance of this risk factor is relatively esteemed low by the research participants in both sectors, it is presumed the research participants in both sectors have a similar perception to this risk factor. It is a normal practice in infrastructure development process to conduct project evaluation at the feasibility study stage prior to decision of investment in a project. In a feasibility study, an infrastructure project plan is evaluated from various aspects, including technical soundness, economic feasibility and financial viability, and in addition impacts to the natural and social environments due to the project. The private sector has know-how to conduct this kind of integrated evaluation on infrastructure projects. From this analysis result of the relative importance, the private sector is the best party to manage this risk.

Based on the above discussion from 1) to 21), the suitable party to control/manage each risk is summarized in Table 5.3.9 below.

Table 5.3.9 Better Party in Control of Predominate Risks

Risk Category (C) and Risk Factor (R)			Average Relative Importance		Better Party to take Risk in terms of Average Relative Importance	Better Party to take Risk and the Extent of Share based on discussions
			Public N=13	Private N=11		
C1	Political risk		0.284	0.324-	Public sector	Public sector-whole part
	R2	Non-availability of foreign exchange	0.154	0.160	Public sector	Public sector-whole part
	R5	Breach of contract by government	0.097	0.069	**Private sector**	**Public sector-whole part**

99

	R7	General changes in legislation	0.043	0.095	Public sector	Public sector-whole part
C2	Economic/commercial risk		0.150	0.160	Public sector	Public sector-whole part
	R10	Inflation fluctuation	0.047	0.026	**Private sector**	**Public sector-whole part**
	R11	FX fluctuation	0.059	0.090	Public sector	Public sector-whole part
	R12	Interest rate fluctuation	0.044	0.044	Share	Public sector-whole part
C3	Land and construction risk		0.126	0.149	Public sector	Share between both sectors
	R13	Construction cost overrun	0.072	0.051	Private sector	Private sector-whole part
	R14	Land cost escalation	0.022	0.035	Public sector	Public sector-whole part
	R15	Construction time overrun	0.032	0.063	Public sector	Share between both sectors
C4	Business risk		0.136	0.103	Private sector	Private sector-major part
	R17	Tariff setting uncertainty	0.037	0.027	Private sector	Private sector-major part
	R20	Unpaid bills by consumers	0.033	0.016	Private sector	Private sector-whole part
	R21	Abuse of power by government officials	0.065	0.060	**Private sector**	**Public sector-whole part**
C5	Operation risk		0.104	0.085	Private sector	Private sector-major part
	R26	Operation and maintenance cost escalation	0.038	0.027	Private sector	Private sector-whole part
	R27	Equipment defect-caused interruption	0.029	0.024	Private sector	Private sector-whole part
	R29	Environment protest-caused interruption	0.033	0.034	Public sector	Share between both sectors
C6	Force majeure risk		0.109	0.086	Private sector	Private sector-major part
	R34	Natural disaster	0.039	0.040	Public sector	Share between both sectors
	R35	Man-made disaster	0.021	0.020	Private sector	Share between both sectors
	R39	Labor strike	0.046	0.025	Private sector	Private sector-whole part
C7	Design and procurement risk		0.092	0.092	Share	Share between both sectors
	R40	Poor decision making process	0.038	0.036	Private sector	Share between both sectors
	R41	Lack of transparency in bidding	0.022	0.031	Public sector	Public sector-whole part

	R42	Poor or incomplete project evaluation	0.028	0.025	Private sector	Private sector-whole part

Note:

1) In judgement based on Relative Importance, the party indicates lower Relative Importance value is assumed the better party to take and control the risk.

2) In case the judgement is share, it was considered the judgement based on Relative Importance and the judgement based on discussion was not perfectly inconsistent.

As shown in the above Table 5.3.9, risk allocation in terms of the relative importance estimated based on the assumption explained in the Section 5.3.2 (1) is generally in line with that identified through the discussions in the Section 5.3.2 (2) on the Risk Categories from 1) to 4) and on the Risk Factors from 1) to 21). The cases which indicate inconsistency with the assumption are Risk Factors R5 (Breach of contract by government), R10 (Inflation fluctuation) and R21 (Abuse of power by government officials). The analysis result for these three risk factors might imply that despite the government as a whole might be able to manage these risks, many individuals within the government feel the management functions or systems of the government are disempowering. It is, therefore presumed that despite the public sector is apparently the best party to control/manage the risks, higher relative importance than that of the private sector is obtained.

In this Section, the discussions and considerations on relative importance identified by the research participants in both sectors were made to each of the seven risk categories and the 21 risk factors based on the quantitative analysis, and the results are considered to support the assumption that the party that indicates lower relative importance value is a better party to control or manage the risk.

5.4 SUMMARY

In the previous chapter seven dominant risk categories and 21 risk factors in total, that consist of three risk factors in each of seven risk categories, were explored through analysis for the 1st questionnaire survey results. In this chapter relative importance of a risk is introduced as an index for measuring difference or similarity in risk perceptions by project practitioner. The relative importance of risk category and risk factor are estimated applying AHP method. At first, the 2nd questionnaire survey method for collecting data to be applied for AHP from the research participants is explained, showing the questionnaire survey sheets. In order to calculate relative

importance of risk category and risk factor, pairwise comparison matrices were made using the data collected in the questionnaire sheet from each research participant, and consequently one pairwise comparison matrix (7 rows x 7 columns) for risk category and seven pairwise comparison matrices (3 rows x 3 columns) for risk factor were obtained from the answer to the 2nd questionnaire by participant.

The purpose of AHP analysis in this research is to clarify quantitatively how much each respondent who belongs to either public or private sector intends to share each one of a number of risks associated in a PPP project with other party. It is eventually intended to explore type and extent of risks that each party considers to be least in control or manage of each party, on assumption that the more difficult a practitioner considers to control or manage a risk, the more important the practitioner recognizes the risk, and on the contrary, that if a practitioner considers easy to control or manage a risk, the practitioner recognizes the relative importance of the risk is low.

In the AHP calculation process, it is important to consider consistency of a pairwise comparison matrix and it is necessary to check consistency of a pairwise comparison matrix derived from the judgements of questionnaire respondents and discussion on the consistency is described.

Subsequently, findings obtained from the questionnaire survey are discussed based on the relative importance of risks that were estimated from pairwise comparison matrices of which consistency is within allowable range, 0.1 according to Saaty (2012). Based on the priority ranking of risk categories and risk factors in terms of relative importance, which were derived from judgments of each research participant, discussion on differences or similarities in perception to the risks by research participant was conducted in relation to their current position and experiences. Pairwise comparison results were obtained from 33 respondents in the public sector and 27 respondents in the private sector, respectively. After consistency was tested for the 60 pairwise comparison matrices about seven risk categories, 14 matrices of the public sector respondents and 11 matrices of the private sector respondents turned out to be in the tolerable range of the consistency. Therefore, further discussions were made using the relative importance calculated based on these matrices of 25 research participants.

Relative importance of the seven risk categories is shown both in terms of number and bar chart for 14 research participants in the public sector and 11 research participants in the private sector.

As the relative importance are indicated in normalized number, total of the relative importance number for the seven risk categories is always 1.0 and each of relative importance can be indicated in number between 0.0 and 1.0 (or percentage). From the above calculation results, it can be read that how much important the research participants consider each of the seven risk categories. Comparing the relative importance for the seven risk categories, any trend particular to the public sector or private sector was not observed. Instead, it was observed that there were a variety of perception to the same risk categories by research participant even in the same sector. Both in the public and private sectors several respondents give the highest relative importance to the risk category C1 - Political risk, while there is one respondent in the public sector who gives the lowest importance to C1 and one respondent in the private sector who gives the fourth highest importance to C1 out of seven risk factors. In order to further explore the trend of degree of relative importance judged by respondents in each sector, the estimated values of relative importance were indicated in the rank order. From comparison in terms of the rank order of the relative importance for the seven risk categories, the further specific results were obtained.

In a similar manner, relative importance for the 21 risk factors were analysed. It was, however found that one public sector respondent (respondent code Q1PU31) gave three inconsistent pairwise comparison matrices regarding risk factors out of the seven matrices. Therefore, the questionnaire result from this respondent were excluded from the further discussion. Eventually, the questionnaire results from 13 public respondents and 11 private respondents were used for analysis of relative importance of the risk factors.

In the end, using the average relative importance, it was attempted to identify the better party to control or manage the risk categories and the risk factors. On the other hand, identification of the better party to control or mange the risk category or risk factor was attempted based on the discussions and considerations for each of the four risk categories and the 21 risk factors. By comparing these two ways of the risk allocation, validation of the risk allocation based on the relative importance value were demonstrated.

CHAPTER SIX: FRAMEWORK DEVELOPMENT AND VALIDATION

6.1 INTRODUCTION

This chapter presents a framework for adequate risk allocation between the public and private sectors in PPP based infrastructure project that was developed based on the findings through the questionnaire surveys and analysis for the survey results, and further accompanying recommendations. Those are expected to serve as a guide to assist in introducing PPP based infrastructure development projects in water supply sector in Sri Lanka.

At first, all findings obtained through various analyses conducted in the Chapter 4 and the Chapter 5 are summarized in this chapter. Subsequently, a concept underlying the risk allocation between the public sector and the private sector in infrastructure project development is discussed. In developing or implementing a PPP based infrastructure project, the risk allocation between both sectors is dependent on the project scope determined according to the public demands/requirements and the necessary solutions for meeting the demands/requirements. As indicated in Figure 2.2.1, some typical PPP models/structures are established according to the extent of the private sector involvement.

Furthermore, variations of the typical project model/structure might be identified depending on the extent of a government involvement as well. As discussed in the Section 2.2, determination of a PPP project model/structure is a core activity of the government in implementing a project applying PPP, however "How can the suitable model be established?" it is eventually related to the necessity of the project, that is, what is the public demand/requirements and what kind of project scope is necessary for giving the solution. A government should be responsible for this determination based on the government policy of infrastructure development and for taking some extent of risk in the project because PPP is not a system to simply transfer the risks associated with infrastructure development to the private sector but a system to share the risks between both sectors. The government is responsible for formulating a project model/structure of PPP based infrastructure development project that is attractive enough for the private sector to enter even if the private sector takes the risks.

Lastly, this chapter also discusses feedback from the framework evaluation where perspectives were sought from the research participants on the framework and recommendations.

6.2 SUMMARY OF FINDINGS IN THIS RESEARCH

The findings obtained through various analyses in the Chapter 4 and Chapter 5 are summarized below.

6.2.1 Findings from 1st Questionnaire Survey Result and the Analysis

1) In general, the respondents of both sectors selected the same risk factors in terms of risk which is least in their control. This indicates that irrespective of the sectors and organizations that the respondents belong to and of the positions of the respondents, a number of respondents in respective sectors are considered to have a common perception that it is difficult for them to control these risk factors.

2) While there are several risk factors that are allocated to the public sector which is the best party to manage them in previous research on perceived or preferred risk allocation between public and private sectors in PPP projects, a number of project practitioners in the public sector of Sri Lanka consider the same risk factors are least in their control.

3) Regarding the seven risk factors, including C1/R5, C1/R6, C3/R16, C6/R38, C7/R41, C7R46 and C7/R47, this survey result might imply that although government as a whole might be able to manage the above seven risk factors, many individuals within the government feels the management functions or systems of the government are disempowering.

6.2.2 Findings from 2nd Questionnaire Survey Result and the Analysis

In addition to the findings obtained through the 1st Questionnaire Survey, the findings from the quantitative aspect discussed in Chapter 5 are given below.

(1) Relative Importance Estimated for Risk Categories

1) As observed in Figures 5.3.1 and 5.3.2, there is large extent of individual difference in perception to a risk category by respondent even in the same sector, however in terms of average value, that is considered to represent a general feature of each sector, it seems that there is no significant difference in degree of relative importance to each risk category between the public sector and the private sector. This similarity results from the following features that are commonly observed in both sectors.

  ➢ More than 60% of the respondents judged that Risk Category C1 (political risk) is the

most important category giving comparatively higher value of relative importance (around 30% to 55% out of 100% in total of the seven risk categories).

➢ More than half of respondent's rank Risk Category C2 (economic/commercial risk) to comparatively high positions, 2nd place or 3rd place

➢ For the Risk Categories C3 (land and construction risk) and C4 (business risk), some respondents rank these categories to comparatively high positions, while similar number of respondents rank them to lower than 3rd position. The respondents' judgments are at variance even in the same sector.

➢ For the Risk Categories C5 (operation risk risk), C6 (force majeure) and C7 (design and procurement risk), the number of respondents who ranked these categories to 4th to 7th positions are equal to or larger than those who ranked to 1st to 3rd positions. In addition, many respondents give relative importance value less than 10% to these categories.

2) In terms of the rank order of the relative importance of risk categories (ref. Table 5.3.3), 71% of the respondents in the public sector and 64% of the respondents in the private sector perceived Risk Category C1(Political risk) as the most important risk category. Furthermore, the respondents who chose C1 as the most important risk category or the 2nd most important risk category are 71% in the public sector and 91% in the private sector. The above results indicate it is a common recognition that C1 is a considerably important risk category out of the seven categories for major part of the respondents in both sectors.

(2) Relative Importance Estimated for Risk Factors

It can be concluded that although there is a variety of judgment or perception to the relative importance of 21 risk factors even in the same sector, the general trend, that is presented in average relative importance to the risk factors in Figure 5.3.6, is considerably similar between both sectors.

(3) Approach to Adequate Risk Allocation Between the Public and Private Sectors

1) The relative importance was estimated based on the result of a pairwise comparison between two risk categories or factors conducted by the research participants. When a research participant conducted a pairwise comparison, what is the base that he/she considers the risk is more important than the other one. It is assumed in this research that

when a project practitioner considers more difficult to control or manage a risk, he/she recognizes the risk is more important. On the contrary, when a project practitioner considers the sector or organization that he/she belongs to has enough capability to control or manage the risk factor, the practitioner recognizes importance of the risk factor is lower. Based on this, it can be eventually assumed that the party that indicates lower relative importance value is a better party to control/manage the risk.

2) Discussions and considerations on relative importance judged by the research participants in both sectors were made to each of the seven risk categories and the 21 risk factors based on the quantitative analysis, and the results are considered to support the assumption that the party that indicates lower relative importance value is a better party to control or manage the risk, as identified in Table 5.3.9.

6.3 FRAMEWORK FOR ADEQUATE RISK ALLOCATION

6.3.1 Basic Concept of Risk Allocation

As discussed in Section 2.5.3 (1), at the procurement stage of a project the public sector prepares a transaction structure, where a list of the specific risks registered in the PPP project and how the public sector client of the project intends to allocate the project risks between the contracting parties – between the public and private sectors are indicated. It is prepared as part of bid documents and provided to bidders in the course of bid procedure to procure private project operator. Based on this specific transaction structure, the private bidders can estimate the bid price incorporating the recovery of the cost of managing the risks allocated to the private bidders. In preparation of the transaction structure for a specific project, more generic guide for risk allocation can assist the public sector in preparing the transaction structure. Risk allocation framework as given in Table 2.3.2 as a sample is, therefore considered to be defined as a guide for preparing multiple risk registers based on a balanced risk allocation between the public and private sectors.

Risk allocation between the public sector and the private sector is gained through an <u>intermediate</u> position between two divergent forms of infrastructure development on a continuum. As discussed in the Section 2.2.1, there is a variety of PPP based project development forms, according to the extent of the private sector involvement. In terms of the risk allocation between the public sector and the private sector in implementing an infrastructure development project, there are two

divergent methods that are considered to form polar opposites on the continuum. One is the traditional infrastructure development undertaken by a government. Most of the risks are taken by the government and the private sector is involved for a short term as contractor and/or supplier. The other is a self-paying basis or concession basis infrastructure development undertaken by a private operator. While a variety of risk including major risks, such as demand risk and financing risk are transferred to the private operator, the private operator can retain a right to exclusively operate a public infrastructure for a long term, collect the investment fund and make a profit by providing services with the user through operation of the facilities/system. The above discussed concept for risk allocation measure is illustrated in Figure 6.3.1.
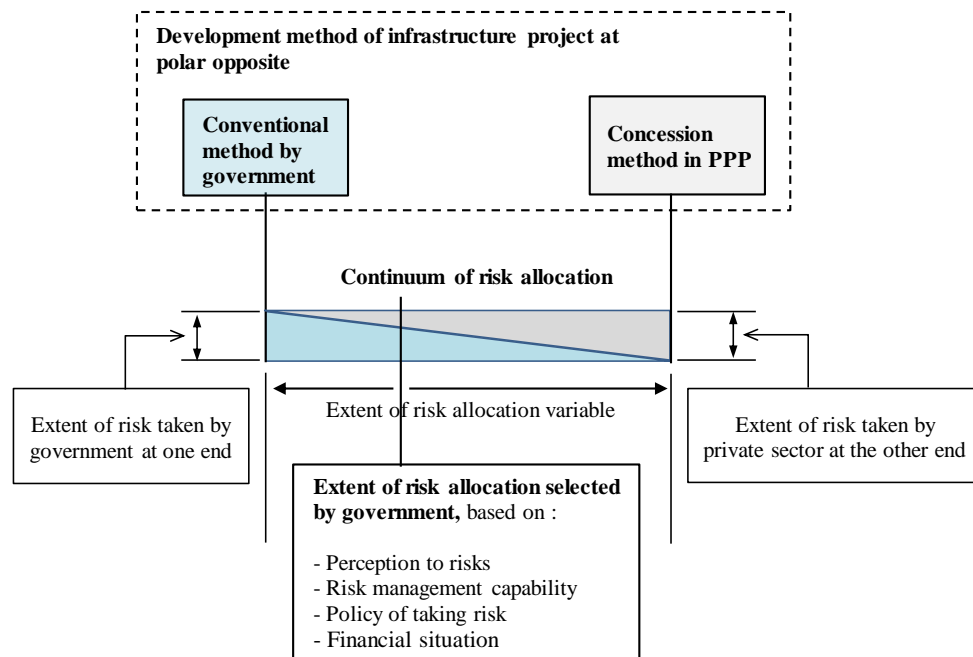
Figure 6.3.1 Concept of Risk Allocation

A generic risk allocation framework can also be used in the course of formulation of PPP project. Once the government decides to develop project on a PPP basis, the next step required for the government is to identify the appropriate PPP model (ADB, 2009). It is a key factor to develop the best suited PPP model for implementation of project, considering the specific project requirements of the government. In the Section 2.3.3, some successful PPP models that were adopted in India are indicated in the context of the water supply value chain. It can be seen from this reference that the PPP models are developed so as to manage the specific risks associated with the components of value chain, through allocation of the risks between the government and the private operator. In

formulating a water supply project, the project requirements are closely related to the value chain, that is the government needs to identify which part of the value chain or the entire should be included in the scope of project. The type and extent of risks are specifically related with the components of water supply value chain. Therefore, risk allocation framework is expected to serve as a guide to assist project practitioners of the government in identifying appropriate PPP model and preparing the risk register.

An important activity during the formulation of a PPP project for the government is to determine the best suited PPP model for implementing the project based on the risk allocation mechanism on the continuum as shown in Figure 6.3.1, through understanding the realistic capabilities to take risks of both sectors. The best suited model should be identified in terms of adequate risk allocation that can be agreed by both sectors and the risk allocation should be clearly incorporated into the request for proposal (RFP), in order to avoid conflicts related to the extent of transfer of risks from public to private sector. Risk allocation framework is, therefore considered as a guide which can suggests the course of action in discussing adequate risk allocation for identification of the best suited PPP model.

The risk allocation framework shown in Table 6.3.1, that is the final compilation of discussions through Chapter 4 and Chapter 5 in this research, indicates a locally focused predominate risk list associated with PPP water supply project in Sri Lanka together with the preferred allocation strategy between the public and private sectors. It is, therefore considered to serve as a guide in preparing RFP based on a transaction structure and the bid documents used in the course of project procurement undertaken by the government - the public client of project and to fit into the definition of risk allocation framework mentioned in the beginning of this Section 6.3.1.

6.3.2   Risk Allocation Framework Recommended in This Research

(1)   Comparison to Frameworks in Other Research Cases

As discussed in Section 2.5.3, many researchers have proposed risk allocation frameworks in PPP/PFI project. Six cases of research on development of risk allocation framework are presented in Table 2.5.2 where different analysis methods are applied by each researcher. However, the research methodology is common to all six cases and consists of three basic steps including data collection through questionnaire survey to project experienced practitioners, conversion of the

collected descriptive data to numerical data and analysis applying the numerical data to decision-making technique. While different data conversion technique (from descriptive data to numerical data) and different decision-making technique are applied by each research case, questionnaire survey is used in all six cases for data collection from selected project practitioners both in the public and private sectors who have sufficient experiences in implementation of infrastructure projects. However, the six cases have different features in terms of the questionnaire structure.

In comparison to the above six cases, while research methodology adopted in this research is same as those of the six research cases, different analysis method of decision-making technique from those used in the six research cases is applied in this research. The pairwise comparison rating used in this technique is considered easy for respondents to present their perceptions in number. However, the point of risk allocation framework recommended in this research is focused on the nature of data collected through the two questionnaire surveys and an assumption on interpretation of the analysis results of decision-making for risk allocation between the public and private parties as discussed in the Section 5.3.2 (1). The above-mentioned advantages are explained in the subsequent sections.

(2)   Data Collected through Questionnaire Surveys

In the 1st questionnaire survey of this research, a list of risk factor by risk category is shown to research participants and they were asked to choose risk factors that are least in their control. This question is simple and considered possible for the respondents to answer without feeling heavy load, compared to the questions used in other research cases, such as "To identify which is better party to control a specific risk", "To give proportion of allocation to a specific risk between public and private parties or "To show extent of respondent's agreement to situation of environmental factors in deciding risk allocation strategy which are provided by researcher". If a question is simple and clear, it would be easy for respondents to answer, and thus it is considered more reliable and consistent data can be obtained from their answers.

In the 2nd questionnaire survey, the research participants are asked to conduct pair-wise comparisons among risk categories and risk factors identified in the 1st questionnaire survey. Pairwise comparison is a technique to convert decision-maker's subjective idea or perception to numerical data. In other research cases, rating method such as five points Likert Scale or seven-points grading system is often used as the conversion technique. In rating work by pairwise

comparison, respondents are always allowed to examine importance or grade of a risk in comparison to another risk, that is, respondents can judge thinking which item is more important instead of thinking how much important an item is, and thus a pairwise comparison is assumed to be able to reduce respondent's ambiguity in rating the risks and the obtained results are considered to represent the respondent's idea or perception more reliably, compared to other rating methods.

(3)   Assumption about Interpretation of Calculated Relative Importance of Risk

Ameyaw and Chan (2015b) states it is a general consensus that risks should be allocated to the contracting party best able to control and manage them. The question is how the contracting party best able to control and manage the risks can be identified. In this research, the party which would be best (or better) able to control and manage a specific risk is identified by using relative importance of the risk as index for decision-making of allocation. Furthermore, considering the nature of research data collected through the two questionnaires as discussed in the above sections 6.3.2 (2), an assumption about consideration of the respondents in conducting a pair-wise comparison to identify relative importance between risks was made as given below.

Assumption about consideration of respondents in pair-wise comparison

In conducting a pairwise comparison of risks, when a respondent – project practitioner that belongs to either the public sector or private sector recognizes it is more difficult for his/her sector to control or manage a specific risk, he/she identifies the risk is more important. On the contrary, when a project practitioner recognizes the sector or organization that he/she belongs to has enough capability to control or manage the risk, the practitioner recognizes importance of the risk is lower.

Based on this, it is further assumed that the party that indicates lower relative importance value is a better party to control/manage the risk.

(4)   Recommended Risk Allocation Framework

Risk allocation framework is derived from "Better party in control of predominant risks" shown in Table 5.3.9. The table shows risk allocation identified in terms of relative importance of risks estimated applying AHP method and risk allocation identified through discussion made in the Section 5.3.2 (2). It is clear that risk allocation in terms of the estimated relative importance based on the assumption explained in the Section 6.3.2 (3) is generally in line with that identified through discussions in the Section 5.3.2 (2). The cases which indicate inconsistency between both risk

allocation strategies are Risk Factors R5 (Breach of contract by government), R10 (Inflation fluctuation) and R21 (Abuse of power by government officials). It is apparent that the whole these risks should be controlled by the government, nevertheless higher relative importance values are obtained for the public sector. This situation might imply that many individuals within the public sector feel the management functions or systems of the public sector are disempowering. Therefore, in the recommended risk allocation framework whole part of these three risks are allocated to the public though the risk allocation in terms of relative importance indicates the private sector is better party to control these three risks.

An adequate risk allocation framework as final compilation of this research provided in Table 6.3.1, specifically assuming the implementation of PPP based infrastructure project in water supply sector in Sri Lanka.

Table 6.3.1 Framework of Adequate Allocation of Predominate Risks

Risk Category (C) and Risk Factor (R)			Better Party to take Risk in terms of Average Relative Importance
C1	Political risk		Public sector-whole part
	R2	Non-availability of foreign exchange	Public sector-whole part
	R5	Breach of contract by government	Public sector-whole part
	R7	General changes in legislation	Public sector-whole part
C2	Economic/commercial risk		Public sector-whole part
	R10	Inflation fluctuation	Public sector-whole part
	R11	FX fluctuation	Public sector-whole part
	R12	Interest rate fluctuation	Public sector-whole part
C3	Land and construction risk		Share between both sectors
	R13	Construction cost overrun	Private sector-whole part
	R14	Land cost escalation	Public sector-whole part
	R15	Construction time overrun	Share between both sectors
C4	Business risk		Private sector-major part
	R17	Tariff setting uncertainty	Private sector-major part
	R20	Unpaid bills by consumers	Private sector-whole part
	R21	Abuse of power by government officials	Public sector-whole part
C5	Operation risk		Private sector-major part
	R26	Operation and maintenance cost escalation	Private sector-whole part
	R27	Equipment defect-caused interruption	Private sector-whole part
	R29	Environment protest-caused interruption	Share between both sectors

C6	Force majeure risk		Private sector-major part
	R34	Natural disaster	Share between both sectors
	R35	Man-made disaster	Share between both sectors
	R39	Labor strike	Private sector-whole part
C7	Design and procurement risk		Share between both sectors
	R40	Poor decision making process	Share between both sectors
	R41	Lack of transparency in bidding	Public sector-whole part
	R42	Poor or incomplete project evaluation	Private sector-whole part

(5)   Limitation of Risk Allocation Framework

Risk allocation framework indicated above is developed based on the findings and analysis results of the two questionnaire surveys which were conducted to the Sri Lankan project practitioners who have been involved in implementation of the infrastructure projects in Sri Lanka. In the 1st questionnaire survey, the research participants were asked to choose a maximum of five risks in the risk list indicated in the questionnaire that respondents consider to be least in their control for successful implementation throughout the entire life of PPP infrastructure project in water supply sector in Sri Lanka. As mentioned in the item 2) of section 1.3.2 Research Objectives, in this research locally focused risk list in water supply sector is made through the questionnaire survey. In addition, as discussed in the section 2.3.3, PPP model best suitable to project is closely related to the project nature, including project scope identified, project requirements, type and extent of risks associated with project, that is different by project. As explained in section 2.4, implementation of an infrastructure project in water supply sector is closely related to satisfaction of basic human needs and therefore, it may be necessary for the government to take more risks, compared to the projects in other sectors.

It is, therefore considered that the proposed framework can serve as a guide in identifying adequate risk allocation for infrastructure project in water supply sector in Sri Lanka. However, discussion on applicability of the framework proposed in this research to other sectors is a future research subject.

(6)   Applicability of Proposed Framework to Sri Lankan Social/Political Context

The proposed risk allocation framework in this research is expected to serve as a guide for the purpose of promoting PPP infrastructure development project in water supply sector in Sri Lanka.

As mentioned repeatedly in this thesis, it is an important key to success of PPP infrastructure project that the risk factors associated with the project are adequately allocated between the public and private sectors, and subsequent to risk allocation, a PPP model best suited to the project scope is identified. In Sri Lanka, while the government takes up introduction of PPP concept into the infrastructure development in water supply sector as the government policy, it is fact that there is no experience of PPP water supply project in Sri Lanka. The risk allocation in this research was discussed based on the risk categories and risk factors which were identified through research of PPP water supply project in other countries, and the risk allocation framework was developed through quantitative analysis for the risk perception of Sri Lankan project practitioners in both public and private sectors, that are well experienced in infrastructure development in water supply sector and in other sectors which have actual experiences of PPP based project. Therefore, in the social and political context of Sri Lanka, this risk allocation framework is considered to assist the Sri Lankan government in developing PPP infrastructure project in water supply sector.

However, further elaboration would be necessary especially in identifying any PPP contract/model best suited to the project based on the concept of adequate allocation of specific risks in individual PPP project. In the section 2.2.3, three keys to success of a PPP project, 1) adequate risk allocation, 2) preparation of RFP in which the private sector is interested, and 3) conclusion of long-term contract, are presented. In this research while discussion was made focusing on adequate risk allocation as critical element in implementation of PPP project and the risk allocation framework was recommended, discussion was not made in connection with the best suited PPP model that is closely related to the other two keys. It would be, therefore, necessary to develop a risk allocation framework which can serve as a guide for identifying the best suited PPP model to specific PPP water supply infrastructure project.

6.4 VALIDATION OF FRAMEWORK

The framework for adequate risk allocation between the public and private sectors in PPP based infrastructure project was developed based on the findings through the questionnaire surveys and analysis for the survey results, and further accompanying recommendations. Those are expected to serve as a guide to assist in introducing PPP based infrastructure development projects in water supply sector in Sri Lanka. In developing a framework, it is required to evaluate the validity for wider use in developing or implementing a PPP based project.

114

6.4.1 Validation Method

Validation was conducted applying the questionnaire survey (the 3rd questionnaire). The framework for adequate risk allocation proposed by the researcher, and the research findings and recommendations which were obtained through this research and are the base of the framework. The questionnaire is composed of feedback to research findings and suggested recommendations, and the research participants were asked to provide responses on the validity of the findings and on the relevance of the recommendations with regards to the respondents' experience. The 3rd Questionnaire sheet is attached in the Appendix B3.

6.4.2 Research Participants for Validation

The 60 research participants who answered to the 2nd questionnaire survey were selected for the 3rd questionnaire and the 3rd questionnaire sheets were sent to the potential respondents, with a cover letter explaining the survey purpose, background and significance as explained in the previous section 4.2.2. In this questionnaire, it is reiterated that confidentiality and anonymity of the responses would be strictly maintained.

Responses to the 3rd questionnaire were returned from 23 participants consisting of 14 respondents of public sector and 9 of private sector. The background information of individual respondent that were provided by the respondents in the answer to the 1st questionnaire as listed in Table 4.2.2. Although the response rate of 38% is much lower than those of the 1st questionnaire and the 2nd questionnaire, it is still acceptable range (Wibowo and Mohamed, 2008) and the 23 responses were valid and usable. This questionnaire sheets were sent to the potential research participants by e-mail and the opportunity to clarify the respondent's question were considered to be secured sufficiently.

Given the limited population meeting the desired criteria, it can therefore be assumed that the views of the respondents are reliable and noteworthy in representing the current local situation/problems of implementation of PPP based projects in water sector in Sri Lanka, providing validity to the survey results irrespective of the sample size. In addition, the use of the same research participants who were involved in the previous questionnaire surveys in this research would ensure to obtain a reliable response.

6.4.3 Evaluation on Validity of Research Outcomes

Evaluation on validity of research outcomes were made based on the responses from the research participants. The respondents are asked to provide responses to the questions indicated in the questionnaire. The questionnaire results are shown in the Tables 6.4.1 and 6.4.2.

Table 6.4.1 Response from Public Sector Respondents

Question No.	Unit	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
I-1	no.	0	1	1	11	1	14
	%	0	7.1	7.1	78.6	7.1	100
I-2	no.	1	3	3	6	1	14
	%	7.1	21.4	21.4	42.9	7.1	100
I-3	no.	0	3	4	6	1	14
	%	0	21.4	28.6	42.9	7.1	100
I-4	no.	0	0	0	8	6	14
	%	0	0	0	57.1	42.9	100
I-5	no.	0	1	5	7	1	14
	%	0	7.1	35.7	50.0	7.1	100
I-6	no.	0	1	1	11	1	14
	%	0	7.1	7.1	78.6	7.1	100
I-7	no.	0	1	3	6	4	14
	%	0	7.1	21.4	42.9	28.6	100
I-8	no.	0	0	2	7	5	14
	%	0	0	14.3	50.0	35.7	100
II-1	no.	0	0	2	8	4	14
	%	0	0	14.3	57.1	28.6	100
II-2	no.	0	0	2	9	3	14
	%	0	0	14.3	64.3	21.4	100
II-3	no.	Majority of respondents agrees to framework with reference to the results of Questions II-4 and II-5					
	%						

		Not sure of its capability	Not capable	Neutral	Capable	Highly capable	Total
II-4	no.	0	0	1	10	3	14
	%	0	0	7.1	71.4	21.4	100
II-5	no.	0	0	5	6	3	14
	%	0	0	35.7	42.9	21.4	100

Table 6.4.2 Response from Private Sector Respondents

Question No.	Unit	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
I-1	no.	0	0	1	6	2	9
	%	0	0	11.1	66.7	22.2	100
I-2	no.	0	1	0	5	3	9
	%	0	11.1	0	55.6	33.3	100
I-3	no.	0	0	0	8	1	9
	%	0	0	0	88.9	11.1	100
I-4	no.	0	0	2	5	2	9
	%	0	0	22.2	55.6	22.2	100
I-5	no.	0	0	0	8	1	9
	%	0	0	0	88.9	11.1	100
I-6	no.	0	2	3	4	0	9
	%	0	22.2	33.3	44.4	0	100
I-7	no.	0	0	0	8	1	9
	%	0	0	0	88.9	11.1	100
I-8	no.	0	1	1	7	0	9
	%	0	11.1	11.1	77.8	0	100
II-1	no.	0	0	0	7	2	9
	%	0	0	0	77.8	22.2	100
II-2	no.	0	1	1	6	1	9
	%	0	11.1	11.1	66.7	11.1	100
II-3	no.	Majority of respondents agrees to framework with reference to the results of Questions II-4 and II-5					
	%						

		Not sure of its capability	Not capable	Neutral	Capable	Highly capable	Total
II-4	no.	1	0	0	8	0	9
	%	11.1	0	0	88.9	0	100
II-5	no.	1	0	0	8	0	9
	%	11.1	0	0	88.9	0	100

The above results from the research participants suggest that the findings and recommendations are valid. Furthermore, as indicated in the answers to the question II-4 and II-5, majority of the research respondents agreed that the framework will serve as a guide for the government to introduce PPP based infrastructure development projects in water supply sector in Sri Lanka, and for the private sector to consider the participation in the PPP based infrastructure project.

Responses from research participants in the public and private sectors are provided in APPENDIX E.

6.5 SUMMARY

Purpose of this chapter is to develop a framework for adequate risk allocation between the public and private sectors in PPP based infrastructure project and to evaluate the validity. The framework is developed based on the findings through the questionnaire surveys which were discussed in Chapter 4 and Chapter 5 and analysis for the survey results, and further accompanying recommendations. Therefore, at first in this chapter the key findings in the two questionnaires survey were summarized. Subsequently, prior to discussion of development of risk allocation framework, a definition of risk allocation framework is presented referring a literature, and it is discussed how risk allocation framework elaborated in this research fits into the definition. A data set for constructing a risk allocation framework was collected from the research participants through questionnaire survey **by asking them to choose risks that are least in their control/management, out of the risk list shown in the questionnaire. This question is simple and easy for the respondents to answer without feeling heavy load, compared to the questions used in other research cases where a risk allocation is proposed. Therefore, the answers of respondents are considered to represent more reliably their perceptions to risks.** Furthermore, **an assumption which underlies the relation between the relative importance value and the project practitioners' perception to the risk is developed in this research. The risk allocation framework developed in terms of relative importance based on this assumption is well consistent with risk allocation identified through prevalent discussion on nature of risks and the allocation.** In addition, applicability of the proposed risk allocation to the other sector and the applicability to the social and political context of Sri Lanka are discussed considering the development background of the framework.

Lastly, evaluation of the validity of the research findings, recommendations and the framework were conducted, applying a questionnaire survey. A questionnaire sheet which shows these research outcomes were sent to 60 research participants who participated in the previous questionnaire survey and 24 responses were obtained. Through this validation the results from the research participants suggest that the findings and recommendations are valid.

CHAPTER SEVEN: CONCLUSION AND RECOMMENDATION

7.1 INTRODUCTION

This chapter provides conclusion of the research and recommendations for future research. In this research a framework for adequate risk allocation between the public and private sectors in implementing a PPP based infrastructure project in water supply sector in Sri Lanka has been explored by analysing the perceptions of the experienced Sri Lankan project practitioners to the risks associated with PPP based projects. The project practitioners' perceptions of the risks were assessed from the quantitative aspect by analysing data collected through two questionnaire surveys to Sri Lankan project practitioners. First, this chapter overviews the entire research process, and then presents the overview of research findings and research outcomes that are the key conclusion of the research. Subsequently, this chapter discusses achievement of the research objectives which were established in the initial stage of the research, and key contributions of the research are discussed from the aspects of knowledge, method and practice. Furthermore, this chapter presents practical implications arising from the research and the research limitations observed in the course of the research works, especially limitations associated with the questionnaire surveys and the data analysis method (AHP) applied for quantification of the perceptions to the risks. Lastly, this chapter provides recommendations for further research based on discussion on the research limitations and the improvement. The above-mentioned research conclusions and the recommendations are summarized in the last section.

7.2 AN OVERVIEW OF THE RESEARCH

Infrastructure development using PPP method is generally a prospective method for governments that are required to undertake continuous development of infrastructure with limited financial resources. It is, however, far from easy for the government to undertake infrastructure projects applying this method. Infrastructure projects involve a variety of risks which were traditionally borne by the government and the PPP concept transfers those risks, in part, to the private sector. The objectives which are pursued by the public and private sectors through implementation of such ventures can also often be seen to be

conflicting. This conflict may relate to different perceptions of risks between both sectors. If an agreed method which assesses project risks and the adequate allocation that is acceptable to both sectors is developed, it would contribute to the success of private sector involvement in public infrastructure projects. It is, therefore, the aim of this research to develop a participatory framework for allocation of risk between public and private sectors engaged in PPP infrastructure projects within the water supply sector in Sri Lanka.

In order to achieve this research aim, locally focused data were collected through the two questionnaire surveys conducted on experienced Sri Lankan project practitioners both in the public and private sectors **by asking them to choose risks that are least in their control/management, out of the risk list shown in the questionnaire. This question is simple and easy for the respondents to answer without feeling heavy load, compared to the questions used in other research cases where a risk allocation is proposed. Therefore, the answers of respondents are considered to represent more reliably their perceptions to risks.** Analyses, discussions and recommendations were made based on those data. Subsequently, based on the findings obtained through the data analyses in this research, the recommendations, that would help to provide a guide for the Sri Lankan government to consider an adequate risk allocation between the public and private sectors in formulating PPP based infrastructure project in water supply sector, are given.

The aim of this research is to develop a framework for adequate allocation of risk between public and private sectors engaged in PPP infrastructure projects within the water supply sector in Sri Lanka. In order to address the research aim, one research question posed in this research is What are the dominant risks perceived by project partners. The answer to this question is obtained through the 1st Questionnaire Survey. The questionnaire survey result provides some considerations which are a base to further evaluate the perceptions of the respondents to the relative importance of risks in implementation of PPP based projects by sector or position they belong to.

The 2nd Questionnaire is designed based on the 1st Questionnaire result. The findings obtained from the 2nd Questionnaire survey were discussed based on the relative importance of risks that were estimated by using AHP method, which was used for the quantitative discussions on the respondents' perceptions to the risks. Using the relative importance values, difference in the respondents' perceptions to the major risks

associated with PPP based infrastructure projects between the public sector and the private sector were considered. Based on these considerations, relevance between the relative importance value and the best party to control/manage each risk category and risk factor were demonstrated.

7.3 ACHIEVEMENT OF RESEARCH OBJECTIVES

Objective 1: *Understand the concepts and research related to frameworks to manage risks in PPP water supply projects, through literature review.*

This objective is addressed in Chapter 2 and Chapter 4. The risks associated with PPP based infrastructure development are first identified through literature. ADB that is a multilateral financing organization suggests an illustrative list of risks associated with a project and its consequences. This list of risks is generic and is made as exhaustive as possible. On the other hand, the risks a PPP project may be exposed to are affected by several factors, such as the type and scale of a project, the country where the project is located, and the type of PPP implemented. In addition, the importance of a particular risk factor may also be different from project to project and/or from country to country. A number of risk factors and the categories in PPP projects or the critical success factors of PPP projects have been identified and discussed in governments' guidelines and in many research. In Chapter 2 it is concluded that critical success factors vary depending on the situations of governments' policy and public requirements particular to the country. Therefore, it is not appropriate to adopt a generic framework and any research should adopt a more locally focused interviews and case study analysis to unravel CSFs (Critical Success Factors) in managing operational PPPs. However, any risk list specifically for a PPP based infrastructure project in water supply sector in Sri Lanka is not identified in published literatures. In this research locally focused risk list is made through the questionnaire survey.

Objective 2: *Identify and classify the dominant risks associated with the PPPs models which could be applied for the water supply projects in Sri Lanka, and identify the risk perceptions of Sri Lankan project practitioners*

This objective is addressed in Chapter 2 and Chapter 4. Identification and classification of the risks associated with the PPPs models which could be applied for water supply projects in Sri Lanka was achieved through the literature review. As the result, 48 risk factors were identified and classified into seven risk categories. The risk list was prepared for the questionnaire survey for the purpose of collecting data of perceptions of Sri Lankan project practitioners to the risks associated with PPP based infrastructure project.

To address this research objective two research questions are posed, 1. What are the dominant risks perceived by project partners and 2. What are the differences in risk perceptions between project practitioners by sector or organization/position they belong to. The purpose of the 1st Questionnaire was to explore the answers to the above-mentioned research questions from quantitative viewpoints, and to select adequate risk factors by risk category for the 2nd Questionnaire. In this research the potential participants are experienced practitioners of PPP based infrastructure projects, especially in water supply/sanitation sector in Sri Lanka and their opinions, ideas or perceptions was requested regarding critical risk factors and the allocation between the public and the private sectors in implementing a PPP based infrastructure project.

Objective 3: *Assess the relative importance of the dominant risk factors in risk allocation in the context of Sri Lanka's water supply projects through questionnaire with experienced practitioners of PPPs project in both public and private sectors.*

This objective is addressed in Chapter 5. In Chapter 4, dominant risk factors perceived by Sri Lankan project practitioners were explored through analysis for the 1st questionnaire survey results. Consequently, 21 risk factors in total, that consist of three risk factors in each of seven risk categories, were identified as dominant risk factors and used for the 2nd questionnaire survey. In Chapter 6 the differences and similarities in risk perceptions amongst the project practitioners by sector or organization/position they belong to are explored more specifically from quantitative aspect.

In order to measure the difference or similarity in risk perceptions by project practitioner, relative importance of a risk factor is introduced as an index. A relative importance of risk factors is presented in a value between 0 and 1 by applying AHP method. In the 2nd questionnaire survey the research participants are asked to carry out a pairwise

comparison amongst Risk Categories and amongst Risk Factors selected through the 1st Questionnaire survey. Subsequently, analyses and discussions on the 2nd questionnaire results and the findings are conducted based on the quantified relative importance of the risk categories and the risk factors. By achievement of this objective, perceptions of the Sri Lankan project practitioners to the various risks associated with PPP based infrastructure project were presented quantitatively and many findings were obtained and discussed. These findings suggest a framework for adequate allocation of risks between the public and private sectors in implementing PPP based projects.

Objective 4: Propose a framework for future use in adequate allocation of risks between the public and private sectors in implementing PPPs water supply projects in Sri Lanka.

This objective is addressed in Chapter 5. In the questionnaire survey of this research the research participants were asked to choose risk factors that are least in their control. This is the base for identifying the importance of a risk factor when the research participants conducted a pairwise comparison between two risk factors. **An assumption which underlies the relation between the relative importance value and the project practitioners' perception to the risk is developed in this research**, that is if a project practitioner considers controllability of his/her organization to a risk is low, the risk might be a higher priority for the organization to manage. Based on this, it is further assumed that the party that indicates lower relative importance value is the suitable party to control/manage the risk. The risk allocation framework is suggested based on the relative importance values calculated for the public sector and private sector by risk category and risk factor. **The risk allocation framework developed in terms of relative importance based on this assumption is well consistent with risk allocation identified through prevalent discussion on nature of risks and the allocation.**

Objective 5: Validate the proposed framework through with some of the respondents who answered to the questionnaire on risk identification and assessment.

This objective is addressed in Chapter 6. A risk allocation framework is proposed based on the research findings and recommendations. Validation of the research findings, recommendations and a risk allocation framework were conducted by conducting a questionnaire survey for the same research participants who participated in the 1st

Questionnaire survey and the 2nd Questionnaire survey. Questionnaire sheets that indicate the proposed framework, and the research findings and recommendations that are the base of the framework were sent to the 60 research participants. The researcher received the answers from 23 research participants. The questionnaire results from the research participants suggest that the findings and recommendations are valid. Furthermore, the answers from the respondents indicated majority of the research respondents agreed that the framework would serve as a guide for the government to introduce PPP based infrastructure development projects in water supply sector in Sri Lanka, and for the private sector to consider the participation in the PPP based infrastructure project.

7.4 RESEARCH CONTRIBUTIONS

This research has contributed to the existing body of knowledge through the development of a novel method to identify quantitatively the party which is supposed to be best (or better) able to control and manage the risks associated with the PPP based project in water supply sector in Sri Lanka. In addition, in identification of risk categories adopted for the analysis in this research through literature reviews, a new risk category (Design and Procurement) was added to frameworks suggested in the previous studies. This new category was chosen by the majority of the Sri Lankan respondents as high rank risk through the questionnaire survey in this research, and thus this survey result is considered to justify inclusion of this new category.

In identification of the best party able to control the risks by the method developed in this research, it was found that some risk factors were identified by those working in the Sri Lankan public sector as out of their control, while these risk factors are allocated by the previous studies to the public sector as the best party to retain the risks. There is an apparent contradiction in the perceived control of risk. Regarding this result, it was assumed in this research that although government as a whole might be able to manage these risks, the individual within the government feels the management functions or systems of the government are disempowering. Furthermore, validity of these research findings and the recommendations based on the findings are tested through a questionnaire survey by the Sri Lankan experienced project practitioners both in the public sector and the private sector.

PPP based project is still an emerging concept in many developing countries, including Sri Lanka. Sri Lanka has some experiences in implementing projects adopting PPP concept, however these experiences have been limited to sectors such as ports, telecommunication and power, and thus research on both PPP project and PPP project in water supply sector are also very limited. Considering this situation in actual PPP projects and the researches in relation to PPP project development in Sri Lanka, the research outcomes can offer useful suggestions to the government in guiding to introduce PPP based infrastructure project in water supply sector and to the private sector in considering the participation in PPP based infrastructure project in water sector, as well as contribute to the research field of risk allocation in PPP based infrastructure project in water supply sector in Sri Lanka and other developing countries.

7.5 PRACTICAL IMPLICATIONS

The findings of this research have many important implications that may assist project practitioners involved in infrastructure project development, especially practitioners in government organizations. The PPP based project concept is to transfer the project risks, in part or as a whole, to the private sector. If the government of a country that has only very limited experiences of PPP project, such as Sri Lanka expects to develop a sustainable foundation for undertaking PPP infrastructure projects, the government should carefully examine the type and extent of the risks to be transferred to the private sector so that the financial burden due to the risks to the private operator can be minimized. One of the most important implications in this research is that, although government might be able to manage the political risks, many individuals within the government feel the management functions or systems of the government are disempowering. This implication was derived from both discussions for the 1st Questionnaire result and the quantitative analysis for the 2nd Questionnaire result. The role of government in providing the public service can be switched from a provider to a buyer of services through PPP and the government can focus on its core responsibilities of policymaking and regulation (MOF Singapore, 2012). This implies that the management functions or system of the Sri Lankan government to fulfil the core responsibility are disempowering. Furthermore, in the risk allocation framework proposed in this research, some risk factors for which a

share risk responsibility is suggested, this implies that it is further suggested to prepare a list of the specific components that cause the risk and identify the better party to take each component.

7.6 LIMITATIONS OF THE RESEARCH

The core part of this research is structured by the two questionnaire surveys and data analyses applying AHP method to the data collected through the questionnaires. Therefore, the research outcomes are affected by the limitations of questionnaire survey and the limitations that are inherent in the AHP method itself.

In selecting the risk factors for the pairwise comparison by respondents, only three risk factors in each of seven risk categories, which is the minimum number of factors for making a matrix, were used not to unnecessarily increase the workload to the research participants. However, the total number of the risk factors that were used for the discussions on formulating a risk allocation framework is also limited to the minimum.

The researcher sent the questionnaires to 100 potential respondents and received the answer from 60 respondents in total of both sectors. The number of respondents which was eventually used for discussion of the risk allocation framework was only 24 respondents, including 13 respondents in the public sector and 11 respondents in the private sector. These 24 answers may not be sufficient in sample number for the further discussion in terms of the generalization. The AHP method requires the pairwise comparison matrix to have the consistency within allowable range. However, Saaty T.L. (2012) states that as far as a pairwise comparison is conducted using discrete values and the reciprocals, consistency of the pairwise comparison is not always perfect even if a research participant properly conducts pairwise comparison. This is the reason why only 24 answers were used for the further discussion. Other 36 answers did not meet the requirement of the consistency condition in AHP method and were not used for the further discussion.

In this research a risk allocation framework is proposed as research outcome. The framework is developed based on the findings and analysis results of the two questionnaire surveys which were conducted to the Sri Lankan project practitioners who have been involved in implementation of the infrastructure projects in Sri Lanka. In this

126

research, locally focused risk list in water supply sector is made through the questionnaire survey. In addition, PPP model best suitable to project is closely related to the project nature, including project scope identified, project requirements, type and extent of risks associated with project, that is different by project. Considering the project nature in water supply sector that is closely related to satisfaction of basic human needs, it may be necessary for the government to take more risks, compared to the projects in other sectors.

Therefore, the risk allocation framework proposed in this research can serve as a generic guide in identifying adequate risk allocation for infrastructure project in water supply sector in Sri Lanka, however discussion on applicability of the framework proposed in this research to other sectors is a future research subject.

The proposed risk allocation framework is considered suitable to assist the Sri Lankan government in developing PPP infrastructure project in water supply sector, in the social and political context of Sri Lanka. However, further elaboration would be necessary especially in identifying any PPP contract/model best suited to the project based on the concept of adequate allocation of specific risks in individual PPP project. In this research while discussion was made focusing on adequate risk allocation as critical element in implementation of PPP project and the risk allocation framework was recommended, discussion was not made in connection with the best suited PPP model. It would be, therefore, necessary to develop a risk allocation framework which can serve as a guide for identifying the best suited PPP model to specific PPP water supply infrastructure project.

7.7 RECOMMENDATIONS FOR FURTHER RESEARCH

The recommendations for further research are provided as below, based on the findings of this research and the research limitations. The recommendations are made in relation to the three points, including increase of risk factor contained in a pairwise comparison matrix, improvement of consistency of pairwise comparison matrix, and extension of adequate risk allocation framework.

Increase of the number of risk factors in conducting the AHP analysis may contribute to extending the risk allocation framework. However, if the number of risk factor contained in a pairwise comparison matrix is increased, the workload to the research participant is

also increased. In addition, the consistency of the pairwise comparison matrix as a result of their comparison work tends to decrease. It is, therefore, recommended to consider how to balance the burden of pairwise comparison with the need to examine more risk factors.

The most important subject in this research is how the number of pairwise comparison matrix that meets the consistency in AHP method can be increased. By improving this point, validity of the discussion based on the result of AHP analysis can be enhanced. For giving a solution to this subject, if the researcher detects a pairwise comparison matrix that indicate low consistency in AHP, the pairwise comparison matrix which is made based on the respondent's judgement should be reviewed through communication with the respondent and the consistency be improved.

7.8 SUMMARY

At first this final chapter has presented an overview of the research and overview of the research finding and outcomes. The findings have mainly been obtained through analyses and discussions for the results of the two questionnaire surveys which were conducted in this research. Especially, based on the 2nd questionnaire result, perceptions/ideas of the research participants to the risks were presented in value as relative importance of risk, and a framework of adequate risk allocation between the public and private sectors has been recommended. **In this research an assumption which underlies the relation between the relative importance value and the project practitioners' perception to the risk is developed, that is if a project practitioner considers controllability of his/her organization to a risk is low, the risk might be a higher priority for the organization to manage. Based on this, it is further assumed that the party that indicates lower relative importance value is the suitable party to control/manage the risk.** The risk allocation framework is suggested based on the relative importance values calculated for the public sector and private sector by risk category and risk factor. **The risk allocation framework developed in terms of relative importance based on this assumption is well consistent with risk allocation identified through prevalent discussion on nature of risks and the allocation.**

Subsequently, it is described that how the five project objectives set up at the initial stage of this research was addressed and achieved. The project aim has also been achieved through achievement of the five research objectives.

The research contribution to the existing body of knowledge is presented, and further important implications that were explored from the research findings and may assist the project practitioners to be involved in the infrastructure project development. The important implication is that the management functions or system of the Sri Lankan government to fulfil the core responsibility in PPP based infrastructure project are disempowering.

Lastly, the research limitations are described. Those are subjects related to the validity of discussions, analysis results and findings in this research. Based on these research limitations, the recommendations for further research are proposed.

REFERENCES

ADB (2009) *Toolkit for Public Private Partnerships in Urban Water Supply for Maharashtra: Local Government Consultations and Sector Assessment for Developing Possible PPP Models for the State of Maharashtra.* New Delhi, India: PPP Cell, Department of Economic Affairs, Ministry of Finance, Government of India.

ADB (2019) *Public-Private Partnerships Monitor Second Edition.* Metro Manila, Philippines: Asian Development Bank.

Alexander, M. (2012) Decision-making using the analytic hierarchy process (AHP) and SAS/IML. *NESUG2012.* Social Security Administration, Baltimore, MD.

Ameyaw, E. E. and Chan, A. P. C. (2014) Implementing PPP in water supply projects in Ghana: a model of CSFs in: Nkum, R.K., Nani, G., Atepor, L., Oppong, R.A., Awere, E., & Bamfo-Agyei, E. *(Eds) Procs 3rd Applied Research Conference in Africa. (ARCA) Conference*, 7-9 August 2014, Accra, Ghana. pp. 285-299.

Ameyaw, E.E. and Chan, A.P.C. (2015a) Evaluation and ranking of risk factors in public-private partnership water supply projects in developing countries using fussy synthetic evaluation approach. *Expert system with applications,* 2015. 42(12), pp. 5102-5116.

Ameyaw, E.E. and Chan, A.P.C. (2015b) Risk allocation in public-private partnership water supply projects in Ghana. *Construction Management and Economics,*. 33(3), pp. 187-208.

Ameyaw, E.E. and Chan, A.P.C. (2015c) Risk ranking and analysis in PPP water supply infrastructure projects. *Facilities.* 33(7/8), pp. 428 – 453.

Chan, A.P.C. and Cheung, E. (2014) *Public private partnerships in international construction: learning from case study.* New York, USA and Canada: Routledge.

Chou, J.-S., Tserng, H.P., Lin, C., and Yeh, C.-P. (2012) Critical factors and risk allocation for PPP policy: Comparison between HSR and general infrastructure projects. *Transport Policy, Official journal of the World Conference on Transport Research Society,* 22(2012), pp. 36-48.

Creswell, J.W. (2009) *Research design: qualitative, quantitative, and mixed method approaches.* 3rd ed. California, USA: Sage Publications.

Creswell, J.W. (2014) *Research design: qualitative, quantitative, and mixed method approaches.* 4th ed. California, USA: Sage Publications.

Dharmapala, D. and Ranashinghe, M. (2006) Public Private Partnerships for Water Supply to Urban Poor. *Annual Transactions of IESL,* pp. 1-10.

Do, S.T., Likhitruangslip, V., & Onishi, M. (2015) Critical Risk Factors Affecting Investment of Private Sector in Public-Private Partnership Transportation Projects in Vietnam. *The Construction, Building and Real Estate Research Conference of the Royal Institution of Chartered Surveyors in association with The Australasian Universities' Building Association Conference*, 8-10 July 2015.

Dudovskiy, J. (2018) *The ultimate guide to writing a dissertation in business studies: a step-by step assistance.* Business Research Methodology.

European Commission, Director-General Regional Policy (2003) *Guidelines for Successful Public – Private Partnerships.* Brussels: European Commission.

European PPP Expertise Centre (EPEC) (2013) *The Guide to Guidance: How to Prepare, Procure and Deliver PPP Projects*. Luxembourg: European Investment Bank.

Gomm, R. (2004) *Social Research Methodology: A Critical Introduction*. New York: Palgrave Macmillan.

Grix, J. (2002) Introducing Students to the Generic Terminology of Social Research. *Politics*. Vol. 22(3), pp. 175-186.

Heinecke, B. (2002) Involvement of small and medium sized enterprises in the private realisation of public buildings. *Freiberger Arbeitspapiere, No.2002/09*. Freiberg: Technische Universitat Bergakademie Freiberg, Fakultat fur Wiltschaftswissenschaften.

HM Treasury (2013) Government response to: *A new approach to public private partnerships consultation on the terms of public sector equity participation in PF2 projects*. London: HM Treasury.

Holden, M. T. and Lynch, P. (2004) *Choosing the Appropriate Methodology: Understanding Research Philosophy*.

Hoque, S. F. (2012) Urban Water Sector Reforms in India: Financing Infrastructure Development through Market - based Financing and Private – Public Partnerships. National University of Singapore – Lee Kuan Yew School of Public Policy. *Working Paper Series Paper No.: PP 12 - 05* IWP.

House of Commons Treasury Committee (2011) *Private Finance Initiative Seventeenth Report of Session 2010-12: Volume 1*. London: The Stationery Office Limited. (HC 1146).

Irwin, T.C. (2007) *Government Guarantees: Allocating and Valuing Risk in Privately Financed Infrastructure Projects*. Washington, DC: The World Bank.

Irwin, T.C. and Mokdad, T. (2009) *Managing contingent liabilities in public-private partnerships: Practice in Australia*, Chile, and South Africa. Washington, DC: The World Bank.

Jin, X. H., and Zhang, G. (2011) Modelling optimal risk allocation in PPP projects using artificial neural networks. *International Journal of Project Management* 29 (2011), pp. 591-603.

Jomo, K.S., Chowdhury, A., Sharma, K., and Plats, D. (2016) Public-Private Partnerships and the 2030 Agenda for Sustainable Development: Fit for purpose?. *United Nations Department of Economic & Social Affairs, Working Paper No.148,* ST/ESA/2016/DWP/148.

Ke, Y., Wang, S.Q., Chan, A. P. C., and Lam, P. T. I. (2010) Preferred risk allocation in China's public-private partnership (PPP) projects. *International Journal of Project Management* 28 (2010), pp. 482-492.

Kim, J.-H., Kim, J., Shin, S. and Lee, S.-Y. (2011) *Public-Private Partnership Infrastructure Project: Case Studies from the Republic of Korea.* Volume 1: Institutional Arrangements and Performance. Philippines: Asian Development Bank.

Kim, T., Lee, S.J., and Pradeep, M. (2019) Strengthening Public-Private Partnership in Sri Lanka's Infrastructure Development Project: The Colombo Port Case. *Asian International Studies Review. Vol. 20 No.1* (June 2019), pp. 91-120.

Kwak, Y. H., Chih, Y.Y., and Ibbs, C. W. (2009) Towards a Comprehensive Understanding of Public Private Partnerships for Infrastructure Development. *California Management Review.* vol. 51 no. 2 Winter, CMR.Berkley.EDU.

Li, B., Akintoye, A., Edwards, P.J. and Hardcastle, C. (2005a) Perceptions of Positive and Negative Factors Influencing the Attractiveness of PPP/PFI Procurement for Construction Projects in the UK: findings from a questionnaire survey. *Engineering, Construction and Architectural Management,* 12(2), pp. 125-148.

Li, B., Akintoye, A., Edwards, P.J. and Hardcastle, C. (2005b) The allocation of risk in PPP/PFI construction projects in the UK. *International Journal of Project Management,* 23(2005), pp. 25-35.

Li, J. and Zou, P.X.W. (2012) *Risk identification and assessment in PPP infrastructure projects using fuzzy analytical hierarchy process and life-cycle methodology.* Sydney, New South Wales: Faculty of The Built Environment, University of New South Wales.

Mack, N., Woodsong, C., MacQueen, K.M., Guest, G. and Namey, E. (2011) *Qualitative Research Method: A Data Collector's Field Guide.* North Carolina USA: Family Health International.

Manu, P.A. (2012) *An investigation into the Accident Causal Influence of Construction Project Features.* Thesis for the degree of Doctor of Philosophy (PhD). UK: University of Wolverhampton.

Meyer, K.S. (2012) *Testing Tradition: Assessing the Added Value of Public-Private Partnerships.* Arlington, VA: The National Council for Public Private Partnerships.

Ministry of Finance (MOF), Singapore (2012) *Public Private Partnership Handbook.* Version 2. Singapore: Ministry of Finance, Singapore. Available from: http://www.pppinindia.com/reports-policy-documents.php

Moulyton, L. and Anheier, H.K. (2001) Public-private partnerships in the United States: historical patterns and current trends. *Civil Society Working Paper 16.* Centre for Civil Society, London School of Economics and Political Science, London WC2A 2AE.

Naderifar, M., Goli, H., and Ghaljaei, F. (2017) Snowball Sampling: A Purposeful Method of Sampling in Qualitative Research. *Strides in Development of Medical Education.* September; 14(3): e67670.

Ng, A. and Loosemore, M. (2006) Risk allocation in the private provision of public infrastructure. *International Journal of Project Management,* doi:10.1016/j.ijproman.2006.06.005.

Osei-Kyei, R. and Chan, A.P.C. (2017) Comparative Analysis of the Success Criteria for Public-Private Partnership Projects in Ghana and Hongkong. *Project Management Journal.* 48(4), pp. 80-92.

Peckiene, A., Komarovska, A. and Ustinovicius, L. (2013) 11th International Conference on Modern Building Materials, Structures and Techniques, Overview of Risk Allocation between Construction Partis. *Procedia Engineering,* 57 (2013), pp. 889-894.

Puentes, R. (2012) *Strengthen Federalism: Establish a National PPP Unit to Support Bottom-Up Infrastructure Investment.* Washington, D.C.: Brookings.

Ranasinghe, M. (1998) Thoughts on a methodology to analyse viability of private-sector participation in new infrastructure projects in developing countries. *Impact Assessment and Project Appraisal.* 16 (3), pp. 203-213. U.K.: Beech Tree Publishing.

Ranasinghe, M. (2000) Private sector participation in existing water supply projects: a model to analyse the viability. *Annual Transactions, Institution of Engineers Sri Lanka.* Vol.1, Part B, pp. 19-25.

Rashed, M.A., Faisal, F. and Shikha, H. A. (2011) *Fiscal Risk Management for Private Infrastructure Projects in Sri Lanka.*

Rohman, M.A., Doloi, H., & Heywood, C. (2015) The Community Perspective of The Social Benefit of Public Private Partnerships (PPP) Toll Road Projects. *The Construction, Building and Real Estate Research Conference of the Royal Institution of Chartered Surveyors in association with The Australasian Universities' Building Association Conference*, 8-10 July 2015.

Saaty, T.L. (2012) *Decision making for leaders: the analytic hierarchy process for decisions in complex world*. 3rd ed. Pittsburgh, USA: RWS Publications.

Schaferhoff, M., Campe, S. and Kaan, C. (2009) Transnational Public-Private Partnerships in International Relations: Making Sense of Concepts, Research Frameworks, and Results. *International Studies Review.* 11, pp. 451 -474.

Shadish, W.R., Cook, T.D. and Campbell, D.T. (2002) *Experimental and Quasi-Experimental Designs for Generalized Causal Inferences*. Boston New York: Houghton Mifflin Company.

Shuaib, M.R., Dahiru, A. and Ruya, F. (2015) Critical Success Factors of PPP/PFI Projects in Nigeria. *The Construction, Building and Real Estate Research Conference of the Royal Institution of Chartered Surveyors in association with The Australasian Universities' Building Association Conference*, 8-10 July 2015.

Stangor, C. (2010) *Introduction to Psychology*. Boston: Flat World Knowledge.

Tawalare, A. and Balu, Y. (2016) Performance Evaluation of Implementation of Continuous Water Supply Projects: Two Case Studies from India. *World Multidisciplinary Civil Engineering-Architecture-Urban Planning Symposium 2016.* Procedia Engineering 161(2016), pp. 190-194.

The Quality Assurance Agency for Higher Education (2011) *The UK doctorate: a guide for current and prospective doctoral candidates.* UK: The Quality Assurance Agency for Higher Education.

Triantaphyllou, E. and Mann, S.H. (1995) Using the Analytic Hierarchy Process for Decision Making in Engineering Applications: Some Challenges. *International Journal of Industrial Engineering: Applications and Practice.* Vol. 2, No. 1, pp. 35- 44.

Trochim, W. M. K. (2006) *Research Methods Knowledge Base*. ResearchGate.

UNESCAP (2011) *A Guidebook on Public-Private Partnership in Infrastructure.* Bangkok: United Nations Economic and Social Commission for Asia and Pacific.

USAID (2017) *Report on Sri Lanka's Current PPP Environment and Recommendations for Future PPP Strategy: Leadership in Public Financial Management II.* USA: Nathan Associates Inc.

Wibowo, A. and Mohamed, S. (2008) Perceived Risk Allocation in Public-Private Partnered (PPP) Water Supply Project in Indonesia. *First International Conference on Construction in Developing Countries* (ICCIDC-1) "Advancing and Integrating Construction Education, Research & Practice". August 4 -5 2008, Karachi, Pakistan.

Wibowo, A. and Mohamed, S. (2010) Risk criticality and allocation in privatized water supply project in Indonesia. *International Journal of Project Management.* 28 (2010), pp. 504-513.

World Bank IFC MIGA (2012) *World Bank Group Support to Public-Private Partnerships: Lesson from Experiences in Client Countries, FY02-12*. Washington, DC: World Bank.

World Bank Group, PPIAF (2016) *THE STATE OF PPPs: Infrastructure Public-Private Partnerships in Emerging Markets & Developing Economies 1991-2015*. Washington DC: World Bank.

World Economic Forum (2008) *World Economic Forum Water Initiative: Realizing the Potential of Public-Private Partnerships Projects in Water*. Geneva, Switzerland: World Economic Forum.

APPENDICES

APPENDIX A: PUBLICATIONS

Conference Paper

S M Tanabe and M RANASINGHE (2013), Viability of private sector involvement in infrastructure project development in developing country, Proceedings, *The Second World Construction Symposium* 2013: Socio Economic Sustainability in Construction, June 2013, Colombo, Sri Lanka, pp. 483-491.

S.M.Tanabe, M.A Shelbourn and M RANASINGHE (2014) PPP – An Expected Approach for Infrastructure Development In Developing Country, *Australian Journal of Asian Country Studies,* Australian Society for Commerce Industry & Engineering Journals, 1(2), pp 89-100

APPENDIX B: QUESTIONNAIRE APPLIED

Appendix B1: Questionnaire Sheet – Stage 1

Appendix B2: Questionnaire Sheet – Stage 2

Appendix B3: Questionnaire Sheet – Stage 3

University of the
West of England
BRISTOL

Frenchay Campus
Coldharbour Lane
Bristol BS16 1QY
Telephone +44 (0)117 965 6261
www.uwe.ac.uk

7 October 2016

To whom it may concern

AUTHORIZATION TO RESEARCH PROJECT

This is to confirm that our Part-Time PhD student, **Samanthi Manoja Tanabe** is conducting a research to evaluate and develop a participatory framework for the allocation of risks between the parties engaged in a public infrastructure project (focusing on water supply/sanitation sector) formulated under PPPs in Sri Lanka.

We confirm that the research is purely academic and core to Samanthi's PhD programme at the University of the West of England, Bristol; and that she has our full authorization to conduct the research under our supervision.

We would be most grateful if you could kindly provide Samanthi every assistance with her research.

Appreciating your kind understanding and cooperation.

Contact Details of Respondents

As mentioned in the PARTICIPANT'S RIGHT in PARTICIPANT INFORMATION SHEET that is delivered to you together with this sheet, your participation in this research study is voluntary. You may choose not to participate and you may withdraw your consent to participate at any time. You will not be disadvantaged in any way should you decide not to participate or to withdraw from this study.

Please read the following sentence and mark with a tick ☑ in the tick box if you agree, then please provide your contact details in the table below.

Consent
"I have read the PARTICIPANT INFORMATION SHEET attached herewith and have been given the opportunity to ask questions. I give my consent to participate in this research study and understand how to withdraw from this study.☐ "

(1) Full Name	
(2) Email address	
(3) Respondent's code	To be allocated by the researcher

Note:
The above details will be stored separately from the questionnaire sheets, instead only the Respondent's code allocated by the researcher will be indicated on the questionnaire sheets to protect the anonymity and confidentiality of your answer.

Contact information
If you have any questions or concerns about this study or if any problems arise, please contact (Samanthi Manoja Tanabe) at University of the West of England.
Department of Architecture & The Built Environment
Faculty of Environment and Technology
University of the West of England, Bristol
Coldharbour Lane
Bristol
Contact email address: Samanthi2.Tanabe@live.uwe.ac.uk
Contact phone number: 0094776331438

If you have any questions or concerns about your rights as a research participant, please contact University of the West of England, University Research Ethics Committee.

Professor Paul Olomolaiye (Director of Studies)
Faculty of Environment and Technology
University of the West of England, Bristol
Coldharbour Lane
Bristol
BS16 1QY
ROOM 3Q59
t: +44(0) 117 3283378
e: Paul.Olomolaiye@uwe.ac.uk

Respondent's Code	To be allocated by the researcher

QUESTIONNAIRE SHEET – STAGE ONE

04th March, 2017

Research Title:

A risk allocation framework for public private partnerships (PPP) water infrastructure projects in Sri Lanka

Contents of Questionnaire

INTRODUCTION

Topic of Research

Protection of Anonymity and Confidentiality

Contact Details of Respondents

Contact Information of Researcher

QUESTIONNAIRE SHEET

STAGE-1

Section 1: Profile of respondent and organization

Section 2: Selection of key risk factors

STAGE-2

Section 3: Execution of pairwise comparison

INTRODUCTION

Topic of Research:

This research will develop a participatory framework for adequate risk allocation between the public and the private parties engaged in Public Private Partnership (PPP) infrastructure projects in Sri Lanka. PPPs system best applicable to individual country and sector may not always be same considering the development level of the country, political will, government policy, development status of the private sector. This research will be focusing on infrastructure development in the water supply/sanitation sector. Especially, various potential risks associated in the water supply/sanitation projects in Sri Lanka will be assessed quantitatively based on the knowledge of well experienced PPP project practitioners both in public and private sectors.

In order to proceed with the research, we would like you to provide your contact details and the data/information as shown in the Section 1 to Section 4 given below.

Protection of Anonymity and Confidentiality

There is no right or wrong answers to the questionnaire. We will use your answers anonymously and will not let anyone know what you have responded, so that the way you answer will not affect you. In the published thesis only aggregated results based on your answer will be presented without mentioning the data source – i.e. you the research participant. In dealing with the information/data to be provided by you, we will pay maximum attention to protecting your confidentiality. Your identity will not be revealed in any publication resulting from this study. Although we will ask you to provide your contact details as shown in a separate sheet, these personal information will be used for sole purpose of contacting each of you and stored separately from this questionnaire data.

Contact Details of Respondents (A separate sheet to ask the following contact details will be sent to respondents.)

(1) Full Name	Samanthi Manoja Tanabe **(sample only)**
(2) Email address	Samanthi2.Tanabe@live.uwe.ac.uk **(sample only)**
(3) Respondent's code	To be allocated by the researcher

Contact Information of Researcher

If you have any questions about this questionnaire, please contact (Samanthi Manoja Tanabe) at University of the West of England.

Department of Architecture & the Built Environment

Faculty of Environment and Technology

University of the West of England, Bristol

Coldharbour Lane

Bristol

Contact email address: Samanthi2.Tanabe@live.uwe.ac.uk

Contact phone number in Sri Lanka: +94-(0)776331438

QUESTIONNAIRE SHEET

STAGE-1

Section 1: Profile of respondent and organization

Please tell us about your experience and role within your organization by answering the questions below:

(1) Number of years of experience in the construction industry or infrastructure development	
(2)-1 The number of PPP based projects that you have been involved with,	
(2)-2 and the number of water supply/sanitation projects out of these projects	
(3) The name of organization that you are now working for	
(4) Your present position in the above organization, such as manager, director and so on	

Section 2: Selection of key risk factors

We have identified a number of risks that may be categorized as shown in the table below.

Please choose a maximum of 5 risks in each category which you consider to be least in your control by means of such as risk avoidance, risk reduction or risk transfer for successful implementation throughout the entire life of PPP infrastructure project in water supply/sanitation sector in Sri Lanka and mark with a tick ☑ in the column labeled mark.

If you have identified any other risks than those indicated here that you consider critical, please show the risk and put ☑ mark in the space provided at the bottom of each category.

If the new risk you have identified does not fit into any of the categories then add another category in the space provided at the bottom of the table.

Table 1 Tentative List of Risk Category and Risk

Category No.	Category	Risk No.	Risk	Mark
C1	Political risk	R1	Nationalization/Expropriation	
		R2	Non-availability of foreign exchange (FX)	
		R3	Restriction of FX transferability	
		R4	Restriction of FX exchangeability	
		R5	Breach of contract by government	
		R6	Premature termination by government	
		R7	General changes in legislation	
		R8	Discriminatory changes in legislation	
		R9	Specific changes in legislation	
			Other risk in the same category, if any	
C2	Economic/commercial risk	R10	Inflation fluctuation	
		R11	FX fluctuation	
		R12	Interest rate fluctuation	
			Other risk in the same category, if any	

C3	Land and construction risk	R13	Construction cost overrun	
		R14	Land cost escalation	
		R15	Construction time overrun	
		R16	Protracted negotiation on land price	
		Other risk in the same category, if any		
C4	Business risk	R17	Tariff setting uncertainty	
		R18	Premature termination by operator	
		R19	Breach of contract by operator	
		R20	Unpaid bills by consumers	
		R21	Abuse of power by government officials	
		R22	Failure in financial closure	
		R23	Failure in refinancing	
		R24	Demand uncertainty	
		R25	Entry of new competitor	
		Other risk in the same category, if any		
C5	Operation risk	R26	Operation and maintenance cost escalation	
		R27	Equipment defect-caused interruption	
		R28	Non-availability of raw water	
		R29	Environment protest-caused interruption	
		R30	Technical leakage during distribution	
		R31	Electricity blackout	
		R32	Water meter manipulation	
		R33	Low quality of raw water	
		Other risk in the same category, if any		
C6	Force majeure risk	R34	Natural disaster	
		R35	Man-made disaster	
		R36	Declared war	
		R37	Riot	
		R38	Terrorism attack	

		R39	Labor strike	
		Other risk in the same category, if any		
C7	Design and procurement	R40	Poor decision making process	
		R41	Lack of transparency in bidding	
		R42	Poor or incomplete project evaluation	
		R43	Improper design	
		R44	Construction method/design change	
		R45	Site availability	
		R46	Supporting incentive of government risk	
		R47	Unfair process of selection of contractor	
		R48	Low capacity of Special Purpose Company (SPC)	
		Other risk in the same category, if any		
other category, if any		**Other critical risks for the category, if any**		

Note: **The above categories and risks will be finalized by adjusting the number and description of the categories or risks, based on the answers from the respondents. In the next stage, we will ask you to use your judgment to compare the relative importance of the categories/risks which have been finalized.**

QUESTIONNAIRE SHEET – STAGE TWO

JULY, 2018

Research Title:

A risk allocation framework for public private partnerships (PPP) water infrastructure projects in Sri Lanka

Contents of Questionnaire

INTRODUCTION

Topic of Research

Protection of Anonymity and Confidentiality

Contact Details of Respondents

Contact Information of Researcher

QUESTIONNAIRE SHEET

STAGE-1

Section 1: Profile of respondent and organization

Section 2: Selection of key risk factors

STAGE-2

Section 3: Execution of pairwise comparison

Topic of Research:

This research will develop a participatory framework for adequate risk allocation between the public and the private parties engaged in Public Private Partnership (PPP) infrastructure projects in Sri Lanka. PPPs system best applicable to individual country and sector may not always be same considering the development level of the country, political will, government policy, development status of the private sector. This research will be focusing on infrastructure development in the water supply/sanitation sector. Especially, various potential risks associated in the water supply/sanitation projects in Sri Lanka will be assessed quantitatively based on the knowledge of well experienced PPP project practitioners both in public and private sectors.

In order to proceed with the research, we would like you to provide your contact details and the data/information shown in the Section 1 to Section 4 given below.

Protection of Anonymity and Confidentiality

There is no right or wrong answers to the questionnaire. We will use your answers anonymously and will not let anyone know what you have responded, so that the way you answer will not affect you. In the published thesis only aggregated results based on your answer will be presented without mentioning the data source – i.e. you the research participant. In dealing with the information/data to be provided by you, we will pay maximum attention to protecting your confidentiality. Your identity will not be revealed in any publication resulting from this study. Although we will ask you to provide your contact details as shown in a separate sheet, these personal information will be used for sole purpose of contacting each of you and stored separately from this questionnaire data.

Contact Details of Respondents (A separate sheet to ask the following contact details will be sent to respondents.)

(1) Full Name	Samanthi Manoja Tanabe **(sample only)**
(2) Email address	Samanthi2.Tanabe@live.uwe.ac.uk **(sample only)**
(3) Respondent's code	To be allocated by the researcher

Contact Information of Researcher

If you have any questions about this questionnaire, please contact (Samanthi Manoja Tanabe) at University of the West of England.

Department of Architecture & the Built Environment

Faculty of Environment and Technology

University of the West of England, Bristol

Coldharbour Lane

Bristol

Contact email address: Samanthi2.Tanabe@live.uwe.ac.uk

Contact phone number in Sri Lanka: +94-(0)776331438

STAGE-2

Section 3: Execution of pairwise comparison

We would like you to show your idea of relative importance amongst the selected risks and the categories. List of Risk Category and Risks are given in Table 1 below, which are prepared based on the critical risk factors and the categories selected or provided by respondents in the Section 2 through the STAGE-1 questionnaire survey.

Table 1 List of Risk Categories and Risks Selected in Stage 1

Category No.	Category	Risk No.	Risk
C1	Political risk	R2	Non-availability of foreign exchange (FX)
		R5	Breach of contract by government
		R7	General changes in legislation
C2	Economic/commercial risk	R10	Inflation fluctuation
		R11	FX fluctuation
		R12	Interest rate fluctuation
C3	Land and construction risk	R13	Construction cost overrun
		R14	Land cost escalation
		R15	Construction time overrun
C4	Business risk	R17	Tariff setting uncertainty
		R20	Unpaid bills by consumers
		R21	Abuse of power by government officials
C5	Operation risk	R26	Operation and maintenance cost escalation
		R27	Equipment defect-caused interruption
		R29	Environment protest-caused interruption
C6	Force majeure risk	R34	Natural disaster
		R35	Man-made disaster
		R39	Labor strike
C7		R40	Poor decision making process

		R41	Lack of transparency in bidding
	Design and procurement risk	R42	Poor or incomplete project evaluation

How to answer to this question

The above selected critical risk factors and the categories are indicated in the Table 3 in the next page for your answer. When one risk factor or category indicated in the column (A) is compared to the other risk factor or category in the column (B), the pairwise comparison values are presented quantitatively with the respective definition as shown in the sample table below.

Please select one space on each row of Risks/Categories in Table 2 and mark with a tick ✓ in the column as shown in the sample below. This questionnaire (Table 3) consists of 2 tables for comparison amongst Risk Factors and for comparison amongst Risk Categories.

Table 2 Sample of Selection and Mark

Category	(A)		A is dominant.	A is strongly more important than B.	A is more important than B.	A is slightly more important than B.	A and B are equally important.	B is slightly more important than A.	B is more important than A.	B is strongly more important than A.	B is dominant.	(B)	
	Risk No.	Risk	9	7	5	3	1	3	5	7	9	Risk No.	Risk
Category	R1	Nationalization/Expropriation					✔					R2	Non-availability of foreign exchange (FX)
	R1	Nationalization/Expropriation			✔							R3	Restriction of FX transferability
	R1	Nationalization/Expropriation								✔		R4	Restriction of FX exchangeability

If you have any questions about this questionnaire, please contact (Samanthi Manoja Tanabe) at University of the West of England.

Department of Architecture & The Built Environment

Faculty of Environment and Technology

University of the West of England, Bristol

Coldharbour Lane, Bristol

Contact email address: Samanthi2.Tanabe@live.uwe.ac.uk

Contact phone number in Sri Lanka: +94-(0)776331438

Table 3 (1) Pairwise Comparison amongst Risk Factors

Category	(A)		A is dominant.	A is strongly more important than B.	A is more important than B.	A is slightly more important than B.	A and B are equally important.	B is slightly more important than A.	B is more important than A.	B is strongly more important than A.	B is dominant.	(B)	
	Risk No.	Risk	9	7	5	3	1	3	5	7	9	Risk No.	Risk
C1 : Political Risk	R2	Non-availability of foreign exchange (FX)										R5	Breach of contract by government
	R2	Non-availability of foreign exchange (FX)										R7	General changes in legislation
	R5	Breach of contract by government										R7	General changes in legislation
C2 : Economic/Commercial Risk	R10	Inflation fluctuation										R11	FX fluctuation
	R10	Inflation fluctuation										R12	Interest rate fluctuation
	R11	FX fluctuation										R12	Interest rate fluctuation
C3 : Land and Construction Risk	R13	Construction cost overrun										R14	Land cost escalation
	R13	Construction cost overrun										R15	Construction time overrun
	R14	Land cost escalation										R15	Construction time overrun
C4 : Business Risk	R17	Tariff setting uncertainty										R20	Unpaid bills by consumers
	R17	Tariff setting uncertainty										R21	Abuse of power by government officials
	R20	Unpaid bills by consumers										R21	Abuse of power by government officials

C5 : Operation Risk	R26	Operation and maintenance cost escalation	157									R27	Equipment defect-caused interruption
	R26	Operation and maintenance cost escalation										R29	Environment protest-caused interruption
	R27	Equipment defect-caused interruption										R29	Environment protest-caused interruption
C6 : Force majeure Risk	R34	Natural disaster										R35	Man-made disaster
	R34	Natural disaster										R39	Labor strike
	R35	Man-made disaster										R39	Labor strike
C7 : Design and Procurement Risk	R40	Poor decision making process										R41	Lack of transparency in bidding
	R40	Poor decision making process										R42	Poor or incomplete project evaluation
	R41	Lack of transparency in bidding										R42	Poor or incomplete project evaluation

Table 3 (2) Pairwise Comparisons amongst Risk Categories

(A)		A is dominant.	A is strongly more important than B.	A is more important than B.	A is slightly more important than B.	A and B are equally important.	B is slightly more important than A.	B is more important than A.	B is strongly more important than A.	B is dominant.	(B)	
Category No.	Risk Category	9	7	5	3	1	3	5	7	9	Category No.	Risk Category
C1	Political Risk										C2	Economic/Commercial Risk
C1	Political Risk										C3	Land and Construction Risk
C1	Political Risk										C4	Business Risk
C1	Political Risk										C5	Operation Risk
C1	Political Risk										C6	Force Majeure Risk
C1	Political Risk										C7	Design and Procurement Risk
C2	Economic/Commercial Risk										C3	Land and Construction Risk
C2	Economic/Commercial Risk										C4	Business Risk
C2	Economic/Commercial Risk										C5	Operation Risk
C2	Economic/Commercial Risk										C6	Force Majeure Risk
C2	Economic/Commercial Risk										C7	Design and Procurement Risk
C3	Land and Construction Risk										C4	Business Risk
C3	Land and Construction Risk										C5	Operation Risk
C3	Land and Construction Risk										C6	Force Majeure Risk
C3	Land and Construction Risk										C7	Design and Procurement Risk
C4	Business Risk										C5	Operation Risk
C4	Business Risk										C6	Force Majeure Risk
C4	Business Risk										C7	Design and Procurement Risk
C5	Operation Risk										C6	Force Majeure Risk

C5	Operation Risk				159						C7	Design and Procurement Risk
C6	Force Majeure Risk										C7	Design and Procurement Risk

Respondent's Code	

QUESTIONNAIRE SHEET – STAGE THREE

30th November, 2020

Research Title:

A risk allocation framework for public private partnerships (PPP) water infrastructure projects in Sri Lanka

Dear Sir/Madam,

A FRAMEWORK FOR VALIDATION ON STRATEGIES FOR ADEQUATE RISK ALLOCATION BETWEEN THE PUBLIC AND THE PRIVATE SECTORS IN PPP BASED INFRASTRUCTURE PROJECT IN WATER SUPPLY SECTOR IN SRI LANKA

Thank you for participating in the data gathering for my PhD research. I have now identified strategies that can stimulate the successful developing a participatory framework for adequate risk allocation between the public and the private parties engaged in Public Private Partnership (PPP) infrastructure projects in water supply sector in Sri Lanka. The research has identified the relative importance of risks associated with a PPP project through analyzing Sri Lankan project practitioners' perception to the risks, and finally identified a framework for risk allocation between the public sector and the private sector for development of a successful PPP based infrastructure project.

It is thought that the attached framework would be a useful resource to the government/public agencies and the private sector organizations which seek a successful structure of PPP based infrastructure project and the way of participation in the project. In view of this, I would be very grateful if you could respond to the feedback form attached, to help establish the relevance of the research findings and recommendations. As before, confidentiality and anonymity are guaranteed as all the information gathered will conform to the University's Ethical procedure. Please return the completed feedback sheet by email. Alternatively, if you wish to give the feedback over the telephone please send me an email.

If you have any questions about this questionnaire, please feel free to contact me.

Yours faithfully,

Samanthi Manoja Tanabe

Department of Architecture & the Built Environment

Faculty of Environment and Technology

University of the West of England, Bristol

Coldharbour Lane

Bristol

Contact email address: Samanthi2.Tanabe@live.uwe.ac.uk

Contact phone number in Sri Lanka: +94-(0)776331438

Questionnaire for Validation of the Research Findings

I. RESEARCH FEED BACK FORM

Please provide responses on how valid the research findings are with regards to your experience. To what extent do you agree with this research findings shown below? Please tick (✓) one option.

Qualitative Assessment of Risk Perception

1. Many well experienced Sri Lankan practitioners of infrastructure projects in the public and the private sectors selected the same risk factors in terms of risk which is least in their control. This indicates that irrespective of the sectors and organizations that the practitioners belong to and of their positions, a number of project practitioners in respective sectors have a common perception to many risk factors associated with a PPP based project that it is difficult for them to control these risk factors.

(   ) Strongly Disagree, (   ) Disagree, (   ) Neutral, (   ) Agree, (   ) Strongly Agree

2. Five risk factors, including C2/R10 (Inflation fluctuation), C2/R12 (Interest fluctuation), C5/R26 (Operation and maintenance cost escalation), C6/R34 (Natural disaster), and C7/R40 (Poor decision making process) are perceived as difficult to control by the majority (over 3/4 of the total respondents) of the Sri Lankan project practitioners in both public and private sectors who participated in this research.

(   ) Strongly Disagree, (   ) Disagree, (   ) Neutral, (   ) Agree, (   ) Strongly Agree

3. Regarding the some risk factors, including C1/R5 (Breach of contract by government), C1/R6 (Premature termination by government), C3/R16 (Protracted negotiation on land price), C6/R38 (Terrorism attack), C7/R41 (Lack of transparency in bidding), C7R45 (Site availability) and C7/R46 (Supporting incentive of government risk), although a government is generally considered to be the best party to manage the above risk factors as a whole, many individuals within the Sri Lankan government feel the management functions or systems of the government are disempowering.

(   ) Strongly Disagree, (   ) Disagree, (   ) Neutral, (   ) Agree, (   ) Strongly Agree

Quantitative Assessment of Risk Perception

In order to measure the difference or similarity in risk perceptions by project practitioner, relative importance of risk is introduced as an index. Relative importance of risk is calculated in a value between 0 and 1, based on the questionnaire results responded by the Sri Lankan practitioners of infrastructure project in the public and private sectors.

4. Relative importance of seven Risk Categories, including C1 (political risk), C2 (economic/commercial risk), C3 (land and construction risk), C4 (business risk), C5 (operation risk), C6 (force majeure risk), and C7 (design and procurement risk) are calculated. It is a common perception of the project practitioners in both public and private sectors that the risk category C1(political risk) is predominantly important compared to the other six.

( ) Strongly Disagree, ( ) Disagree, ( ) Neutral, ( ) Agree, ( ) Strongly Agree

5. Despite C1 is apparently the risk category of which the whole should be managed under the government's responsibility, many individuals within the Sri Lankan government feel the management functions or systems of the government are disempowering.

( ) Strongly Disagree, ( ) Disagree, ( ) Neutral, ( ) Agree, ( ) Strongly Agree

6. To the risk categories C2 and C3, the average degree of relative importance is given by the project practitioners of both sectors. It is expected major part of the risks in the categories C2 and C3 are controlled and managed mainly by the public sector.

( ) Strongly Disagree, ( ) Disagree, ( ) Neutral, ( ) Agree, ( ) Strongly Agree

7. To the risk categories C4, C5 and C6, the relative importance less than average is given by the both sectors' practitioners. This result is considered to indicate that both sectors recognize the private sector is better party to retain and manage these risks.

( ) Strongly Disagree, ( ) Disagree, ( ) Neutral, ( ) Agree, ( ) Strongly Agree

8. In case of the risk category C7, a low relative importance is shown by both sectors. However, the relative importance values given by both sectors' project practitioners are same. The risks in this category should be generally shared between both sectors.

( ) Strongly Disagree, ( ) Disagree, ( ) Neutral, ( ) Agree, ( ) Strongly Agree

II. SUGGESTED RECOMMENDATIONS

Based on the research findings the following recommendations have been given. Please provide responses on the relevance of the recommendations with regards to your experience. To what extent do you agree with the recommendations shown below? Please tick (✓) one option.

1. Risk factors in the category of political risk (C1) are controlled by the Sri Lankan government's regulatory framework. It is, however, considered that many individuals within the government feel the management functions or systems which is based on the regulatory framework are disempowering. It is required to develop a regulatory framework consistent with the government policy for infrastructure development in water supply sector by PPP based project, and then to improve the management functions or systems for political risk factors.

(　) Strongly Disagree, (　) Disagree, (　) Neutral, (　) Agree, (　) Strongly Agree

2. Risk factors in the category of economic/commercial risk (C2) can be managed by entering into financial tools which are controlled by the Sri Lankan government's financial policy. It is, however, considered that many individuals within the government feel the management functions or systems which is based on the financial policy are disempowering. It is required to develop a regulatory framework consistent with the government financial policy in implementing an infrastructure development project in water supply sector by PPP based project, and then to improve the management functions or systems for economic/commercial risk factors.

(　) Strongly Disagree, (　) Disagree, (　) Neutral, (　) Agree, (　) Strongly Agree

3. Recommended risk allocation framework between the public and the private sectors is given in the following table. Please tick (✓) one option in the right column of the Table with regards to your experiences.

Framework of Adequate Allocation of Predominate Risk Categories and Factors

		Risk Category (C) and Risk Factor (R)	Suitable Party to control Risk and the Extent of Share	Dis-agree	Neutral	Agree
C1		Political risk	Public sector-whole part			
	R2	Non-availability of foreign exchange	Public sector-whole part			
	R5	Breach of contract by government	Public sector-whole part			
	R7	General changes in legislation	Public sector-whole part			
C2		Economic/commercial risk	Public sector-whole part			
	R10	Inflation fluctuation	Public sector-whole part			
	R11	FX fluctuation	Public sector-whole part			
	R12	Interest rate fluctuation	Public sector-whole part			
C3		Land and construction risk	Share between both sectors			
	R13	Construction cost overrun	Private sector-whole part			
	R14	Land cost escalation	Public sector-whole part			
	R15	Construction time overrun	Share between both sectors			
C4		Business risk	Private sector-major part			
	R17	Tariff setting uncertainty	Private sector-major part			
	R20	Unpaid bills by consumers	Private sector-whole part			
	R21	Abuse of power by government officials	Public sector-whole part			
C5		Operation risk	Private sector-major part			
	R26	Operation and maintenance cost escalation	Private sector-whole part			
	R27	Equipment defect-caused interruption	Private sector-whole part			

	R29	Environment protest-caused interruption	Share between both sectors			
C6	Force majeure risk		Private sector-major part			
	R34	Natural disaster	Share between both sectors			
	R35	Man-made disaster	Share between both sectors			
	R39	Labor strike	Private sector-whole part			
C7	Design and procurement risk		Share between both sectors			
	R40	Poor decision making process	Share between both sectors			
	R41	Lack of transparency in bidding	Public sector-whole part			
	R42	Poor or incomplete project evaluation	Private sector-whole part			

4. Would you say that the framework is capable of assisting the government in guiding to introduce PPP based infrastructure development project in water supply sector?

( ) Not sure of its capability, ( ) Not capable, ( ) Neutral, ( ) Capable, ( ) Highly capable

5. Would you say that the framework is capable of assisting the private sector in considering the participation in PPP based infrastructure development project in water supply sector?

( ) Not sure of its capability, ( ) Not capable, ( ) Neutral, ( ) Capable, ( ) Highly capable

Please provide any additional comments here (Please add extra pages if required).

Thank you very much for your time.
Samanthi M. Tanabe

APPENDIX C: METHODOLOGY OF DATA ANALYSIS USING AHP

C-1 Rationale of Using AHP Method

The analytic hierarchy process (AHP) is a technique which can derive a ranking in a complex, unanticipated and multi-criteria situation, from the idea, opinion and recognition of individuals. It is appropriate to make a holistic and synthesized assessment of risks, based on the expertise and experiences of individuals which have been involved in the objective field. This process is a mathematical calculation process and the key factor to achieve the successful results through this process is considered how the appropriate numerical input data can be collected. In this sense, the design of questionnaires where human knowledge and perceptions are to be converted to numerical data is important. The purpose of this AHP analysis is to clarify quantitatively how much each respondent who belongs to either public or private sector intends to share each one of several risks associated in a PPP project with other party. It is eventually intended to explore type and extent of risks that each party considers least in their control or manage.

As result of the analysis, extents of relative importance amongst selected risk categories and risk factors in each category were presented in number. It is here necessary to think what the extent of relative importance of risks means. Moreover, when thinking about a risk category and a risk factor, why a project practitioner thinks it very important, while the other practitioner thinks it not very important. This difference in perception of importance to a risk category and a risk factor may be associated with the person's perception of the magnitude of control/management capability to the risk factor of the sector or organization to which he/she belongs. It is expected to use AHP analysis for contrasting these differences (or similarities) in perception to risk categories and risk factors amongst sectors or organizations.

A person's perception in number is a kind of decision-making subject under many different conditions. It would be considerably difficult subject to give a solution quantitatively applying traditional statistical technique, such as multiple-variable analysis, or any obscure mathematical analysis might be required to obtain the solution which capture all the conditions, because of the following reasons:

1) It is admitted that risk allocation strategies may vary from risk to risk and from project to project,

2) Risk allocation practices in PPP projects have been found highly variable, intuitive, subjective and unsophisticated,

3) All the essential components which influence the optimal risk allocation strategy underlie non-linear and complex dynamics.

It is considered that it may be difficult to give an absolute solution to a decision-making subject by pure mathematical technique because of the variable, intuitive and subjective nature of the decision-making subject in which a decision-maker's idea, opinion or feeling may be involved. However, one of the mathematical based models which can represent a variable, intuitive and subjective mechanism such as decision-making process of risk allocation in PPP projects is Analytical Hierarchy Process (AHP). This method is established by incorporating decision-makers' idea and can capture the essential components of the underlying non-linear and complex dynamics.

C-2 Application of AHP Method to This Research

The purpose of analysis for the questionnaire survey results in this research is not to estimate general characteristics of the objective group based on data collected through a random sampling, but to consider quantitatively any relation or trend between the individual characteristics of respondents such as their background and experiences, and the relative importance (weight) of the risk categories and risk factors that was calculated applying the weight evaluation method of AHP for the questionnaire results.

When considering share of a risk between the public and private sectors in implementing a PPP based water supply project, how important is the risk for each of the project practitioners, that is, what is the bases that a project practitioner considers the risk is important. It is assumed in this research that when a practitioner considers more difficult to control or manage a risk, the practitioner recognizes the risk is more important. On the contrary, it is assumed that when a practitioner considers easier to control or manage a risk, the practitioner recognizes the importance of the risk is lower. This assumption is based on that in the 1st Questionnaire Survey in this research the respondents are asked to choose a maximum of five risk factors in each risk category which they consider to be least in their control.

In this research relative importance to the seven risk categories and 21 risk factors (three risk factors identified by risk category) by questionnaire respondent are analyzed quantitatively using

AHP method, in relation to the features of the respondents such as sector and organization that they belong to, position in the organization and experiences involved in any infrastructure development project. It is, therefore, expected to consider and clarify any relevance between their position/experiences and their perceptions to the risks in terms of relative importance of risk.

C-3 Analysis Using AHP Method

As mentioned in the above section, the relative importance (weight of elements that compose a pairwise comparison matrix) of risk categories and risk factors is estimated using the pairwise comparison matrices derived from the answers to the questionnaire by the research participants. Research participants were asked to compare risk categories and risk factors in pairs against a given criterion. The criterion in the pairwise comparison is which risk factor is least in control or manage for the research participant.

(1)   Pairwise comparison matrix

When conducting pairwise comparison for a series of object items (risk categories or risk factors in this research) C_1, C_2, C_3, ………, C_n against a given criterion, the pairwise comparison values which were selected by the research participants are expressed in a pairwise comparison matrix as shown in Table C.3.1. A pairwise comparison value, that is, relative importance of C_i compared to C_j is expressed as a_{ij}. It is apparent that a_{ij} is 1.0 when $i = j$. Only the pairwise comparison values at right side of the diagonal line consisting of a_{11}, a_{22}, a_{33}, …., a_{nn} are derived from answers to the questionnaire based on the subjective judgments of the research participants. The pairwise comparison values (a_{ji}) at left side of the same diagonal line are calculated as a reciprocal of a_{ij} as given in the following formula.

$$a_{ji} = 1/a_{ij}$$

Table C.3.1 Pairwise Comparison Matrix

	C_1	C_2	C_3	…	…	…	C_n
C_1	a_{11}	a_{12}	a_{13}	…	…	…	a_{1n}
C_2	a_{21}	a_{22}					a_{2n}
C_3	a_{31}		a_{33}				a_{3n}
.	.			..			.
.	.				..		.
.	.					..	.
C_n	a_{n1}	a_{n2}	a_{n3}	…	…	…	a_{nn}

(2)   Estimate of Relative Importance

Relative importance (weight) of each risk category and risk factor is estimated based on a pairwise comparison matrix as given in Table C.3.2. In this research the weights are estimated using geometric mean of pairwise comparison values, and at the same time consistency of pairwise comparison matrix is calculated for each weight estimated. Only pairwise comparison matrices that satisfy the consistency calculated on geometric mean are used for the further analysis or discussion.

Table C.3.2 Calculation of Relative Importance

	C_1	C_2	C_3	…	…	…	C_n	G. Mean	Weight by G. Mean
C_1	a_{11}	a_{12}	a_{13}	…	…	…	a_{1n}	$g.m_1$	w_{1g}
C_2	a_{21}	a_{22}					a_{2n}	$g.m_2$	w_{2g}
C_3	a_{31}		..				a_{3n}	$g.m_3$	w_{3g}
.	.		..				.	.	.
.	.			..			.	.	.
.	.				..		.	.	.
C_n	a_{n1}	a_{n2}	a_{n3}	…	…	…	a_{nn}	$g.m_n$	w_{ng}
							Total	[g.m]	1.000

Note: G.–Mean - Geometric mean of pairwise comparison values in each row

[g.m]   : Total sum of $g.m_1$ to $g.m_n$

  [g.m] $w_{ig} = g.m_i / (i = 1, 2, 3 ……., n)$

(3)   Consistency of Pairwise Comparison Matrix

Saaty T.L. (2012) states that the analytic hierarchy process is completed by establishing priorities among the elements of the hierarchy, synthesizing people's judgments to yield a set of overall priorities, checking the consistency of these judgments, and coming to a final decision based on the results of this process. The first step of this process is to compare the elements in pairs against a given criterion. In this pairwise comparison a simple matrix (pairwise comparison matrix), that is derived from subjective judgments of the questionnaire respondents, is used for calculation of the priorities, or relative importance among the element. If further discussions on people's perceptions to the risk categories and risk factors are made based on the judgments (or pairwise comparison matrices), these judgements are expected to have perfect consistency or to avoid judgments that appear to be random.

However, according to Saaty T.L. (2012) usually people cannot be so certain of their judgments that they would insist on forcing consistency in the pairwise comparison matrix. Saaty further states that we may not be perfectly consistent, but that is the way we tend to work, and as long as there is enough consistency to maintain coherence among the objects of our experience, the consistency need not be perfect. Based on this idea, Saaty establishes a range of consistency between tolerable inconsistency and perfect consistency where all knowledge must be admitted. In this research consistency of all the research participants' judgements (pairwise comparison matrices) were checked for screening the matrices whose consistency is out of the tolerable range.

If the degree of inconsistency of a pairwise comparison matrix is larger than the allowable maximum value (limit of tolerable inconsistency), reliability of the pairwise comparison matrix is considered insufficient. Therefore, in this research the reliability of pairwise comparison matrix was verified using consistency index (C.I. not larger than 0.1 according to Saaty's suggestion) based on geometric mean. Pairwise comparison matrices that satisfy allowable condition of C.I. were adopted for further analysis and discussion. Pairwise comparison matrices of risk category and risk factor with consistency indices for all research participants are provided in Appendix D.

APPENDIX D: CALCULATION OF RELATIVE IMPORTANCE

Appendix D1: Calculation of Relative Importance for Risk Categories

Appendix D2: Calculation of Relative Importance for Risk Factors

Appendix D1: Calculation of Relative Importance for Risk Categories

Repondent ID: PU-2
Organization:
Position in the Organization:
1) Comparison of Risk Category

Calculation Sample Adopted for further Analysis
Weight indicates relative importance values for the respective Risk Categories (C1 to C7).
Tolerable range of Consistency Indec(C.I.) is not more than 0.1.

Risk C.	C1	C2	C3	C4	C5	C6	C7	G.Mean	Weight	λ_{max} calculation matrix							total	total/weight	C.I.
C1	1	1	5	5	1	5	5	2.508	0.297	0.2965	0.2591	0.4014	0.6428	0.1182	0.2933	0.2933	2.3047	7.772139	
C2	1	1	3	3	3	3	3	2.192	0.259	0.2965	0.2591	0.2409	0.3857	0.3546	0.1760	0.1760	1.8888	7.289848	
C3	1/5	1/3	1	1	1	1	1	0.679	0.080	0.0593	0.0864	0.0803	0.1286	0.1182	0.0587	0.0587	0.5900	7.349266	
C4	1/5	1/3	1	1	3	3	3	1.088	0.129	0.0593	0.0864	0.0803	0.1286	0.3546	0.1760	0.1760	1.0611	8.253382	
C5	1	1/3	1	1/3	1	3	3	1.000	0.118	0.2965	0.0864	0.0803	0.0429	0.1182	0.1760	0.1760	0.9762	8.258067	
C6	1/5	1/3	1	1/3	1/3	1	1	0.496	0.059	0.0593	0.0864	0.0803	0.0429	0.0394	0.0587	0.0587	0.4255	7.254507	
C7	1/5	1/3	1	1/3	1/3	1	1	0.496	0.059	0.0593	0.0864	0.0803	0.0429	0.0394	0.0587	0.0587	0.4255	7.254507	
Total								8.459	1.000										
																Average		7.633102	0.1

Repondent ID: PU-4
Organization:
Position in the Organization:
1) Comparison of Risk Category

Calculation Sample not Adopted for further Analysis
Weight indicates relative importance values for the respective Risk Categories (C1 to C7).
Tolerable range of Consistency Indec(C.I.) is not more than 0.1.

Risk C.	C1	C2	C3	C4	C5	C6	C7	G.Mean	Weight	λ_{max} calculation matrix							total	total/weight	C.I.
C1	1	1	5	1	5	1	1	1.584	0.183	0.1830	0.1386	0.2898	0.0918	0.3648	0.3827	0.0730	1.5237	8.326091	
C2	1	1	5	1	1	1/7	5	1.199	0.139	0.1830	0.1386	0.2898	0.0918	0.0730	0.0547	0.3648	1.1956	8.627252	
C3	1/5	1/5	1	1	1	1/5	1	0.502	0.058	0.0366	0.0277	0.0580	0.0918	0.0730	0.0765	0.0730	0.4365	7.530824	
C4	1	1	1	1	1	1/5	1	0.795	0.092	0.1830	0.1386	0.0580	0.0918	0.0730	0.0765	0.0730	0.6938	7.55703	
C5	1/5	1	1	1	1	1/5	1	0.631	0.073	0.0366	0.1386	0.0580	0.0918	0.0730	0.0765	0.0730	0.5474	7.503726	
C6	1	7	5	5	5	1	5	3.312	0.383	0.1830	0.9701	0.2898	0.4591	0.3648	0.3827	0.3648	3.0143	7.875788	
C7	1	1/5	1	1	1	1/5	1	0.631	0.073	0.1830	0.0277	0.0580	0.0918	0.0730	0.0765	0.0730	0.5829	7.990761	
Total								8.655	1.000										
																Average		7.915925	0.2

Note:

This calculation was applied for all research participants and the relative importance of each risk category was estimated. Calculation result which satisfied the tolerable range of Consistency Index (C.I.) was adopted for further analysis and discussions.

Appendix D2: Calculation of Relative Importance for Risk Factors

Calculation Sample Adopted for further Analysis

Repondent ID: PU-1

Organization:

Position in the Organization:

1) Comparison of Risk Factor in Category C1

Risk C.	R2	R5	R7	G.Mean	Weight	λ_{max} calculation matrix			total	total/weight	C.I.
R2	1	1	3	1.442	0.460	0.4600	0.3189	0.6634	1.4422	3.1356	
R5	1	1	1	1.000	0.319	0.4600	0.3189	0.2211	1.0000	3.1356	
R7	1/3	1	1	0.693	0.221	0.1533	0.3189	0.2211	0.6934	3.1356	
			Total	3.136	1.000				Average	3.1356	0.068

2) Comparison of Risk Factor in Category C2

Risk C.	R10	R11	R12	G.Mean	Weight	λ_{max} calculation matrix			total	total/weight	C.I.
R10	1	1/3	1/3	0.481	0.143	0.1429	0.1429	0.1429	0.4286	3.0000	
R11	3	1	1	1.442	0.429	0.4286	0.4286	0.4286	1.2857	3.0000	
R12	3	1	1	1.442	0.429	0.4286	0.4286	0.4286	1.2857	3.0000	
			Total	3.365	1.000				Average	3.0000	0.000

3) Comparison of Risk Factor in Category C3

Risk C.	R13	R14	R15	G.Mean	Weight	λ_{max} calculation matrix			total	total/weight	C.I.
R13	1	1	1	1.000	0.319	0.3189	0.4600	0.2211	1.0000	3.1356	
R14	1	1	3	1.442	0.460	0.3189	0.4600	0.6634	1.4422	3.1356	
R15	1	1/3	1	0.693	0.221	0.3189	0.1533	0.2211	0.6934	3.1356	
			Total	3.136	1.000				Average	3.1356	0.068

4) Comparison of Risk Factor in Category C4

Risk C.	R17	R20	R21	G.Mean	Weight	λ_{max} calculation matrix			total	total/weight	C.I.
R17	1	1/3	1/5	0.405	0.097	0.0972	0.0674	0.1401	0.3047	3.1356	
R20	3	1	1/5	0.843	0.202	0.2915	0.2021	0.1401	0.6338	3.1356	
R21	5	5	1	2.924	0.701	0.4858	1.0106	0.7007	2.1972	3.1356	
			Total	4.173	1.000				Average	3.1356	0.068

5) Comparison of Risk Factor in Category C5

Risk C.	R26	R27	R29	G.Mean	Weight	λ_{max} calculation matrix			total	total/weight	C.I.
R26	1	3	1	1.442	0.460	0.4600	0.6634	0.3189	1.4422	3.1356	
R27	1/3	1	1	0.693	0.221	0.1533	0.2211	0.3189	0.6934	3.1356	
R29	1	1	1	1.000	0.319	0.4600	0.2211	0.3189	1.0000	3.1356	
			Total	3.136	1.000				Average	3.1356	0.068

6) Comparison of Risk Factor in Category C6

Risk C.	R34	R35	R39	G.Mean	Weight	λ_{max} calculation matrix			total	total/weight	C.I.
R34	1	3	1/3	1.000	0.281	0.2808	0.4050	0.1947	0.8806	3.1356	
R35	1/3	1	1/3	0.481	0.135	0.0936	0.1350	0.1947	0.4233	3.1356	
R39	3	3	1	2.080	0.584	0.8425	0.4050	0.5842	1.8317	3.1356	
			Total	3.561	1.000				Average	3.1356	0.068

7) Comparison of Risk Factor in Category C7

Risk C.	R40	R41	R42	G.Mean	Weight	λ_{max} calculation matrix			total	total/weight	C.I.
R40	1	1	3	1.442	0.460	0.4600	0.3189	0.6634	1.4422	3.1356	
R41	1	1	1	1.000	0.319	0.4600	0.3189	0.2211	1.0000	3.1356	
R42	1/3	1	1	0.693	0.221	0.1533	0.3189	0.2211	0.6934	3.1356	
			Total	3.136	1.000				Average	3.1356	0.068

Note:

This calculation was applied for all research participants and the relative importance of each risk factor was estimated by category. Only calculation result which satisfied the tolerable range (not more than 0.1) of Consistency Index (C.I.) was adopted for further analysis and discussions.

174

APPENDIX E: VALIDATION OF SUGGESTED FRAMEWRK

1. Response from Public Sector Respondents

Q-I-1: (Question No. corresponds to question in the feedback form in Appendix B3.)

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitation project	Name of orgnization that you belong to	Your present position in your organization	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1PU1	0/3	16	3	Ministry of Finance,PPP unit	C.O.O				1	
Q1PU2	0/2	30	2	Ministry of finance	Director - Economic and financial				1	
Q1PU3	10	7	2	Ministry of finance	Director				1	
Q1PU7	16	0	(14)	NWSDB	AGM (R&D)				1	
Q1PU9	40	2	1	UNIVOTEL	Academic				1	
Q1PU11	30	0	0	Bank of Ceylon	CEO/GM				1	
Q1PU13	27	15	5	Ministry of Industry and Commerce	Senior Advixor					1
Q1PU15	4	3	2	CECB	Engineer water/drainage				1	
Q1PU19	30	10	7	CECB	Senior Consultant				1	
Q1PU21	13	2	1	NBRO	Senior Engineer		1			
Q1PU23	10	3	1	CECB	Mechanical Engineer				1	
Q1PU24	22	15	5	CECB	DGM(WS&D)				1	
Q1PU25	10	0	0	CECB	Project Manager				1	
Q1PU31	34	1	1	NWSDB	AGM			1		
					Total	0	1	1	11	1
					Percentage	0.0	7.1	7.1	78.6	7.1

Q-I-2:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitation project	Name of orgnization that you belong to	Your present position in your organization	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1PU1	0/3	16	3	Ministry of Finance,PPP unit	C.O.O		1			
Q1PU2	0/2	30	2	Ministry of finance	Director - Economic and financial				1	
Q1PU3	10	7	2	Ministry of finance	Director			1		
Q1PU7	16	0	(14)	NWSDB	AGM (R&D)				1	
Q1PU9	40	2	1	UNIVOTEL	Academic			1		
Q1PU11	30	0	0	Bank of Ceylon	CEO/GM			1		
Q1PU13	27	15	5	Ministry of Industry and Commerce	Senior Advixor					1
Q1PU15	4	3	2	CECB	Engineer water/drainage		1			
Q1PU19	30	10	7	CECB	Senior Consultant		1			
Q1PU21	13	2	1	NBRO	Senior Engineer				1	
Q1PU23	10	3	1	CECB	Mechanical Engineer	1				
Q1PU24	22	15	5	CECB	DGM(WS&D)				1	
Q1PU25	10	0	0	CECB	Project Manager				1	
Q1PU31	34	1	1	NWSDB	AGM				1	
					Total	1	3	3	6	1
					Percentage	7.1	21.4	21.4	42.9	7.1

Q-I-3:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitati on project	Name of orgnization that you belong to	Your present position in your organization	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1PU1	0/3	16	3	Ministry of Finance,PPP unit	C.O.O				1	
Q1PU2	0/2	30	2	Ministry of finance	Director - Economic and financial			1		
Q1PU3	10	7	2	Ministry of finance	Director				1	
Q1PU7	16	0	(14)	NWSDB	AGM (R&D)				1	
Q1PU9	40	2	1	UNIVOTEL	Academic		1			
Q1PU11	30	0	0	Bank of Ceylon	CEO/GM			1		
Q1PU13	27	15	5	Ministry of Industry and Commerce	Senior Advixor					1
Q1PU15	4	3	2	CECB	Engineer water/drainage				1	
Q1PU19	30	10	7	CECB	Senior Consultant			1		
Q1PU21	13	2	1	NBRO	Senior Engineer				1	
Q1PU23	10	3	1	CECB	Mechanical Engineer			1		
Q1PU24	22	15	5	CECB	DGM(WS&D)		1			
Q1PU25	10	0	0	CECB	Project Manager		1			
Q1PU31	34	1	1	NWSDB	AGM				1	
					Total	0	3	4	6	1
					Percentage	0.0	21.4	28.6	42.9	7.1

Q-I-4:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitati on project	Name of orgnization that you belong to	Your present position in your organization	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1PU1	0/3	16	3	Ministry of Finance,PPP unit	C.O.O					1
Q1PU2	0/2	30	2	Ministry of finance	Director - Economic and financial				1	
Q1PU3	10	7	2	Ministry of finance	Director					1
Q1PU7	16	0	(14)	NWSDB	AGM (R&D)					1
Q1PU9	40	2	1	UNIVOTEL	Academic				1	
Q1PU11	30	0	0	Bank of Ceylon	CEO/GM				1	
Q1PU13	27	15	5	Ministry of Industry and Commerce	Senior Advixor					1
Q1PU15	4	3	2	CECB	Engineer water/drainage					1
Q1PU19	30	10	7	CECB	Senior Consultant				1	
Q1PU21	13	2	1	NBRO	Senior Engineer				1	
Q1PU23	10	3	1	CECB	Mechanical Engineer					1
Q1PU24	22	15	5	CECB	DGM(WS&D)				1	
Q1PU25	10	0	0	CECB	Project Manager				1	
Q1PU31	34	1	1	NWSDB	AGM				1	
					Total	0	0	0	8	6
					Percentage	0.0	0.0	0.0	57.1	42.9

Q-I-5:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitati on project	Name of orgnization that you belong to	Your present position in your organization	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1PU1	0/3	16	3	Ministry of Finance,PPP unit	C.O.O				1	
Q1PU2	0/2	30	2	Ministry of finance	Director - Economic and financial			1		
Q1PU3	10	7	2	Ministry of finance	Director				1	
Q1PU7	16	0	(14)	NWSDB	AGM (R&D)		1			
Q1PU9	40	2	1	UNIVOTEL	Academic			1		
Q1PU11	30	0	0	Bank of Ceylon	CEO/GM			1		
Q1PU13	27	15	5	Ministry of Industry and Commerce	Senior Advixor					1
Q1PU15	4	3	2	CECB	Engineer water/drainage				1	
Q1PU19	30	10	7	CECB	Senior Consultant				1	
Q1PU21	13	2	1	NBRO	Senior Engineer			1		
Q1PU23	10	3	1	CECB	Mechanical Engineer				1	
Q1PU24	22	15	5	CECB	DGM(WS&D)				1	
Q1PU25	10	0	0	CECB	Project Manager				1	
Q1PU31	34	1	1	NWSDB	AGM			1		
					Total	0	1	5	7	1
					Percentage	0.0	7.1	35.7	50.0	7.1

Q-I-6:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitati on project	Name of orgnization that you belong to	Your present position in your organization	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1PU1	0/3	16	3	Ministry of Finance,PPP unit	C.O.O				1	
Q1PU2	0/2	30	2	Ministry of finance	Director - Economic and financial				1	
Q1PU3	10	7	2	Ministry of finance	Director				1	
Q1PU7	16	0	(14)	NWSDB	AGM (R&D)				1	
Q1PU9	40	2	1	UNIVOTEL	Academic				1	
Q1PU11	30	0	0	Bank of Ceylon	CEO/GM				1	
Q1PU13	27	15	5	Ministry of Industry and Commerce	Senior Advixor					1
Q1PU15	4	3	2	CECB	Engineer water/drainage				1	
Q1PU19	30	10	7	CECB	Senior Consultant				1	
Q1PU21	13	2	1	NBRO	Senior Engineer		1			
Q1PU23	10	3	1	CECB	Mechanical Engineer				1	
Q1PU24	22	15	5	CECB	DGM(WS&D)				1	
Q1PU25	10	0	0	CECB	Project Manager				1	
Q1PU31	34	1	1	NWSDB	AGM			1		
					Total	0	1	1	11	1
					Percentage	0.0	7.1	7.1	78.6	7.1

Q-I-7:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitati on project	Name of orgnization that you belong to	Your present position in your organization	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1PU1	0/3	16	3	Ministry of Finance,PPP unit	C.O.O					1
Q1PU2	0/2	30	2	Ministry of finance	Director - Economic and financial				1	
Q1PU3	10	7	2	Ministry of finance	Director					1
Q1PU7	16	0	(14)	NWSDB	AGM (R&D)					1
Q1PU9	40	2	1	UNIVOTEL	Academic		1			
Q1PU11	30	0	0	Bank of Ceylon	CEO/GM			1		
Q1PU13	27	15	5	Ministry of Industry and Commerce	Senior Advixor					1
Q1PU15	4	3	2	CECB	Engineer water/drainage				1	
Q1PU19	30	10	7	CECB	Senior Consultant				1	
Q1PU21	13	2	1	NBRO	Senior Engineer			1		
Q1PU23	10	3	1	CECB	Mechanical Engineer				1	
Q1PU24	22	15	5	CECB	DGM(WS&D)				1	
Q1PU25	10	0	0	CECB	Project Manager				1	
Q1PU31	34	1	1	NWSDB	AGM			1		
					Total	0	1	3	6	4
					Percentage	0.0	7.1	21.4	42.9	28.6

Q-I-8:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitati on project	Name of orgnization that you belong to	Your present position in your organization	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1PU1	0/3	16	3	Ministry of Finance,PPP unit	C.O.O				1	
Q1PU2	0/2	30	2	Ministry of finance	Director - Economic and financial					1
Q1PU3	10	7	2	Ministry of finance	Director				1	
Q1PU7	16	0	(14)	NWSDB	AGM (R&D)				1	
Q1PU9	40	2	1	UNIVOTEL	Academic			1		
Q1PU11	30	0	0	Bank of Ceylon	CEO/GM			1		
Q1PU13	27	15	5	Ministry of Industry and Commerce	Senior Advixor					1
Q1PU15	4	3	2	CECB	Engineer water/drainage				1	
Q1PU19	30	10	7	CECB	Senior Consultant				1	
Q1PU21	13	2	1	NBRO	Senior Engineer					1
Q1PU23	10	3	1	CECB	Mechanical Engineer				1	
Q1PU24	22	15	5	CECB	DGM(WS&D)					1
Q1PU25	10	0	0	CECB	Project Manager					1
Q1PU31	34	1	1	NWSDB	AGM				1	
					Total	0	0	2	7	5
					Percentage	0.0	0.0	14.3	50.0	35.7

Q-II-1:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitation project	Name of orgnization that you belong to	Your present position in your organization	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1PU1	0/3	16	3	Ministry of Finance,PPP unit	C.O.O				1	
Q1PU2	0/2	30	2	Ministry of finance	Director - Economic and financial					1
Q1PU3	10	7	2	Ministry of finance	Director				1	
Q1PU7	16	0	(14)	NWSDB	AGM (R&D)				1	
Q1PU9	40	2	1	UNIVOTEL	Academic				1	
Q1PU11	30	0	0	Bank of Ceylon	CEO/GM				1	
Q1PU13	27	15	5	Ministry of Industry and Commerce	Senior Advixor					1
Q1PU15	4	3	2	CECB	Engineer water/drainage				1	
Q1PU19	30	10	7	CECB	Senior Consultant				1	
Q1PU21	13	2	1	NBRO	Senior Engineer			1		
Q1PU23	10	3	1	CECB	Mechanical Engineer				1	
Q1PU24	22	15	5	CECB	DGM(WS&D)					1
Q1PU25	10	0	0	CECB	Project Manager					1
Q1PU31	34	1	1	NWSDB	AGM			1		
					Total	0	0	2	8	4
					Percentage	0.0	0.0	14.3	57.1	28.6

Q-II-2:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitation project	Name of orgnization that you belong to	Your present position in your organization	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1PU1	0/3	16	3	Ministry of Finance,PPP unit	C.O.O				1	
Q1PU2	0/2	30	2	Ministry of finance	Director - Economic and financial				1	
Q1PU3	10	7	2	Ministry of finance	Director				1	
Q1PU7	16	0	(14)	NWSDB	AGM (R&D)				1	
Q1PU9	40	2	1	UNIVOTEL	Academic				1	
Q1PU11	30	0	0	Bank of Ceylon	CEO/GM				1	
Q1PU13	27	15	5	Ministry of Industry and Commerce	Senior Advixor					1
Q1PU15	4	3	2	CECB	Engineer water/drainage				1	
Q1PU19	30	10	7	CECB	Senior Consultant				1	
Q1PU21	13	2	1	NBRO	Senior Engineer			1		
Q1PU23	10	3	1	CECB	Mechanical Engineer				1	
Q1PU24	22	15	5	CECB	DGM(WS&D)					1
Q1PU25	10	0	0	CECB	Project Manager					1
Q1PU31	34	1	1	NWSDB	AGM			1		
					Total	0	0	2	9	3
					Percentage	0.0	0.0	14.3	64.3	21.4

Q-II-3:

Majority of public sector respondents agrees to framework with reference to the results of Questions II-4 and II-5

Q-II-4

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitation project	Name of orgnization that you belong to	Your present position in your organization	Not sure of its capability	Not capable	Neutral	Capable	Highly capable
Q1PU1	0/3	16	3	Ministry of Finance,PPP unit	C.O.O				1	
Q1PU2	0/2	30	2	Ministry of finance	Director - Economic and financial					1
Q1PU3	10	7	2	Ministry of finance	Director					1
Q1PU7	16	0	(14)	NWSDB	AGM (R&D)				1	
Q1PU9	40	2	1	UNIVOTEL	Academic				1	
Q1PU11	30	0	0	Bank of Ceylon	CEO/GM				1	
Q1PU13	27	15	5	Ministry of Industry and Commerce	Senior Advixor					1
Q1PU15	4	3	2	CECB	Engineer water/drainage				1	
Q1PU19	30	10	7	CECB	Senior Consultant				1	
Q1PU21	13	2	1	NBRO	Senior Engineer			1		
Q1PU23	10	3	1	CECB	Mechanical Engineer				1	
Q1PU24	22	15	5	CECB	DGM(WS&D)				1	
Q1PU25	10	0	0	CECB	Project Manager				1	
Q1PU31	34	1	1	NWSDB	AGM				1	
					Total	0	0	1	10	3
					Percentage	0.0	0.0	7.1	71.4	21.4

Q-II-5:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitation project	Name of orgnization that you belong to	Your present position in your organization	Not sure of its capability	Not capable	Neutral	Capable	Highly capable
Q1PU1	0/3	16	3	Ministry of Finance,PPP unit	C.O.O				1	
Q1PU2	0/2	30	2	Ministry of finance	Director - Economic and financial					1
Q1PU3	10	7	2	Ministry of finance	Director					1
Q1PU7	16	0	(14)	NWSDB	AGM (R&D)			1		
Q1PU9	40	2	1	UNIVOTEL	Academic				1	
Q1PU11	30	0	0	Bank of Ceylon	CEO/GM				1	
Q1PU13	27	15	5	Ministry of Industry and Commerce	Senior Advixor					1
Q1PU15	4	3	2	CECB	Engineer water/drainage			1		
Q1PU19	30	10	7	CECB	Senior Consultant			1		
Q1PU21	13	2	1	NBRO	Senior Engineer			1		
Q1PU23	10	3	1	CECB	Mechanical Engineer			1		
Q1PU24	22	15	5	CECB	DGM(WS&D)				1	
Q1PU25	10	0	0	CECB	Project Manager				1	
Q1PU31	34	1	1	NWSDB	AGM				1	
					Total	0	0	5	6	3
					Percentage	0.0	0.0	35.7	42.9	21.4

180

2. Response from Private Sector Respondents

Q-I-1:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitation project	Name of orgnization that you belong to	Your present position in your organization	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1PV8	10	2	0	Private company	Senior Q'ty surveyor				1	
Q1PV9	41	0	0	Eng. Consultant	Director					1
Q1PV12	30	2	2	Eng. Consultant	GM/Engineering				1	
Q1PV14	5	0	0	Pvt. Bank	Manager				1	
Q1PV16	37	0	0	Eng. Consultant	Director					1
Q1PV22	23	0	0	Const. Company	Construction Manager				1	
Q1PV24	9	0	2	Const. Company	Manager				1	
Q1PV26	15	1	0	Eng. Consultant	Civil Engineer				1	
Q1PV27	0/1	0	0	HSBC	Assistant Manager			1		
					Total	0	0	1	6	2
					Percentage	0.0	0.0	11.1	66.7	22.2

Q-I-2:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitation project	Name of orgnization that you belong to	Your present position in your organization	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1PV8	10	2	0	Private company	Senior Q'ty surveyor				1	
Q1PV9	41	0	0	Eng. Consultant	Director					1
Q1PV12	30	2	2	Eng. Consultant	GM/Engineering					1
Q1PV14	5	0	0	Pvt. Bank	Manager					1
Q1PV16	37	0	0	Eng. Consultant	Director				1	
Q1PV22	23	0	0	Const. Company	Construction Manager				1	
Q1PV24	9	0	2	Const. Company	Manager				1	
Q1PV26	15	1	0	Eng. Consultant	Civil Engineer				1	
Q1PV27	0/1	0	0	HSBC	Assistant Manager		1			
					Total	0	1	0	5	3
					Percentage	0.0	11.1	0.0	55.6	33.3

Q-I-3:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitation project	Name of orgnization that you belong to	Your present position in your organization	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1PV8	10	2	0	Private company	Senior Q'ty surveyor				1	
Q1PV9	41	0	0	Eng. Consultant	Director				1	
Q1PV12	30	2	2	Eng. Consultant	GM/Engineering					1
Q1PV14	5	0	0	Pvt. Bank	Manager				1	
Q1PV16	37	0	0	Eng. Consultant	Director				1	
Q1PV22	23	0	0	Const. Company	Construction Manager				1	
Q1PV24	9	0	2	Const. Company	Manager				1	
Q1PV26	15	1	0	Eng. Consultant	Civil Engineer				1	
Q1PV27	0/1	0	0	HSBC	Assistant Manager				1	
					Total	0	0	0	8	1
					Percentage	0.0	0.0	0.0	88.9	11.1

Q-I-4:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitation project	Name of orgnization that you belong to	Your present position in your organization	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1PV8	10	2	0	Private company	Senior Q'ty surveyor				1	
Q1PV9	41	0	0	Eng. Consultant	Director					1
Q1PV12	30	2	2	Eng. Consultant	GM/Engineering			1		
Q1PV14	5	0	0	Pvt. Bank	Manager					1
Q1PV16	37	0	0	Eng. Consultant	Director				1	
Q1PV22	23	0	0	Const. Company	Construction Manager				1	
Q1PV24	9	0	2	Const. Company	Manager				1	
Q1PV26	15	1	0	Eng. Consultant	Civil Engineer			1		
Q1PV27	0/1	0	0	HSBC	Assistant Manager				1	
					Total	0	0	2	5	2
					Percentage	0.0	0.0	22.2	55.6	22.2

Q-I-5:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitation project	Name of orgnization that you belong to	Your present position in your organization	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1PV8	10	2	0	Private company	Senior Q'ty surveyor				1	
Q1PV9	41	0	0	Eng. Consultant	Director				1	
Q1PV12	30	2	2	Eng. Consultant	GM/Engineering				1	
Q1PV14	5	0	0	Pvt. Bank	Manager				1	
Q1PV16	37	0	0	Eng. Consultant	Director				1	
Q1PV22	23	0	0	Const. Company	Construction Manager				1	
Q1PV24	9	0	2	Const. Company	Manager				1	
Q1PV26	15	1	0	Eng. Consultant	Civil Engineer				1	
Q1PV27	0/1	0	0	HSBC	Assistant Manager					1
					Total	0	0	0	8	1
					Percentage	0.0	0.0	0.0	88.9	11.1

Q-I-6:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitation project	Name of orgnization that you belong to	Your present position in your organization	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1PV8	10	2	0	Private company	Senior Q'ty surveyor			1		
Q1PV9	41	0	0	Eng. Consultant	Director		1			
Q1PV12	30	2	2	Eng. Consultant	GM/Engineering				1	
Q1PV14	5	0	0	Pvt. Bank	Manager		1			
Q1PV16	37	0	0	Eng. Consultant	Director				1	
Q1PV22	23	0	0	Const. Company	Construction Manager				1	
Q1PV24	9	0	2	Const. Company	Manager				1	
Q1PV26	15	1	0	Eng. Consultant	Civil Engineer			1		
Q1PV27	0/1	0	0	HSBC	Assistant Manager			1		
					Total	0	2	3	4	0
					Percentage	0.0	22.2	33.3	44.4	0.0

Q-I-7:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitation project	Name of orgnization that you belong to	Your present position in your organization	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1PV8	10	2	0	Private company	Senior Q'ty surveyor				1	
Q1PV9	41	0	0	Eng. Consultant	Director				1	
Q1PV12	30	2	2	Eng. Consultant	GM/Engineering				1	
Q1PV14	5	0	0	Pvt. Bank	Manager				1	
Q1PV16	37	0	0	Eng. Consultant	Director				1	
Q1PV22	23	0	0	Const. Company	Construction Manager				1	
Q1PV24	9	0	2	Const. Company	Manager				1	
Q1PV26	15	1	0	Eng. Consultant	Civil Engineer				1	
Q1PV27	0/1	0	0	HSBC	Assistant Manager					1
					Total	0	0	0	8	1
					Percentage	0.0	0.0	0.0	88.9	11.1

Q-I-8:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitation project	Name of orgnization that you belong to	Your present position in your organization	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1PV8	10	2	0	Private company	Senior Q'ty surveyor			1		
Q1PV9	41	0	0	Eng. Consultant	Director		1			
Q1PV12	30	2	2	Eng. Consultant	GM/Engineering				1	
Q1PV14	5	0	0	Pvt. Bank	Manager				1	
Q1PV16	37	0	0	Eng. Consultant	Director				1	
Q1PV22	23	0	0	Const. Company	Construction Manager				1	
Q1PV24	9	0	2	Const. Company	Manager				1	
Q1PV26	15	1	0	Eng. Consultant	Civil Engineer				1	
Q1PV27	0/1	0	0	HSBC	Assistant Manager				1	
					Total	0	1	1	7	0
					Percentage	0.0	11.1	11.1	77.8	0.0

Q-II-1:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitation project	Name of orgnization that you belong to	Your present position in your organization	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1PV8	10	2	0	Private company	Senior Q'ty surveyor				1	
Q1PV9	41	0	0	Eng. Consultant	Director				1	
Q1PV12	30	2	2	Eng. Consultant	GM/Engineering					1
Q1PV14	5	0	0	Pvt. Bank	Manager				1	
Q1PV16	37	0	0	Eng. Consultant	Director				1	
Q1PV22	23	0	0	Const. Company	Construction Manager				1	
Q1PV24	9	0	2	Const. Company	Manager				1	
Q1PV26	15	1	0	Eng. Consultant	Civil Engineer				1	
Q1PV27	0/1	0	0	HSBC	Assistant Manager					1
					Total	0	0	0	7	2
					Percentage	0.0	0.0	0.0	77.8	22.2

Q-II-2:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitation project	Name of orgnization that you belong to	Your present position in your organization	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1PV8	10	2	0	Private company	Senior Q'ty surveyor			1		
Q1PV9	41	0	0	Eng. Consultant	Director		1			
Q1PV12	30	2	2	Eng. Consultant	GM/Engineering					1
Q1PV14	5	0	0	Pvt. Bank	Manager				1	
Q1PV16	37	0	0	Eng. Consultant	Director				1	
Q1PV22	23	0	0	Const. Company	Construction Manager				1	
Q1PV24	9	0	2	Const. Company	Manager				1	
Q1PV26	15	1	0	Eng. Consultant	Civil Engineer				1	
Q1PV27	0/1	0	0	HSBC	Assistant Manager				1	
					Total	0	1	1	6	1
					Percentage	0.0	11.1	11.1	66.7	11.1

Q-II-3:

Majority of private sector respondents agrees to framework with reference to the results of Questions II-4 and II-5

Q-II-4:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitation project	Name of orgnization that you belong to	Your present position in your organization	Not sure of its capability	Not capable	Neutral	Capable	Highly capable
Q1PV8	10	2	0	Private company	Senior Q'ty surveyor				1	
Q1PV9	41	0	0	Eng. Consultant	Director				1	
Q1PV12	30	2	2	Eng. Consultant	GM/Engineering	1				
Q1PV14	5	0	0	Pvt. Bank	Manager				1	
Q1PV16	37	0	0	Eng. Consultant	Director				1	
Q1PV22	23	0	0	Const. Company	Construction Manager				1	
Q1PV24	9	0	2	Const. Company	Manager				1	
Q1PV26	15	1	0	Eng. Consultant	Civil Engineer				1	
Q1PV27	0/1	0	0	HSBC	Assistant Manager				1	
					Total	1	0	0	8	0
					Percentage	11.1	0.0	0.0	88.9	0.0

Q-II-5:

Respondent Code	No. of years of experience in the construction industry or infrastructure development	No. of PPP based projects that you have been involved in	No. of PPP based water supply/sanitation project	Name of orgnization that you belong to	Your present position in your organization	Not sure of its capability	Not capable	Neutral	Capable	Highly capable
Q1PV8	10	2	0	Private company	Senior Q'ty surveyor				1	
Q1PV9	41	0	0	Eng. Consultant	Director				1	
Q1PV12	30	2	2	Eng. Consultant	GM/Engineering	1				
Q1PV14	5	0	0	Pvt. Bank	Manager				1	
Q1PV16	37	0	0	Eng. Consultant	Director				1	
Q1PV22	23	0	0	Const. Company	Construction Manager				1	
Q1PV24	9	0	2	Const. Company	Manager				1	
Q1PV26	15	1	0	Eng. Consultant	Civil Engineer				1	
Q1PV27	0/1	0	0	HSBC	Assistant Manager				1	
					Total	1	0	0	8	0
					Percentage	11.1	0.0	0.0	88.9	0.0