Risks Allocation in PPP Projects According to Cost of Risk, Partners' Attitude and Partners' Ability in the UAE

توزيع المخاطر في مشاريع الشراكة الحكومية مع القطاع الخاص وفقا لتكلفة المخاطر وموقف الشركاء وكفاءة الشركاء في دولة الامارات العربية المتحدة

by

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Abstract

Public-private partnership is adopted worldwide by governments to procure public projects and services, and to deliver value for money using private finance. This can be achieved by creating a "win-win" situation and balancing the parties' interests to achieve the optimum risks allocation.

Purpose – This study has been devoted to finding out the criteria that influence risk allocation in PPP projects to optimize value for money in public-private partnership projects.

Design/methodology/approach – A comprehensive literature review was carried out first and then a critical review and a comparative analysis were employed to identify a list of risks and criteria impacting the risk allocation. Finally, an empirical questionnaire survey was conducted with PPP experts in the UAE to understand and analyze their feedback/opinions about the proposed criteria and their impacts on risk allocation.

Findings – The study includes developing a comprehensive list of risk events and a list of criteria that affect the risk allocation. In Addtion, the findings show that all risks are impacted by partners' ability, eighteen risks are influenced by partners's attitude, and only twelve risks are impacted by risk cost. The risk allocation is not a static process and will never overstate, as such, the study concludes that the risk allocation should be amended according to the proposed criteria during the performance of the contract to allow the decision makers to re-allocate the risk properly in order to achieve optimum risk allocation.

Research Implications – The paper was limited to proposing theoretically the criteria and exploring their impacts. Therefore, the next step is to examine practically the implementation of the proposed criteria in order to record and analyze the performance, effectiveness, and empirical results of this framework.

Practical Implications – Risk allocation in PPP projects should be a flexible process, that means that risk allocation should be adjusted according to the changes in the proposed criteria. This will assist both partners to better understand the risk allocation, minimize the contract negotiations, and reduce the number of disputes between the partners during the concession period.

Originality/Value – To guarantee the success of PPP projects, it is essential to achieve optimum risk allocation. In practice, optimum risk allocation is rarely attainable and many frameworks and methodologies have been proposed but still the issue is controversial. To this end, this paper proposes to allocate the risks according to the proposed criteria.

Study Limitations - The paper is limited to evaluating the impact of risk costs, partners' attitude, and partners' ability on the risk allocation of design risks, construction risks and operation risks. Therefore, a further study is required to evaluate the impact of the rest of the criteria and to analyze the impact on the rest of the risks. Also, a future study is needed to analyze the interactions between the proposed criteria and to rank them according to their influences.

Keywords: Risks Allocation, Public Private Partnership, Value for Money, Cost of Risk, Partners' Ability, and Partners' Attitude.

الملخّص

تمّ إعتماد مشاريع الشراكة الحكومية مع القطاع الخاص (أو كما يسميها البعض: مشاريع وحدة الشراكة مع القطاع الخاص) من قبل الحكومات في جميع أنحاء العالم لتنفيذ المشاريع والخدمات العامة ولتحقيق أفضل قيمة مقابل المال بإستخدام تمويل القطاع الخاص. ويمكن تطبيق ذلك عن طريق إيجاد بيئة عمل "الفوز للجميع" عن طريق موازنة .مصالح الطرفين والتوزيع الأمثل للمخاطر.

الهدف - أعددت هذه الدراسة لحصر ومعرفة المعايير التي تؤثر على توزيع المخاطر في مشاريع الشراكة الحكومية مع القطاع الخاص من أجل تحقيق أفضل قيمة مقابل المال.

المنهجية / النهج - أجريت أولاً دراسة شاملة للدراسات والبحوث المنشورة ومن ثمّ تم إستخدم الاستعراض النقدي والتحليل المقارن لتحديد قائمة المخاطر والمعايير التي تؤثر على توزيع المخاطر. وأخيرا، تم إجراء إستبيان تجريبي مع خبراء مشاريع الشراكة الحكومية مع القطاع الخاص في دولة الإمارات العربية المتحدة ة لفهم وتحليل آرائهم حول المعايير المقترحة وآثارها على توزيع المخاطر.

النتائج - تتضمن الدراسة وضع قائمة شاملة بالمخاطر وقائمة المعايير التي تؤثر على توزيع المخاطر. وتبين من خلال البحث أنّ جميع المخاطر تتأثر بكفائة الشركاء، وعدد ١٨ خطر تتأثر بموقف الشركاء، وعدد ١٢ خطر فقط تتأثر بتكلفة المخاطر . إلى جانب ذلك، خلصت الدراسة إلى أن توزيع المخاطر يجب أن يكون مرناً و عرضة للتغيير وفقاً للمعايير المقترحة للسماح لصانعي القرار بإعادة توزيع المخاطر بشكل صحيح من أجل تحقيق أفضل توزيع للمخاطر وأفضل قيمة مالية.

فاعلية البحث - الدراسة إقتصرت على إقتراح المعايير المؤثرة على توزيع المخاطر وإستكشاف آثارها نظرياً؛ وهذا يتطللب إجراء المزيد من البحوث التجريبية لدراسة المشاريع التي تطبق المقترح عملياَ لتحليل أداء وفعالية هذا المقترح.

فاعلية النتائج عملياَ - إنّ توزيع المخاطر في مشاريع الشراكة الحكومية مع القطاع الخاص هو عملية مرنة والمقصود هنا أنه ينبغي تعديل توزيع المخاطر وفقا للتغيرات في المعايير المقترحة. ومن شأن ذلك أن يساعد كلا الشريكين على فهم أفضل لتوزيع المخاطر، وتقليل مفاوضات العقود إلى أدنى حد، والحد من النزاع بين الشركاء خلال مرحلة المناقصة.

أصل / أهمية البحث - لضمان نجاح مشاريع االشراكة الحكومية مع القطاع الخاص، من الضروري تحقيق توزيع المخاطر الأمثل. وعمليا، تحقيق توزيع المخاطر الأمثل صعب المنال، وقد اقترحت العديد من الأطر والمنهجيات ولكن هذه المسألة مازلت محل خلاف وإثارة للجدل. وتحقيقا لهذه الغاية، تقترح هذه الدراسة توزيع المخاطر وفقاً للمعايير المقترحة.

حدود / قيود الدراسة - تقتصر الدراسة على تقييم تأثير تكلفة المخاطر ومواقف الشركاء وقدرة الشركاء على توزيع مخاطر التصميم ومخاطر الإنشاء ومخاطر التشغيل. لذلك يلزم إجراء دراسة أخرى لتقييم أثر المعايير الأخرى (الغير مشمولة بالدراسة) وتحليل التأثير على بقية المخاطر. فضلا عن ذلك، هناك حاجة إلى دراسة مستقبلية لتحليل التفاعلات بين المعايير المقترحة وترتيبها وفقا لتأثيراتها.

كلمات البحث الرئيسية : توزيع المخاطر ، الشراكة بين القطاعين العام والخاص، القيمة مقابل المال، تكلفة المخاطر، كفاءة الشركاء ، وكفاءة الشركاء.

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List of Abbreviations

DBFO	Design, Build, Finance and Operate system
PFI	Private Finance Initiative
PPP	Public Private Partnership
PSC	Public-Sector-Comparator
SPV	Special Purpose Vehicle
VfM	Value for Money

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1. Introduction

Risk management is a critical aspect for achieving best Value for Money (VfM) which is the core concept for Public-Private Partnership (PPP) projects (Department of Finance and Administration, 2005). Failure to control the risks might result in severe consequences including defect in quality, delay in completion, cost over-runs and contractual disputes (Shen et al., 2006). Risk management includes identification of key risks and how the risks can be effectively allocated between the public and private parties.

True VfM and a win-win PPP are hardly attainable because risk allocation is not an easy task, and optimal risk allocation does not simply mean to transfer all risks. Effective risk allocation aims to transfer particular risks to the party who is the best able to control them with the best cost, whereas in practice they are allocated to the party least able to refuse them. Many frameworks and methodologies have been proposed but still this subject is open wide.

Public-Private Partnership (PPP) is a type of cooperation between public and private firms in which the two complement each other to produce efficiently community services which were traditionally provided by the public sector. Recently, PPP has become more and more popular and has been employed in many countries to deliver public projects due to the cost merits of the PPP approach which makes it the preferred choice of governments to gain the following benefits:

- PPP projects rely on private funds.
- Major risks are transferred to private partners.
- The experience of the private sector can be exploited.

Broadbent & Laughlin (2003) stated that the original form of PFI (Private Finance Initiative) was the Design, Build, Finance and Operate system (DBFO) and the term PFI, which is the UK term, is a synonym for PPP (Public-Private Partnership). Virtually, there are differences between these two procurement approaches, the PPP and PFI, as follows:

1- The services/projects technically are not under public sector control and the owner of the asset is a subject of dispute under PFI.

2- The public sector does not get involved in the design and specification of the services: that is the private sector's job.
3- The public sector is tightly bound into a long-term legal contract with a private sector that has different values and interest.

The main purpose of this thesis is to propose a practical risk allocation framework to be used in PPP tendering documents in order to save negotiation time and to have an effective risk allocation that leads to the realization of value for money (VfM) and balances the interests of all partners, including the end users. This section includes the following subsections: background, the problem statement, rationale of the study, aims and objectives, research questions, and a brief description about the methodology.

At the outset, it is important to have a look at the development of PPP and understand the associated risks:

1.1 Background

In the 1970s and 1980s public services were exposed to privatization in the UK, Australia and New Zealand. This imitated the traditional US model, given that in USA the key public services are provided by private utility companies. Privatization, therefore, is a form of liberalization policy (Broadbent & Laughlin 2003).

In the UK and Australia there was a small number of services which could be sold off and in New Zealand there were political and economic drawbacks associated with privatization. Therefore, by the 1990s the three countries had decided to move away from privatization. This turning point launched the need to engage with the private sector in another form which prepared the ground for the emergence of PPP, which is known as the Private Finance Initiative (PFI) in the UK, and Privately Financed Projects (PFP) in Australia (Broadbent & Laughlin 2003).

Although the UK's PFI was initiated by the Conservative Chancellor of the Exchequer, Norman Lamont in 1992 and the Conservatives believed that the private firms would

deliver public services better than the public sector, the Conservative government utilized PFI in only a few projects during their administration which came to and in 1997 when the Conservative party was defeated in a general election by the Labour Party. In contrast the Labour government employed PFI/PPP in all departments of government creating 450 PFI contracts including hospital and schools projects (Broadbent & Laughlin 2003).

Over the past two decades more than 1,400 PPP contracts were signed in the European Union with an approximate value of €260 billion (Gulf News, 2012).

- **PPP in the UAE**

The UAE spends billions of Dirhams on infrastructure projects, and in the era of low oil prices the UAE has started encouraging PPP to reduce the pressure on state finance. Besides, participation of the private sector in the country's development has become a priority in the country's policy agenda. Gulf Business (2016). In 2015, the emirate of Dubai issued its PPP law in response to the vision of H. H. Sh. Mohammed Bin Rashid Al Maktoum, UAE Vice President and the Ruler of Dubai, on the importance of engaging the private sector in the development process (Guide to Public Private Partnership in Dubai 2016).

Earlier in 2006, the Abu Dhabi Economic Development Council (Adnec) was created in order to facilitate partnerships between the public and private sectors. So Adnec plays a role in bring together private and public sector groups and to encourage the exchange of ideas and experience between both sectors, besides seeking a more dynamic role for the private sector in Abu Dhabi development (Abu Dhabi Reforms Investment Agencies 2006).

HSBC and Dubai International Capital in 2006 launched a $500 million fund to invest in infrastructure projects across the Middle East and North Africa (MENA). The fund will target the utilities, energy and transport sectors through public-private partnerships.

In 2011, the Department of Transport of Abu Dhabi announced the development of the Mafraq-Ghweifat highway project which is the first road in the Middle East region to be developed on a public-private partnership basis (Martin & Ratcliffe 2011). As well,

Dubai's Roads & Transport Authority (RTA) planned to develop a metro station (the area around the Union Square) through PPP (Martin 2012).

Martin (2010) cited Abu Dhabi Water & Electricity Authority (Adwea) has one of the most successful IWPP programmes in the region, in Taweelah A-2, with a capacity of 710 MW and 50 million imperial gallons per day of desalination which was built under a build-own-operate (BOO) framework contract (Gulf News, 2012). In 2011, Dubai Electricity & Water Authority's (DEWA) developed five independent power projects using public-private partnerships, and the consortium was led by Japan's Marubeni (Martin & Ratcliffe 2011).

The Ajman Wastewater Treatment Plant is set for a major expansion after Ajman Sewerage Private Company Limited, a successful public-private partnership between the Government of Ajman and two leading international experts, BESIX and Veolia, signed a deal aimed at expanding the treatment plant capacity expected to be completed before the end of 2016. Emirate New Agency (2015).

As we can see above, the numbers of PPP projects are increasing in the UAE, and the government has encouraged the use of PPPs in the country's development. On November 2015, the UAE issued a new law to encourage PPPs: "Dubai's Law No. 22 of 2015" concerning regulating the partnership between the Public and Private Sector (the PPP Law) Smith (2015).

- **Risks in PPP Projects**

Even though PPP has been adopted in many countries many of those PPP projects have been exposed to excessive risks Thomas et al. (2003 in Roumboutsos & Anagnostopoulos 2008). That makes risk management a critical element for the success of PPP projects and many researchers have conducted extensive studies about risk allocation. Medda (2007) and Li et al. (2005) and Ng and Loosemore (2007). In reality, and as supported by many researches, risk management for PPP projects is intuitive and subjective (Lam et al. 2007), in the same way, risk transference is complicated and depends on many factors (Zhang et al. 2002; Lam et al. 2007; Yelin, Chan & Yeung 2010).

Many researchers have offered different risk register, checklist, and risk allocation frameworks for PPP projects (UNIDO 1996; Hardcastle and Boothroyd 2003; Salzmann and Mohammed 1999; Thomas et al. 2003; Ibrahim et al. 2006; Wang et al. 2004; Kapila and Hendrickson 2001; Xenidis and Angelidis 2005; Ozdoganm and Birgonul 2000; Grimsey and Lewis 2004; Elbing and Devapriya 2004; Ng and Loosemore 2007; Kumaraswamy and Zhang 2001; Dey and Ogunlana 2004). (Roumboutsos & Anagnostopoulos, 2008)

Bing et al. (2005) concluded from the survey that 70% of the risks allocated to the private partner under the PPP procurement while only 20% of risk items assigned to private sector in the traditional procurement in Hong Kong. This proves that PPP procurement achieved the aim of shift the risks from the public partner to the private partner.

Medda (2007) stated that identification of the risks and their correct allocation in PPP are complicated to determine. Insufficient risk allocation raises tariff levels in addition to the cost of capital investment. This necessitates the renegotiation of the concessions; this renegotiation of PPP contracts can be a lengthy and costly process.

1.2 Problem Statement

Successful PPP projects should deliver best Value-for-Money (VfM) by achieving optimal risk transferring. Indeed, optimal risk allocation is a chronic challenge.

But why it is challenging to realize the desired optimal risk allocation? Because both sectors are keen to balance the risks and the returns of the project, the public sector intends to mitigate associated financing loss and to transfer the maximum possible risks to the private sector. In contrast, the private sector will strive to take the responsibility of those risks by obtaining adequate expected returns (Cheah and Liu, 2006). Then the government must counterweight the repayment obligations to ensure that the private sector's return does not exceeded the initial projection and will not gain excessive profit. For example, in the Dabhol Power Plant project in India, the internal rate of return turned out to be 26%, which was far above the guaranteed 16% return which meant 60% more (Mehta, 2000). In such situations, and depending on the contractual arrangement, the government should

reduce the tariff to avail the public and the end users. Otherwise, the government could impose higher taxes on the private sector or the facility owner (Jicai & Cheah 2009)

1.3 Rationale of the Study

Numerous scholars worldwide have studied risk allocation criteria and models but, to our knowledge, no one has studied risk allocation in PPP projects in the UAE, therefore we decided to examine the criteria that might impact risk allocation from the perspective of PPP experts in the UAE.

1.4 The Aims and Objectives

In virtually all countries, the public sector is criticized for poorly achieving value for money through risk transferring in PPP projects (Ahadzi & Bowles 2004). Makovšek & Moszoro (2016) added that despite PPP being expected to deliver higher value for money than traditional procurement, governments still pay higher for PPP due to the overdone risk transferring which produces inefficient risk premiums.

As such, the aim of this research is to carry out an in-depth literature review and to evaluate different frameworks and evaluation criteria for risk allocation in PPP projects. So the following objectives are intended to be achieved:

1- To have a general understanding of PPP, VfM and Risks in PPP.
2- To identify all potential risk events that might impact PPP projects in general.
3- To identify the criteria that influence risk allocation in PPP projects supported by empirical feedback from PPP experts in the UAE.
4- To understand how the risk allocation impacts the risk estimation and VfM.

Since the implementation of PPP in the UAE is still in its early stages and there is a rarity of published articles about PPP in UAE, we need to study PPP and associated risks in other countries in order to be able to apply their conclusions and results in local PPP projects in the construction field.

1.5 The Research Questions

Through this research we will try to fill out the following gaps in risk allocation in PPP:

- What are the common risks encountered in the PPP projects?
- Which are the main criteria that affect risk allocation in PPP projects?
- How are the risks re-allocated according to the proposed criteria to achieve the optimum risk allocation between the public and private sectors?
- How does the optimum risk allocation lead to maximum VfM?

1.6 The Methodology

In the introduction we will briefly describe the selected methodology. Based on the literature review we will identify all risk events that might threaten the PPP projects, as well as the risk allocation criteria. After that, we will examine to what extent these criteria impact, and then these criteria will be examined by empirical feedback through one of the research approaches.

The research methodology is "the principles and procedures of the logical thought process which are applied to a specific investigation" (Fellows & Liu, 2003) and defined as "a set of systematic methods applied in conducting a study of a particular area or activity" (Oxford Reference online 2012).

The research methodologies are categorized as follows: qualitative and quantitative. For this research, we are going to adopt both approaches. The qualitative literature appraisal will be employed to identify the risks that PPP projects encounter and to identify how the criteria influence the risk allocation. In addition, the quantitative approach is used to collect empirical feedback and to understand the UAE professionals' opinions about the research subject. Since the main objective of this research is to examine the relationship between the proposed criteria and the optimum risk allocation, the Independent Variables will be assigned for the criteria, which are: cost of risk, partners' attitude and partners' ability, where the optimum risk allocation will be considered as the Dependant Variable by way of allocating each risk event to the party best equipped to handle it.

The main challenge for this study is the data collection from the PPP professionals, as there are very few PPP projects in UAE and a scarcity of PPP experts in the local construction industry. Despite this challenge, the author and supervisor of the study decided to collect the data from PPP experts only, whatever the number of responses will be obtained, to avoid any response bias from non-PPP experts.

2. Literature Review

2.1 Introduction

Establishing an effective Risk Allocation Strategy will help the government to minimise the project's cost which will result in achieving VfM in PPP projects. Another major advantage is to effectively reduce contract negotiation and reducing disputes during the concession period. Hence, the core of the literature review will be about risk allocation in PPP projects.

In the Literature Review Introduction we will have an overview of PPP definitions, PPP advantages and disadvantages, PPP lifecycle, PPP contractual agreement, PPP types and organizational structure, VfM description, VfM in practice, understand the impact of politics in VfM, and risks in PPP projects.

The second section is about Risk Identifications in PPP, where we will identify potential risk events that might impact PPP projects and develop a comprehensive Risks Register. This section also includes a brief description of each risk event. In the third section, we will review the numerous proposals for risk allocation mechanisms and criteria. In the fourth section we will understand the relationship between risk allocation, risk estimation and VfM, and how they are interrelated to each other. This literature review will not include an overview on risk costing methods, contract types, or comparisons between types of PPP projects.

2.1.1 Public Private Partnership (PPP or P3)

Traditional procurement approaches have two major problems: first is the cost overrun and second is the adversarial relationship between the parties especially in fixed-price lump-sum contracts (Lahdenpera 2010 in Chan et al. 2011). Lahdenpera suggested that gain-share and pain-share improve the project's success and enhance collaboration among the parties. Recently, PPP has been widely applied around the world due to its advantages. Lyer & Sagheer (2010) stated that "Public-private partnership has been widely recognized as an innovative institutional mechanism to leverage the private sector's efficiencies in

public services". The main motivators to employing PPP are private debt and equity investment, besides PPP lines up all partners' interests considering the incentive for private partners to handle the risk allocation (Grimsey & Lewis, 2005 in Siemiatycki & Farooqi 2012). In contrast, Siemiatycki & Farooqi (2012) believe that the decision to proceed with a PPP is still not well understood. Furthermore, PPP is not as simple as it sounds due to the multitude of stakeholders and the multifaceted risks. DOLOI, (2012).

- PPP Definition & Structure

The Guide to Public Private Partnership in Dubai (2016) defines PPP as "a contractual relationship bringing together public and private sectors. It aims to ensure the quality of services and to develop the revenues of the government entity by making use of private sector efficacies, potentials, and technical and financial capabilities". Yelin, Chan & Yeung (2010) define the public-private partnership as an innovative tool for attracting private capital in the development of infrastructure projects. In PPPs, both partners employ their competences in different levels of involvement and responsibility, in order to provide more efficient public services (Hong Kong Efficiency Unit 2003a). The simple definition of PPP is that government becomes the purchaser of services from the private sector instead of the owners and operators of public assets as in traditional procurement (Ahadzi & Bowles, 2004). The diagram below shows the typical organizational structure for a PPP contract.

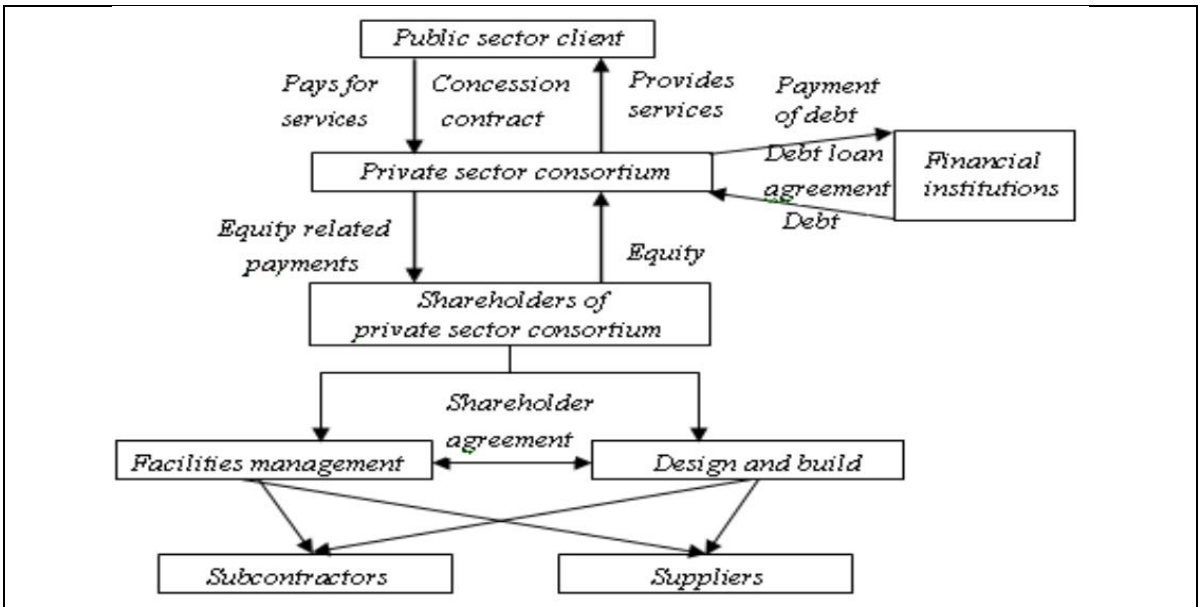


Figure no. 2.1.1 A: Typical organizational structure of PPP contract. Adopted from Akintoye, Beck & Hardcastle (2003).

As well, Chowdhury, Chen & Tiong (2012) illustrate in Figure no.2.1.1.B how the Special Purpose Vehicle (SPV) is interrelated with various parties in a PPP project, and shows common agreements surrounding SPV. For example: loan agreement, concession agreement, O&M agreement, etc.

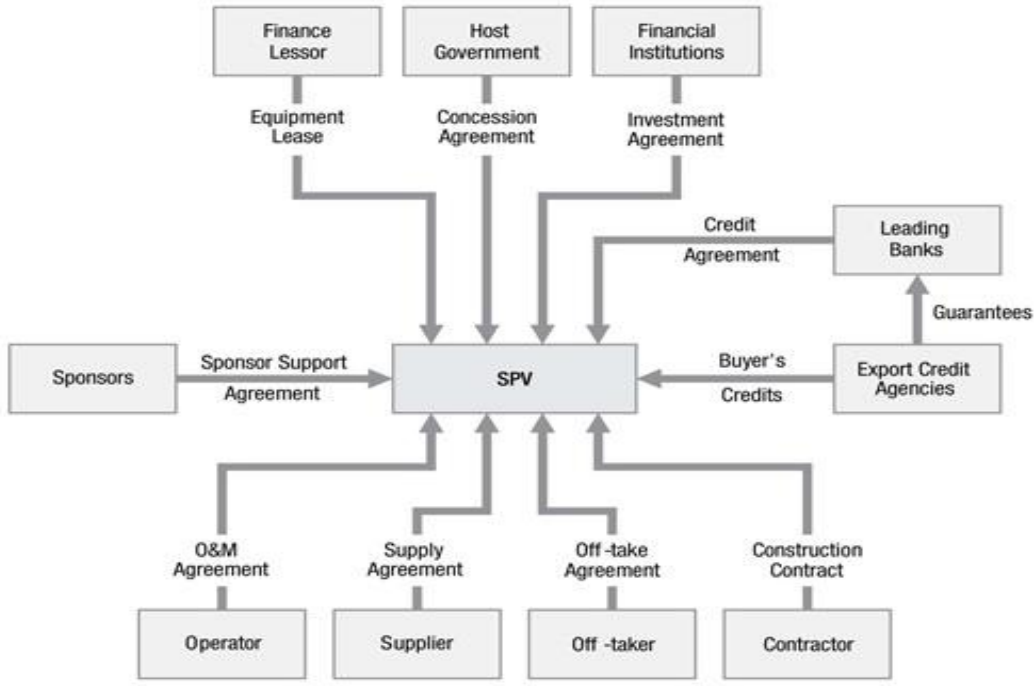


Figure no. 2.1.1 B : Contractual agreements between various parties in PPP project adopted from Chowdhury, Chen & Tiong (2012)

A Special Purpose Vehicle (SPV) is a dedicated company created to control and manage the PPP project and to enter into a long-term contract with the public partner (Yescombe 2014). The SPV will sign a franchise contract with the government, the SPV is responsible for project financing, construction, operations and can recover their investments and obtain reasonable compensation within the concession period of the contract. In order to ensure the SPV can obtain loans from financial institutions successfully, the government will normally contract a direct agreement with the bank. At the end of the concession, the SPV will be dissolved, and the public rental project property will be transferred to the government (Chen 2012).

- PPP Categories

PPP projects are categorized based on different criteria, for example:

1- Contract period: short-term and long term PPP contract (Siemiatycki & Farooqi 2012).

2- Approaches for repaying the private initial capital investment: for example in Ontario, three PPP repayment models are used: User-Fees-Based PPP, availability payments PPP, and construction completion payments (Siemiatycki & Farooqi 2012). Lossa & Martimort (2012) classified two models for recovering the investment in PPP: the Concession Model where the private sector recoups the investment through charges to end users, e.g. toll roads; and the PFI model where the public sector reimburses the firm through shadow fees as the end users do not pay, e.g. hospital projects.

It is worth mentioning that the selected approach for repaying is critical to determine which risks are transferred to the private sector. Siemiatycki & Farooqi, (2012),

- PPP Lifecycle

Bing et al. (2005) propose that PPP projects consist of three phases: planning, procurement, and contract management. Boussabaine (2014) proposed a generic life cycle which consists of three stages: Project Initiation, Project Development, and Project Implementation. Alhashemi (2008) stated that a typical PPP project consists of six phases, which are: inception, feasibility, procurement, development, operations, and exit.

- PPP Advantages & Disadvantages

Siemiatycki & Farooqi (2012) stated that PPP has been employed in project procurement in order to: enhance efficiency, reduce project costs, and get better results. On the other hand, international evidence indicates that PPP diminishes the competition between bidders as fewer competitors have the required financial and technical capabilities to manage the concession (National Audit Office 2007; Soliño & Vassallo 2009). Makovšek & Moszoro (2016) present the following evidence to confirm that competition in PPP projects is limited due to complexity and transaction requirements:

- National Audit Office in London (2007) reported that there were a maximum of two bidders interested in 33% of PFI projects from 2004 to 2006.
- Zitron (2006) found that there were three bidders for each SPV contract in 86 PPP projects in the UK.

The NAO (2007) affirms that hospital projects in the UK procured by PPP are not of a higher quality than the projects traditionally procured. Li (2005, in Bing et al. 2005) added

that the furthermost disadvantage of PPP procurement is "a lot of management time spent in the contract transaction, lengthy delays in negotiation and high participation cost'. This extensive bidding time in PPP is due to the following:

1- Long negotiation time between the project partners and bidders.
2- Communicating and understanding the risk allocation between the parties.

Siemiatycki & Farooqi, (2012) summarize three drawbacks for PPP:

- The highly confidential commercial information restricts the consultation (Forrer, Kee, Newcomer & Boyer 2010; Shaoul et al. 2010; Siemiatycki 2007).
- The long-term contract for PPP worsens network integration and loosens the flexibility of public policy (Froud & Shaoul 2001; Hodge & Greve 2007; Siemiatycki 2010).
- The partnership agreement is tenuous and that results in costly negotiation and might lead to project failure (Acerete, Shaoul, Stafford, & Stapleton 2010; Guasch 2004).

2.1.2 Value for Money & PPP

- VfM Definition

VfM in PPP projects can be achieved mainly by transferring risks effectively from the public to the private sector. But in reality, the private sector overestimates the risks associated with the project which leads to higher project costs, so the public sector has to accept such high costs and VfM is not achieved. So what does VfM mean and how is it impacted by the risk allocation?

Value for Money (VFM) is the cost saving that is achieved when using PPP compared to traditional procurement approaches. The key reason for procuring projects through public–private partnerships is because of the lowest lifecycle cost and the transferring of risk from the public partner to the private partner which will improve the VfM. The VfM should be conducted in a planning process to evaluate the advantages of PPP over the traditional procurement approaches (Siemiatycki & Farooqi 2012).

- VfM Assessment

The most accepted methodology to calculate the VfM is the Public-Sector-Comparator (PSC) which compares the benefits and cost proposed by the winning bidder against a hypothetical equivalent project delivered through the traditional procurement model. So the VfM comparison is based on the following parameters as shown in figure no.2.1.2A:

- The raw base costs of building, financing, and operating a comparable project using either a PPP or a traditional procurement approach
- The risk retained with the public partner under both procurement approaches
- Transaction costs.

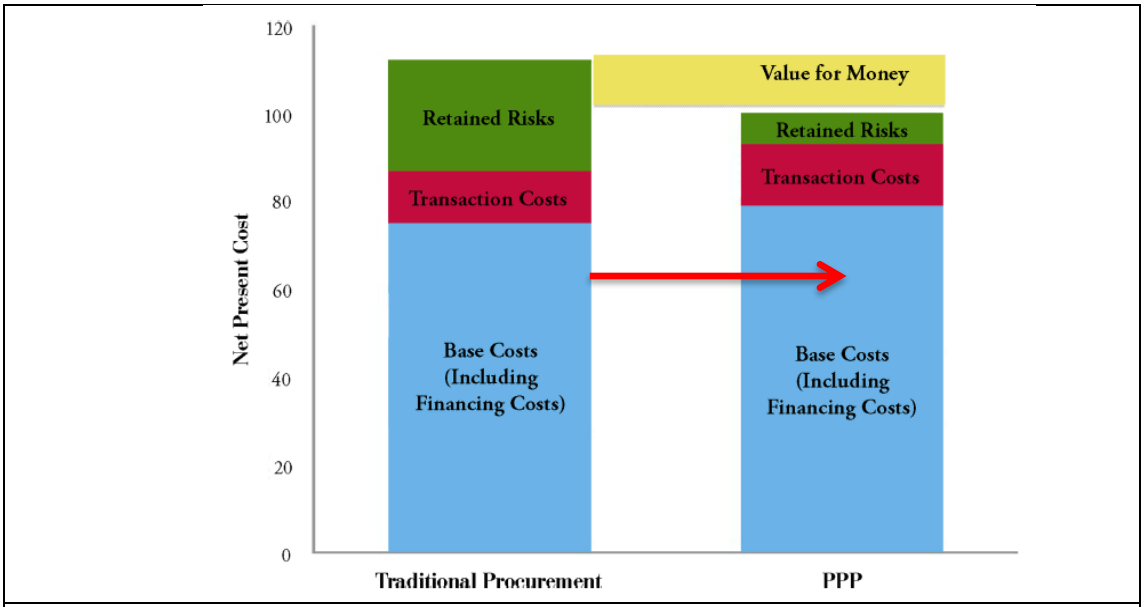
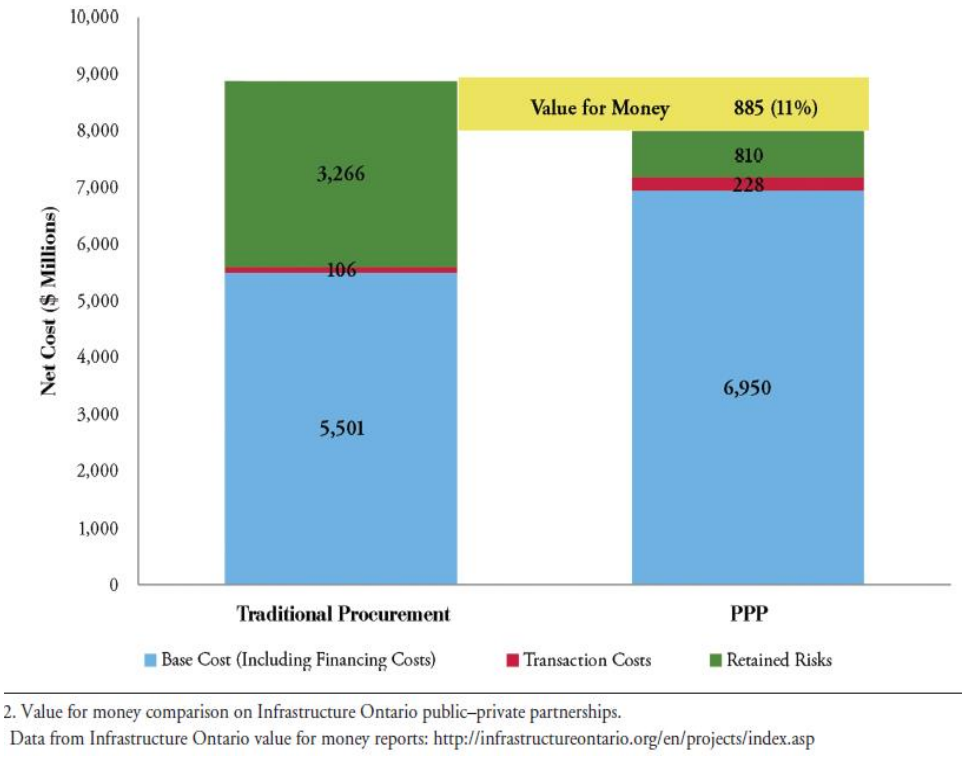


Figure no. 2.2.1 A: defined VFM. Adopted from Siemiatycki & Farooqi, (2012)

The base cost, financed by the private-sector, in the PPP approach is higher than the base cost for the traditionally procured project as illustrated in the Figure above due to the allocation of greatest risks and associated transaction costs to the private partner (Siemiatycki & Farooqi 2012)

Siemiatycki & Farooqi (2012) reviews VfM proposals for 28 PPP projects in Canada, and they conclude that despite the base costs transaction costs in traditional procurement are significantly lower than those in PPP but risk transferring the VfM analysis in favour of PPP, i.e. the cost saving in PPP is around +11% as shown in figure no. 2.2.1 A. For reviewing the VfM appraisals of the 28 projects please refer to Appendix (1).



2. Value for money comparison on Infrastructure Ontario public–private partnerships.
Data from Infrastructure Ontario value for money reports: http://infrastructureontario.org/en/projects/index.asp

Figure no. 2.2.1 B: VfM comparison on Ontario PPP projects adopted from: Siemiatycki & Farooqi, (2012)

Note: The estimation of these risks in Figure no. 2.2.1 B was evaluated through a risk workshop conducted by public-sector sponsors, stakeholders and external expert consultants.

Makovšek & Moszoro (2016) stated that many endeavours have attempted to determine when a PPP would deliver higher value for money than traditional procurement (World Bank 2013) by comparing the cost of public capital (traditional procurement) to the cost of private capital (PPP). Apparently, private financing requires a higher cost of capital than public borrowing due to the estimated risks costs. Klein (1997 in Makovšek & Moszoro 2016). When considering public borrowing, not all true risks are included as ex post facto risks because they can be covered by taxpayers. This option is unavailable for the private sector so all risk costs should be considered as forecasted costs. This will complicate the comparison of value-for-money and make it unfair.

Finally, Zou, et al (2008) stated that:

"Due to different benefits explored in PPP projects and attitudes towards risk and different skills in risk management between public and private partners, the resources of PPP projects are often poorly collocated to achieve balance of interests as well as optimal risk allocation. As a result, the value for money objective is unattainable."

- VfM & Politics

Apparently, the VfM assessment determines the appropriate procurement to be employed for each project, but in reality the political process has a great impact on the procurement decision. We can perceive bias in preparing the VfM appraisal to tailor the assessment toward supporting the PPP approach and this issue has been argued by many scholars. (OECD; Dutz, Dhingra, & Shugart 2006; OECD 2010; Vining & Boardman 2008). Siemiatycki & Farooqi, 2012 concluded from the Ontario experience that the selection of PPP procurement is based on many elements:

- The political dynamics of the community.
- The historical experiences with projects delivered using PPP.
- The outputs of the VfM assessment.

2.1.3 Risks in PPP

Great attention has been drawn recently in literature about risk management in PPP projects (Bing et al. 2005; Li 2003; Grimsey and Lewis 2004; Ng and Loosemore 2007 in Carbonara et al. 2015). They added that PPP provides numerous benefits to the public sector, in spite of its drawbacks and the high-degree of risks which are caused by numerous stakeholders, huge amounts of investments, long concession periods, and so on. Yelin, Chan & Yeung (2010) emphasize the significant role of systematic risk management in early detection, identifying, analyzing, and responding to the risks, as well as introducing mitigation measures (Akbiyikli and Eaton 2004). And it is essential to evaluate all potential risks throughout the whole life cycle of a PPP project.

The EU Guidelines for Successful Public and Private Partnerships (2002 in Medda 2007) defined risk as "any factor, event or influence that threatens the successful completion of a project in terms of time, costs or quality". Lossa & Martimort (2012) argue that PPP is unsuitable in complex projects where risk transfer becomes very costly. In other words, they recommend that PPP is not preferred when operational risks are high. PPP can yield potentially the highest benefit for services where uncertainty is limited or where sufficient past experience exists to inform the parties as to what may happen during operations so that an efficient risk allocation can be achieved.

PPP projects face many risks, which are resulted from:

(1) Absence of efficient risk evaluation process;

(2) Underestimation of time and resource limits;

(3) Insufficient consideration of changes in project implementation;

(4) Underestimating the changes in exchange rates.

Hence, the need for establishing an effective risk management for PPP projects is becoming more urgent (Choi et al., 2004 in Xu et al. (2011). Risk management in PPP consist of four processes: Risk Identification, Risk Assessment, Risk Allocation and Reducing Risk (Shen et al 2006). Many authors have proposed a lifecycle for risk management in PPP: refer to Appendix (3) for two cited examples.

2.2 Risk Identification in PPP

2.2.1 Introduction

The first step in risk management is to identify potential risks that might impact the project. Risk Identification represents a comprehensive list of risks which are grouped in categories and described to clarify their impacts on the project outcome if they materialize. Zou et al. (2008) argue that risk identification should be starting from the feasibility study up to the transferring stages with endless monitoring.

Comprehensive research into PPP risk identification has been conducted by many articles to explore the common risks affecting PPP projects in different sectors and countries. (Deviprasadh 2007; Tieva and Junnonen 2009; Leung and Hui 2005 in Xu et al 2011). In general, there are two common techniques for risk identification:

1. Structured one-to-one interviews.
2. Brainstorming: Nominal group technique and Delphi technique.

In fact, these techniques generate an unstructured list of risks which weaken the attention of project managers in risk management efforts. Furthermore, they fail to recognize the interactions or interdependencies between different risks and underestimate the multiple effects of these risks (Lyer & Sagheer 2010)

2.2.2 Risks Register

Xenidis & Angelides (2005) believed that establishing a comprehensive list of risks will be the base for executing a successful PPP agreement.

So the Author has reviewed the following articles in order to identify all risk events that might confront different types of PPP projects:

1- Pellegrino et al. (2013) identified 22 risks embedded in PPP transportation projects. Figure no.5 shows these risks grouped by project phase.
2- Ameyaw & Chan (2013) identified 40 risks in water supply PPP projects and classified them into eight categorizes.
3- Xu et al. (2011) identified 11 critical risks. And they concluded that government risks are the most critical risks tackled by Chinese PPP projects.
4- Song et al. 2013 identified 10 key risks for PPP waste-to-energy incineration projects in China.
5- Raisbeck (2008) identified major five risks.
6- Alzahrani (2015) identified 78 risks in PPP projects.
7- Doloi (2012) identified 42 risks from seven major PPP projects in Australia.
8- Bing et al. (2005) has cited 46 risks.
9- Lyer & Sagheer (2010) identified 17 risks encountered in Indian road projects.

2.2.3 Risks Description

Table no. 2.2.4 shows all risks identified from the above cited articles, and what follows are short descriptions of some of these risks:

Financial Risk is difficulty in financing such as high costs of financing or failing to meet financing requirements (S. Q. Wang et al. 2000). Grimsey & Lewis (2002) defined Operating Risk as the risk that results from increasing in operating and maintenance costs. Since PPP projects can have a lifespan of over 20 years, government changes and Political Risks are highly possible to occur as the subsequent government might not adhere to

promises made by the former government (Alzahrani, S (2015). Environmental Risk is described as the threat on living organisms and the environment by effluent, emissions, waste, resource depletion, etc., and may occur due to the activities of organisations (Alzahrani 2015). Karim & Alkaf (2011) argue that Relationship Risk relates to organization, responsibilities and commitment. VDTF (2001) defined the Legal Risks as the risk resulted from changes in regulations and policies during the contract term which causes a financially negative effect in the project.

Lyer & Sagheer (2010) defined the Pre-investment Risk as the danger of project cancellation due to reasons such as poor bidder turnout, unfair bids, government decision to drop the project, litigation or inordinate delays in signing the concession agreement, etc. Delay in Financial Closure is the delay in timely arrangements of the necessary debt and equity finance for the project as, for example, road projects require huge capital investments upfront. Resettlement and Rehabilitation, when projects occupy vast stretches of land, they probably disturb human settlements and so there is a requirement for resettlement, otherwise that might stir up public resentment and disrupt such projects. Partnering Risk refers to team spirit, as mutual trust is critical for the success of a consortium. Organizational structure with well-defined functional areas is necessary to avoid conflict among the parties. It has been reported that international joint ventures are subject to very high rates of failure due to cultural and operational difficulties at both national and organizational level (Sridharan 1997). Physical Risk is the danger resulting from damages on structures, construction equipment, labour, etc.

Song et al. (2013) defined the following risks. Government Decision-Making Risk: is related to bureaucratic corruption, incompetence, inadequate preparation, or lack of experience of public officials. Government Credit Risk: Public agencies failing to fulfill their obligations in the concession contract; i.e. it was reported that the probability of local public agencies to breach contract was relatively high in China (Li, 2007).
Contract Change Risk: Such as changes in technical specifications, changes in stakeholders' requirements and changes required by the franchisee. Supply Risk: This refers to the quantity and quality of supplied materials which causes operational problems. Payment Risk: The delay or non-payment of subsidies from the government can cause severe financial problems to the project. Revenue Risk: Many factors affect project

revenue such as transportation costs, grid-connected power, coal price, and operational standards.

Raisbeck (2008) defined Technical Risks: risks that the project will not perform to required technical standards or to its required functionality. Energy Risks: when the project has excessive energy consumption. Integration Risk: when the parties are not working in synergy. Capital Costs Risk: the funds allocated to the project will be insufficient or that project will run over its allocated time and consequently incur further costs. Recurrent Costs Risk Probability: that the forecast income from the project will be below expectations or that the facility's brand image is diminished. Acceptability risk means a change in the quality or feature of the product/service which leads to consumer dissatisfaction and not purchasing the product thereby reducing the revenue.

Ameyaw & Chan (2013) defined the following risks: Unfavorable global private investment climate refers to the general deterioration of the international investment climate which reduces the possibility of finding a private partner. Fuest & Haffner, (2007, p.179): risk of No baselines for performance measurement refers to the assessment of private sector performance to ensure contractual performance.

Doloi (2012) explains the change in output specification as the risk result from conflict between the public and private partners when the public partner pushes for high-end specifications to achieve VfM while the private partner tends to stick to the contract specification. The following table presents short definitions for 37 risks (Ke et al. 2010)

ID	Risk factor	Definition
1	Corruption	Corrupt local government officials demand bribes or unjust rewards
2	Government's intervention	Public sector interferes unreasonably in privatized facilities/services
3	Expropriation and nationalization	Due to political, social or economic pressures, local government takes over the facility run by private firm without giving reasonable compensation
4	Government's reliability	The reliability and creditworthiness of the government to be able and willing to honor their obligations in future
5	Third party reliability	The reliability and creditworthiness of a third party to be able and willing to honor their obligations in future
6	Public/political opposition	Prejudice from public due to different local living standards, values, culture, social system, etc.
7	Immature juristic system	The lack of national PPP law leads to different ways of PPP implementation in different places in China
8	Change in law	Local government's inconsistent application of new regulations and laws
9	Interest rate	Unanticipated local interest rate due to immature local economic and banking systems
10	Foreign exchange and convertibility	Fluctuation in currency exchange rate and/or difficulty of convertibility
11	Inflation	Unanticipated local inflation rate due to immature local economic and banking systems
12	Poor political decision-making	Government officials considers more their career achievement or short-term goals or personal interests, or with little PPP experience etc., resulting in a poor political decision-making process
13	Land acquisition	The project land is unavailable, or unable to be occupied at the required time
14	Approval and permit	Delay or refusal of project approval and permit by local government
15	Improper contracts	Improper arrangements in the contracts including inappropriate risk allocation among stakeholders, commitment from public/private partners
16	Financial risk	Poor financial market or unavailability of financial instrument resulting difficulty of financing
17	Construction/operation changes	Unanticipated changes and errors in the construction/ operation resulting from the improper design or poor investigation
18	Construction completion	Longer construction time than predicted, Construction cost overrun or poor construction quality
19	Delay in supply	Subcontractors and suppliers not being able to supply labor or material on time
20	Technology risk	The technology adopted not being mature or able to meet the requirements
21	Ground/weather conditions	Poor or unexpected ground/weather conditions
22	Operation cost overrun	Operation cost overrun resulting from improper measurement, ill planned schedule or low operation efficiency
23	Competition (exclusive right)	The government does not offer the exclusive right, or does not honor to its commitment and build another competitive project
24	Market demand change	Demand change from other factors, i.e. social, economic, etc., except the exclusive right
25	Tariff change	Improper tariff design or inflexible adjustment framework leading to the insufficient income
26	Payment risk	The consumer/government not being able or willing to pay, due to social or other reasons
27	Supporting utilities risk	Supporting utilities, such as electricity, water, necessary for the construction, operation and management would not be available in a timely manner or at fair rates
28	Residual assets risk	Assets transferred to the government at the end of the concession period would not be normally running
29	Uncompetitive tender	The tendering process and documents vary from project to project and from province to province in China without transparent or standardized models
30	Consortium inability	The consortium not being able to perform its obligations as a PPP project company
31	Force majeure	The circumstances that are out of the control of both foreign and local partners, such as flood, fires, storms, epidemic diseases, war, hostilities and embargo
32	Organization and coordination risk	An increase of transaction cost or a dispute may occur because of the improper organization and coordination
33	Tax regulation changes	Central or local government's inconsistent application of the tax regulation
34	Environmental protection	Stringent regulation which will have an impact on construction firms' poor attention to environmental issues
35	Private investor change	Due to the disputes among private investors or other reasons, one or some investors exit/enter the consortium
36	Subjective evaluation	Subjective evaluation and design of the concession period, tariff structure, market demand, etc.
37	Insufficient financial audit	The government/lenders would not perform a careful audit to the financial status of the project company

Table no.2.2.3 PPP Risks definition, adopted from Ke et al. (2010)

2.2.4 Risks Identification Summary

The following table represents the comprehensive list of risk, developed as a part of the study's scope, according to the following articles as discussed earlier in Section 2.2.2:

A: Pellegrino et al. (2013), B: Ameyaw & Chan (2013), C: Xu et al. (2011)
D: Lyer & Sagheer (2010), E: Song et al. (2013), F: Raisbeck (2008),
G: Doloi, (2012), H: Bing et al. (2005), I: Alzahrani (2015).

Table no. 2.2.4: Risk Register for PPP Projects – Self Generated

No	Risk \ Authors	A	B	C	D	E	F	G	H	I	Total
1	**Reinvestment Risk / Initial Stage**				1				1	1	**3**
	Design / Technical Risk	1		1	1	1	1				**5**
2	Changes in output specification							1	1	1	**3**
3	Innovative design							1			**1**
4	Design complexity							1		1	**2**
5	Defects in design							1	1	1	**3**
6	Unapproved engineering technique								1		**1**
7	**Site Risk & Land acquisition**	1			1			1	1	1	**5**
8	**Financial Closure risk**	1			1					1	**3**
9	**Tender Risk:** Uncompetitive tender, High bidding costs and Inaccurate estimates								1	1	**2**
	Construction risk										
10	Change in scope							1	1		**2**
11	Constructability							1		1	**2**
12	Failure/delay in material delivery							1	1	1	**3**
13	Skilled and unskilled labour availability									1	**1**
14	Defects in construction / Quality							1	1	1	**3**
15	Construction Cost Overrun	1			1		1		1	1	**5**
16	Delay in Completion	1			1		1		1	1	**5**
17	Construction technology risk									1	**1**
18	Failure to meet the criteria	1									**1**
19	Failure/delay in commissioning test							1			**1**
	Operational Risk						1				**1**
20	Operating cost overrun	1	1						1	1	**4**

No	Risk \ Authors	A	B	C	D	E	F	G	H	I	Total
21	Delay /interruption in operation	1	1					1		1	**4**
22	Shortfall in service quality	1	1							1	**3**
23	Maintenance cost overrun								1	1	**2**
24	Frequency of maintenance								1		**1**
25	Obsolete technology		1					1		1	**3**
26	Waste of material									1	**1**
27	Asset service Level Risk	1	1					1			**3**
28	Poor performance / productivity		1		1				1	1	**4**
29	Inability of partners to honour financial obligations (operator default)		1							1	**2**
30	Acceptability risk (aesthetics)		1								**1**
31	Theft		1								**1**
32	No baselines for performance measurement		1								**1**
	Market/Revenue Risk		1				1		1		**3**
33	Change in Tariff	1	1							1	**3**
34	Demand/ Usage risk	1	1	1				1		1	**5**
35	Alternative sources/ Competition		1	1				1		1	**4**
36	Delayed and non-payment		1			1				1	**3**
37	Inaccurate market forecast risk;			1	1			1		1	**4**
38	Increase in material/ Energy cost					1	1			1	**3**
39	Change in Tax							1	1	1	**3**
40	Commercial rights due to vicinity of development							1			**1**
	Financial Risk			1	1						**2**
41	Insufficient allocated funds						1	1	1	1	**4**
42	Interest rate increase	1						1	1	1	**4**
43	Inflation	1		1				1	1	1	**5**
44	Exchange Rate	1								1	**2**
45	Unfavorable global private investment climate / poor financial market		1						1		**2**
46	Financial failure of private consortium							1			**1**
47	Rate of return restrictions									1	**1**
48	Influential economics events								1		**1**
49	**Force Majeure Risk**	1			1			1	1	1	**5**

No	Risk \ Authors	A	B	C	D	E	F	G	H	I	Total
	Regulation & Legal Risks			1	1	1					**3**
50	Weak regulatory and monitoring regime		1								**1**
51	Changes in legislation / law / regulation	1			1			1	1	1	**5**
52	Permit/approval Risk				1			1	1	1	**4**
53	Import / Export restrictions									1	**1**
54	Inadequate distribution of authorities								1		**1**
	Politics Risk			1		1					**2**
55	Political interference	1	1							1	**3**
56	Termination of contract by government.		1			1					**2**
57	Government's commitment risk.		1	1		1		1		1	**5**
58	Change in government		1						1	1	**3**
59	Corruption (government and private sector).		1			1				1	**3**
60	Compulsory acquisition or expropriation of project assets.				1				1	1	**3**
61	Act of war, terrorist, civil commotion, etc.				1						**1**
62	Lack of cooperation of the government							1			**1**
63	Poor public decision making process								1	1	**2**
64	Inconsistencies in government policies									1	**1**
65	Strong political opposition /hostility								1	1	**2**
66	Inability of concessionaire									1	**1**
	Relationship Risks										
67	Strained relationships/ Dispute		1		1		1	1		1	**5**
68	Poor commitment from parties		1						1	1	**3**
69	No risk allocation mechanism		1							1	**2**
70	Weak capacity of public and private partners		1			1					**2**
71	Inexperience in PPPs		1			1			1	1	**4**
72	Contract risk**,** Misinterpretation of contract			1		1		1			**3**
73	Cultural & Works procedure Differences								1	1	**2**
74	Organization and coordination risk								1	1	**2**
	Project and Private Consortium Selection										
75	Suitability of operator		1								**1**
76	Non-transparent and accountable process		1								**1**
77	Private partners' performance record		1								**1**

No	Risk \ Authors	A	B	C	D	E	F	G	H	I	Total
78	Unsuitable PPP model		1								**1**
79	Competence of private consortium		1								**1**
	Social Risks										
80	Public opposition		1		1	1		1	1	1	6
81	Delayed process		1								1
82	No pro-poor measures		1								1
83	Resettlement and Rehabilitation				1						1
	Third Party Risks										
84	Default of sub-contractors or suppliers								1	1	2
85	Unreliable material or energy supply		1			1					2
86	Employee theft		1								1
87	Supporting infrastructure risk			1		1				1	3
88	Tort Liability								1		1
89	**Environmental Risk**				1	1	1			1	4
90	**Physical Risk :** damages in equipment, materials, labour…etc.				1						1
91	**Workers Strike**								1	1	2
	Stakeholder's issue risks										
92	Misunderstanding the role of stakeholders							1	1		2
93	Change of stakeholders							1			1
94	Lack of communication between stakeholders							1			1

2.3 Risk Allocation in PPP

2.3.1 Introduction

In general, public partners can manage risks by using four approaches: Retain, Insure, Transfer or Mitigate. (Zou, et al (2008). And risk allocation is a process to determine the responsibility of the proportion of risk management between firms based on characteristics of risk management service transactions (Jin, 2010). Alzahrani (2015) defined the risk

allocation as a process of assigning the responsibility of a specific risk to one party or more in the contract.

In PPP projects, partners' capabilities in risk management play the main role in determining who should be responsible for which risks (Jin & Zhang 2011). Chan et al. (2011) cited that Cooper et al. (2005) described the optimal risk allocation by transferring the risk to the party who is best able to manage it at least cost, and Ke et al. (2010) added that optimal risk allocation is finding the least costly solution for all parties. Boussabaine (2007) stated the object of appropriate risk allocation is to achieve the lowest overall cost and risk for the project. Nisar (2007) conclude that the party can manage the risk at the lowest cost should be responsible for it.

How does risk allocation in PPP procurement differ from traditional procurement? In traditional projects, the contractor and consultant control all risks related to design and construction and the client handles the operational and financial risks, whereas in PPP the client bears little or almost no risk. Risk allocation is complex process in PPP because it is influenced by many factors such as risk attitude, ability to manage risk and risk premium and inappropriate risk allocation which leads to legal disputes (Alireza et al. (2014b). Inappropriate risk allocation creates many problems as presented by Pipattanapiwong (2004 in Alireza et al. 2014a) in Figure no. 2.3.1A

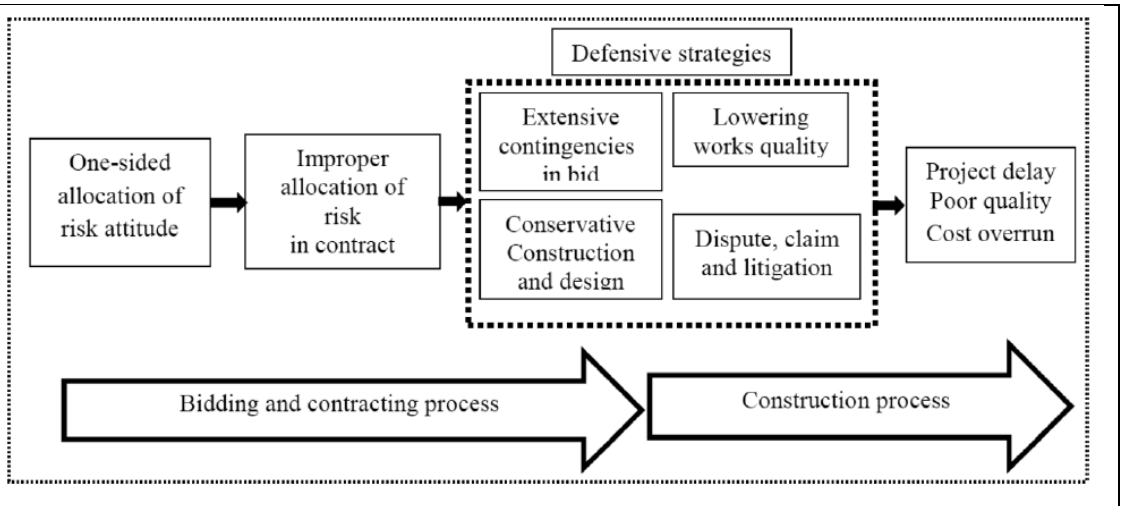


Figure no. 2.3.1 A Problematic issues associated with risk allocation adopted from (Pipattanapiwong (2004 in Alireza et al. 2014b)

Risk allocations to other parties will incur a risk premium, this premium is determined based on risk aversion and competition levels (Makovšek & Moszoro 2016). Evidence shows that when construction risk is fully transferred from the government to the SPV and from the SPV to contractors in PPP contracts the average of cost overruns was 2.3% for large projects whereas in traditional procurement the government bore cost overruns at an average of 9% (Blanc-Brude and Makovsek 2013). In other words, the rational risk allocation between the parties is a cornerstone for the success of the PPP project (Li et al., 2005; Majamaa et al., 2008) in Xu et al. (2011).

The PPP Guide (2016) defined the optimum risk allocation as the point at which if additional risk is retained or transferred the VfM decreases, as shown in Figure no. 2.3.1 B

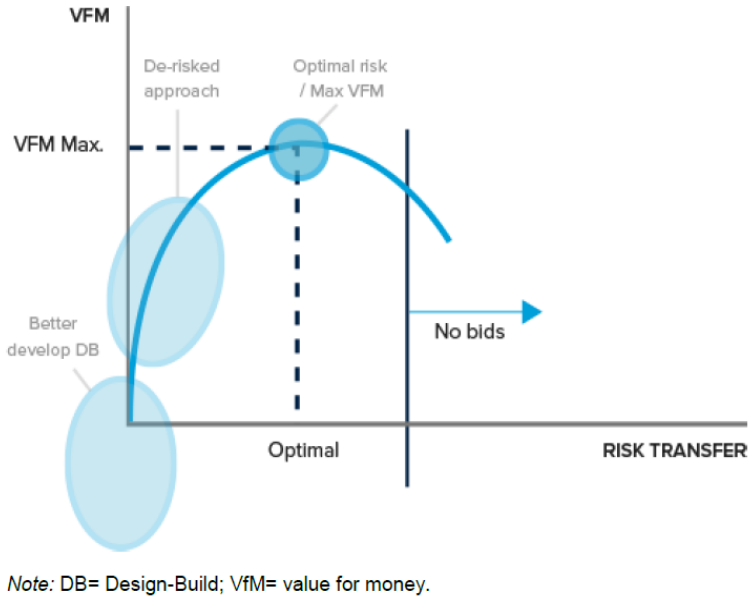


Figure 2.3.1 B: The Optimum Risk Allocation adopted from The World Bank Group (1996 in the PPP Guide, 2016, p. 83)

2.3.2 Risk Allocation Timeline in PPP

When does risk allocation actually happen? Bing et al. (2005) explained the timeline for risk allocation in the PPP project lifecycle (refer to Figure no. 2.3.2). After developing a PPP/PFI business case, the contract procurement steps are as below:

1- Start by advertising in the Official Journal **(OJEC)**.
2- **Shortlist of tenderers** will be developed according to the bidders' responses.

3- The Invitation to Negotiate **(ITN) is issued** to the selected tenderers. The ITN includes instructions to bidders, output specification, proposed contractual terms, evaluation criteria for bids, and an assumed risk allocation scheme in one of following forms: A simple list of risk factors, a risk matrix, and a risk allocation framework
4- At the same time a **negotiation** is required **with all tenderers** to clear up their proposals and to ensure that they comply with the requirements. Then every tenderer submit his ‘‘best and final offer’’ (BAFO) accordingly.
5- After evaluation of all BAFOs the best offer is selected, while keeping a second-option offer in case it is required later. The PPP/PFI proposition should be tested against the key risk transfer, VfM and project criteria.
6- **The final negotiations** then concentrate on the final detail and meeting the requirements of the project funders.
7- At the end of negotiation, the public partner and the selected tenderer finalize the risk allocation scheme; this scheme is enclosed in the **final contract**, and is binding by legal force.

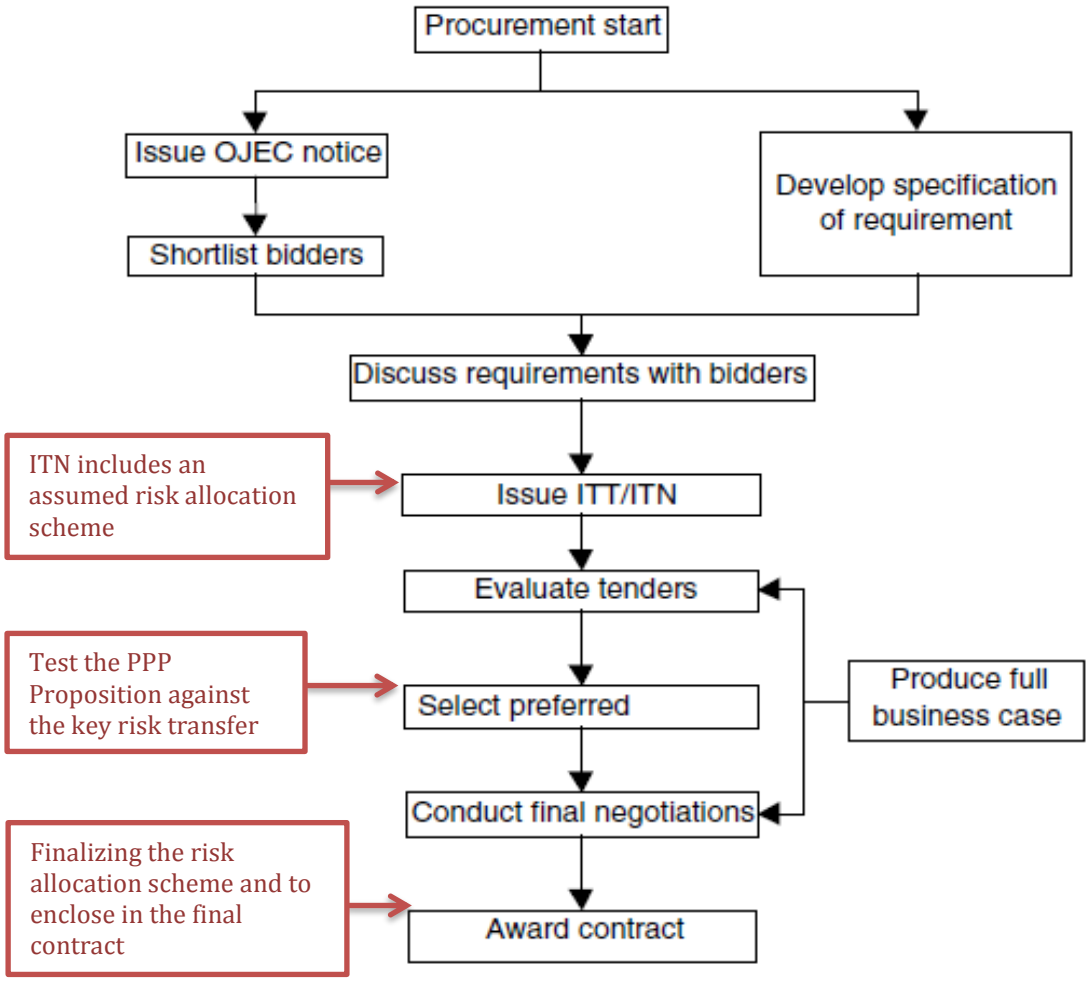


Figure no 2.3.2: PPP/PFI contract procurement process & Risk Allocation (Modified from the Source: HM Treasury 1995)

2.3.3 Risk Allocation Strategies:

Risk allocation has been debated by a large number of authors over many years (Boussabaine 2007). Xu et al. (2011) added that a many researches were devoted to search for suitable methods to facilitate risk allocation. The common accepted principle for risk allocation in PPP is to transfer the risk to the party who is best capable to efficiently manage the risk which leads to lowest risk charges (Li et al. 2005). However, determining the most capable partner for risk management is difficult (Lam et al. 2007) given the technical, legal, political, and economic complexity of infrastructure projects

and the range of constituencies involved. Governments often tend to transfer more risks to the private partner even though such allocation is inefficient (Yelin, Chan & Yeung 2010).

In fact, risk allocation is often transferred inadequately in PPP. Ng and Loosemore (2007). This poor allocation results from the government maintaining a competitive pressure between bidders so that the risk is transferred to the partner who is least able to refuse the risk instead of who is best able to handle it. On the other hand, Faulkner (2004 in Jin & Zhang 2011) argues that sharing risks instead of transferring them will create a win-win mutual profit which is one of the chief features of the ideal PPP.

The study reviews many risk allocation models and criteria. Some scholars study the essential criteria for optimum allocation, while others propose risk allocation models, and some scholars have developed a standard matrix to allocate the risks, as below:

- **Criteria for Risk Allocations:**

Some scholars set criteria or conditions in order to achieve proper risk allocation; these conditions are:

- Risk should be allocated to the party with **the best capability** to control the events that might trigger its occurrence.
- **Risks** must be properly **identified**, understood and evaluated by all parties.
- A party must have the **technical/managerial capability** and the **financial ability.**
- A party must be willing **to accept the risk**.

(Ward et al. [14], Edwards [15], and Flanagan and Norman [16] in Abednego & Ogunlana (2006).

Yelin, Chan & Yeung (2010) carried out a comprehensive literature review and identified 23 factors effecting the risk allocation in PPP projects. Then these factors were filtered and verified through interviews and Delphi Questionnaire Survey to identify nine risk allocation criteria. Table no. 2.3.3 A shows these factors:

Criteria for equitable risk allocation			
Capability of risk management	F1	Foresee the risk	The ability to foresee the probability of risk occurrence and evaluate possible severity of the risk consequence
	F2	Control the chance of risk occurrence	The ability to avoid, minimize, monitor, and control the chance of risk occurrence
	F3	Minimize the loss if risk occurs	The ability to minimize the loss if risk occurs (minimize the severity, extra cost, and delay)
	F4	Sustain the consequence	The ability to sustain the consequences of the risk
	F5	Bear the risk at the lowest price	The ability to bear the risk at the lowest price
Incentive mechanism	F6	Obtain reasonable premium	Be able to get reasonable and acceptable premium
	F7	Obtain intangible asset	Be able to enhance risk undertaker's credibility, reputation, and efficiency in risk management
	F8	Assume the direct loss	Be able to assume the direct loss
Risk preference	F9	Risk attitude	Risk should be allocated to the party who prefer to assume the risk (risk neutral, risk prone, or risk averse)

Table no. 2.3.3 A : Criteria for Equitable Risk Allocation, adopted from Yelin, Chan & Yeung (2010)

The risk attitude of the participants can be divided into three types: risk neutral, risk prone and risk averse. Participant attitude depends on the risk consequences so that when the risk impact is high the participants tend to be averse to risk while with small consequences the parties are prone to taking more risks. Risk assessment by identifying the risks and evaluating their impacts is the primary measure to assign the risks between the parties (Roumboutsos & Anagnostopoulos, 2008).

Alireza et al. (2014b), after reviewing 11 articles and conducting a questionnaire survey, they identified 15 significant criteria for optimal risk allocation and concluded that the following three criteria out of the 15 are the most important criteria: Bear the risk at lowest price, Control the chance of risk, and Risk attitude.

World Bank (1997) selected the following discriminative criteria for risk allocation:

1. The best able to influence and control the risky outcome.
2. The partner able to bear the risk at the lowest cost.

Boussabaine (2014) developed the following table which illustrates the following characteristics of PPP partners: capacity, skills, cost, return, advantage, and knowledge and recommended the following ownership strategy: reject, transfer, mitigate or own.

Ownership strategy	Capacity	Skills	Effort or cost	Return	Advantage	Knowledge
Own	Capital available to deal with owned risk	Capacity for both insight and foresight	Limited effort or cost	Expected return necessary to create a balance between good and bad times investments	Creates competitive advantage	Understand exposure
Mitigate	Adequate capital available and risks sought from other partners	Capability for effective management action	Tolerance and acceptance of cost	Low return but is necessary for developing skills and capabilities	Limited competitive advantage but risks sought other partners	Limited understanding of exposure
Transfer	Limited capital	Little skills and management capabilities	Not optimum to tolerate or accept costs	Minimal return and not wanted by partners	Little competitive advantage for the partner	Little knowledge and understanding of exposure
Reject	Risk's cost exceeds capital capacity of the partner	No skills and management capabilities	Large effort and unwanted risks	Negative outlook	No commercial advantage	No knowledge exists to manage exposure
						Risk ownership

Table no. 2.3.3 B Risk Ownership Strategy adopted from Boussabaine (2014) Page 104

- **Risk Allocation Models:**

Abednego & Ogunlana (2006) argue that risk allocation strategy is more than just deciding who should take the risks. Proper risk allocation should also determine the most appropriate time to allocate the risk and provide an alternative solution. Therefore, they propose a framework as shown in Figure no. 2.3.3 C which is based on four elements: Determining which party (WHO) has the best capabilities to accept (WHAT) risk, the (WHEN) and (HOW) factors should also be considered to ensure proper risk allocation.

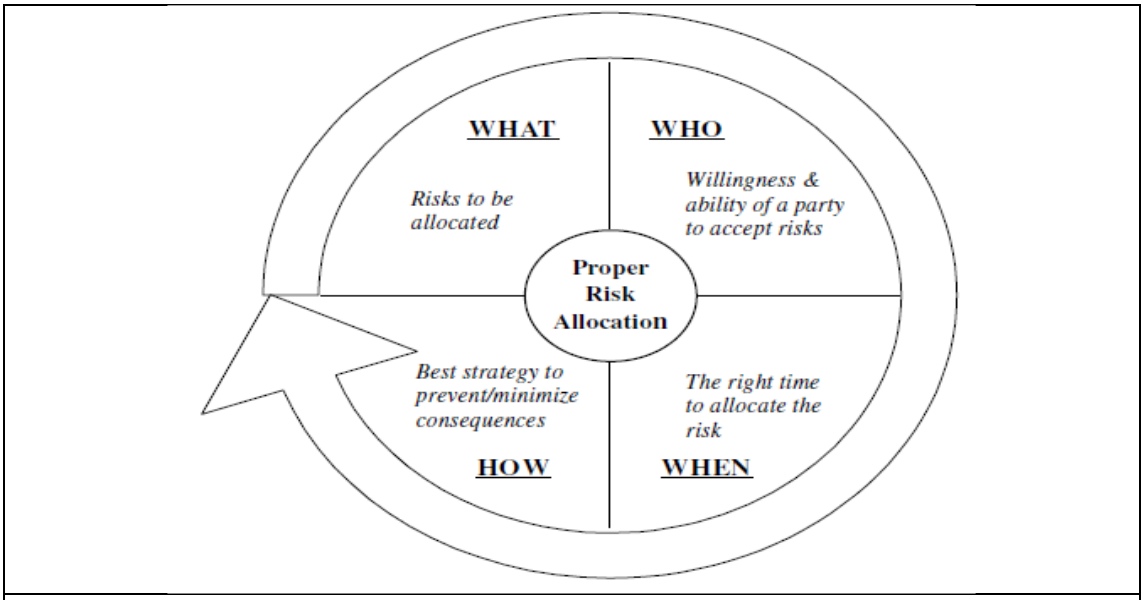


Figure no.2.3.3C : Concept of Proper Risk Allocation adopted from Abednego & Ogunlana, (2006)

Jin (2010) established a framework for risk allocation decision-making process based on the transaction cost economics (TCE) and the resource-based view (RBV) of organizational capability. Refer to Figure no. 2.3.3 D.

Five independent variables have been employed to determine the cost-efficient risk allocation strategy by economizing the transaction cost. Factors affecting the optimal risk allocation process are:

I. **Maturity of Partner's risk management**: Partner's capabilities to identify, analyze, monitor, and control risk events. The difference in risk management skills between both partners has a great effect on the risk allocation.
II. **Private Partner's risk management routines**: The capabilities of private partners to execute risk management activities without scarifying any productivity values.
III. **Cooperation history between partners**: Effective risk management requires time to be developed and relies on the partner's previous experience. So the degree of cooperation is evaluated by the number of projects where partners have cooperated and worked together.
IV. **Partner's risk management commitment**: This requires the commitment of the public partner and the private partner to manage the risk events. The commitment is measured by three indicators:
    - Partner's commitment to try harder to control risk (Ward et al., 1991);
    - Partner's confidence in handling risk (Barnes, 1983);

- Gains expectation when managing the risk (Abrahamson, 1973).

V. The last independent variable is the risk management **environmental uncertainties**: it is measured by 21 environmental factors which are categorized into the following groups: institutional, social and industrial, economic, and project-specific factors.

The proportion of potential risk depends on the level of these six variables which categorize each risk to the suitable governance structures (risk transfer proportions):

- If the proportion is closest to 100%, the best strategy is to transfer the risk to the private partner.
- If the proportion is closest to 0%, the best option is for the public partner to retain the risk.
- If the proportion is somewhere in between (50%), the best option is to share the risk between the parties.

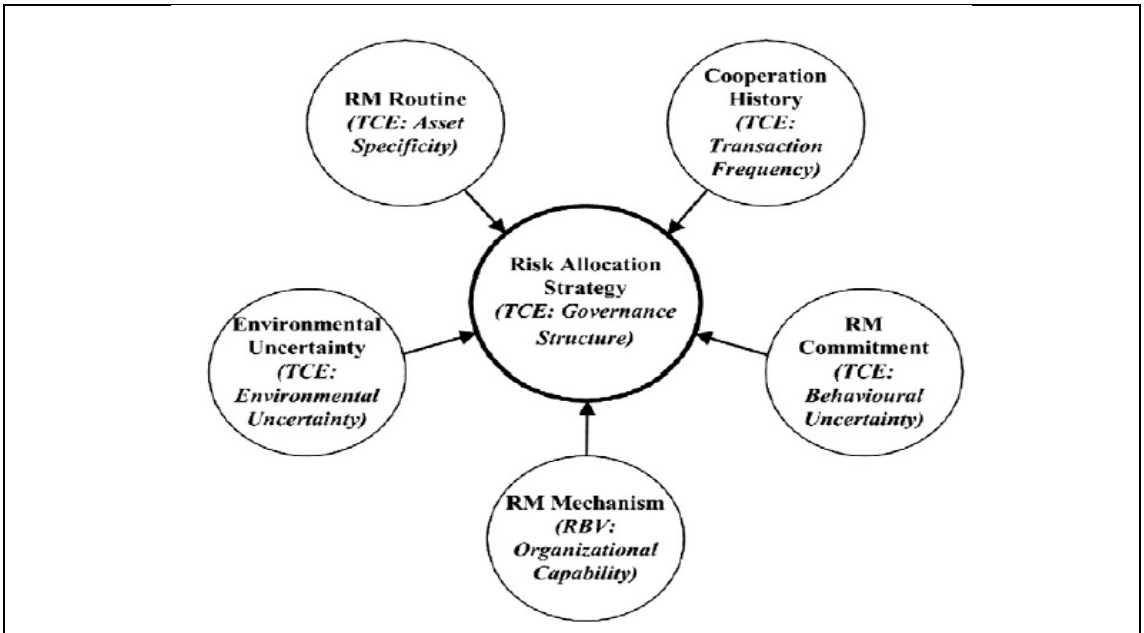


Figure no. 2.3.3 D: A framework for risk allocation Strategy in PPP projects. Adopted from Jin (2010)

The third model proposed by Bing et al. (2005) is shown in Figure no. 2.3.3 E, which is a combined proposal from Al-Bahar and Crandall (1990), Grant (1996), and HM Treasury (2000). In this frame:

- The public partner lists the risks, sets out the likelihood of risk occurrence and estimates the monetary implications. This enables the public partner to decide which

risk is to be transferred to the private partner. The initial risk allocation scheme is given to the short-listed tenderers along with project tender documents.

- When the selected tenderers receive the initial allocation scheme, the tenderers can quote the risks and then there will be one of two scenarios:
  - If the bidder price within the public partners' expectation then the contract can be awarded to the tenderer.
  - If the tenderers' price is not accepted, then the public partner either re-negotiates with the best-offer-tenderer, or re-schedules risks allocation.

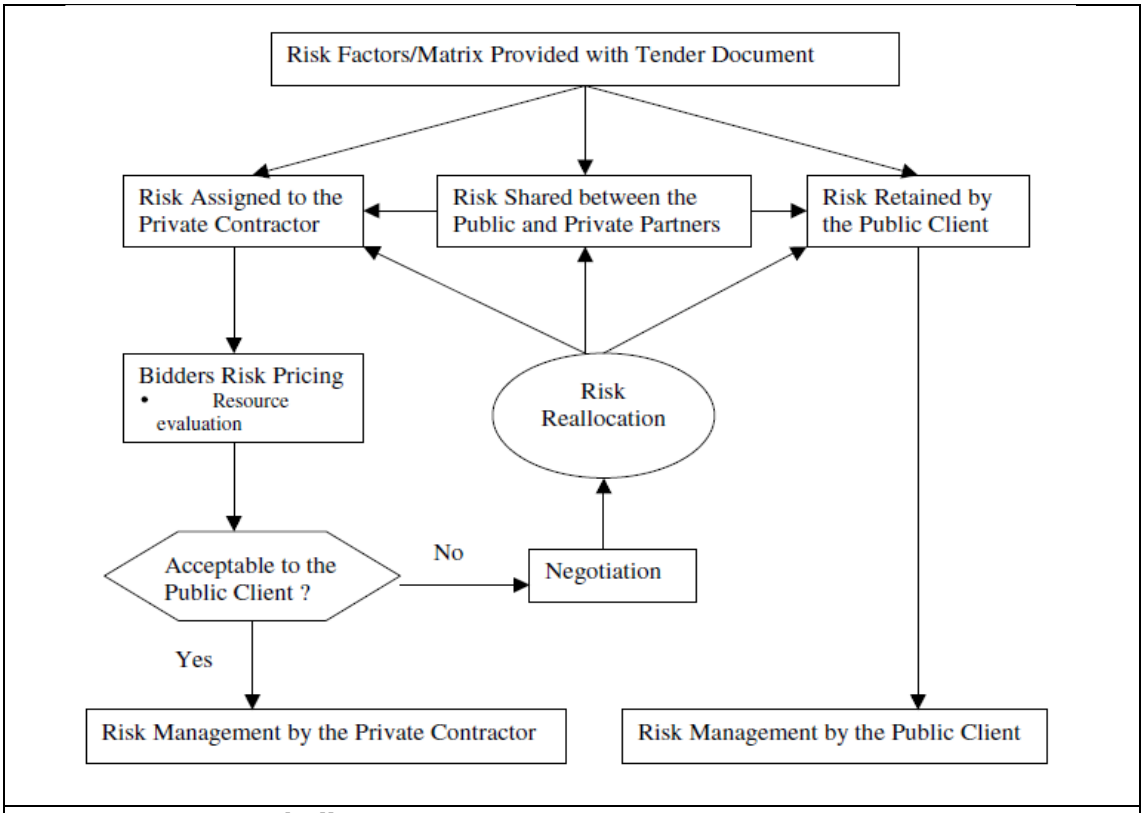


Figure no. 2.3.3 E: Risk allocation process in PPP/PFI contract procurement, Source: Bing et al. (2005)

Jin & Doloi (2008) concluded that the risk allocation decision was not directly driven by partners' RM capability. In fact, partners' risk management routine, risk management mechanism, risk management commitment, partners' cooperation history and business uncertainties associated with project risk management make the public partner choose to transfer more risks. Based on the following proposed framework:

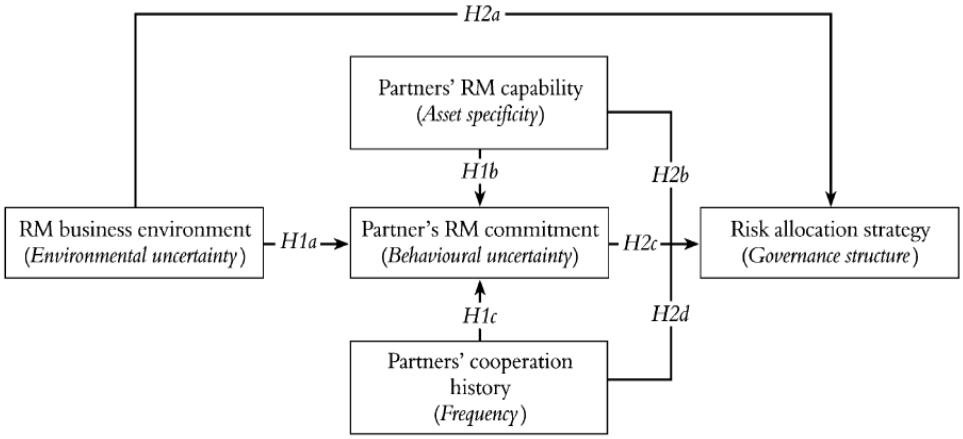


Figure no. 2.3.3 F: Theoretical framework for risk allocation in PPP projects, adopted from Jin & Doloi (2008)

Finally, Alzahrani (2015) studied the impact of risk costs on risk allocation in PPP projects, and he developed a Risk Allocation Heat Map based on the level of risk impact on construction cost. He concluded that for certain risks if the cost of a risk event is low, then this risk should be allocated to one party, while if the same risk incurs medium or high cost then the other party or sharing is the optimum risk allocation. Example is shown in Table no. 2.3.3 G. Accordingly, in Appendix (4) risk event (RP1) allocated to private partner if the risk price is low as a 1st preference, as 2nd preference when the risk cost is very low then transfer the risk to the private sector. However, if the risk cost is high then the risk to be shared is the 3rd preference.

RF	Risk Heat Map			
RPA37	VH	0	0	0
	H	6	0	0
	M	10	5	3
	L	10	19	2
	VL	3	9	1
		Public	Private	Share

Table no. 2.3.3 G: Map of Risk Allocation to Level of Risk Price, Adopted from Alzahrani (2015)

- **Risk Allocation Matrix/Scheme**

Carbonara et al. (2015) proposed the following matrix for risk allocation. He identified the eight most significant risks in PPP motorway projects and allocates them as shown:

Table 2. Key Risks Allocation matrix.

	Private	Equally shared	Public
3. Financial closure risk (project finance)	✓		
5. Construction risks			
5.1 Cost overrun	✓		
7. Revenue risks			
7.2 Demand/usage risk		✓	
9. Financial risks			
9.1 Interest rate increase	✓		
9.2 Inflation	✓		
9.4 Debt servicing risk	✓		
10. Force majeure risks		✓	
11. Regulatory/Political risks			
11.1 Changes in legislation		✓	

Table no. 2.3.3 H : Key Risk allocation Matrix adopted from Carbonara et al. (2015)

Li et al. (2005) distribution of the risk responsibility as the following:

- Public Partner Responsibility: site availability, political risks, relationship risks, force majeure risks.
- Shared Risk: the risk of legislation changes.
- Private Sector Responsibility: including the most of project risks, in particular the risks related to the project itself.

As well, Xu et al. (2011) proposed a simple method to allocate the risks as shown in the table below. When the risks are related to public sector action, they should be allocated to the government. Similarly, any risk that can be efficiently managed by the private sector should be borne by the private sector. Inflation risk, product price risk and inaccurate market forecast should be shared, as both sectors cannot handle these risks independently. Furthermore, some risk allocation depends on project circumstances, hence it is difficult to determine who should bear or share these risks: market demand change risk, contract document risk, and financing risk.

No	Risk factor	Risk Allocation			
		Government	Shared	Private	Undecided
R-1	Political risk	*			
R-2	Legal risk	*			
R-3	Government credit risk	*			
R-4	Market Demand Change Risk		*	*	√
R-5	Inflation risk		*		
R-6	Product price risk		*		
R-7	Inaccurate market forecast		*		
R-8	Contract risk	*	*	*	√
R-9	Financing risk		*	*	√
R-10	Supporting infrastructure risk	*			
R-11	Technical risk			*	

Table no. 2.3.3 I: Risk allocation matrix of Critical Risks Xu et al. (2011)

Su et al (2011) suggested the following preferred risk allocation as follows:

- Political, legal, government credit, and supporting infrastructure risks should be allocated to the government.
- Technical risk should be allocated to the private partner.
- Inflation risk, product price risk, and inaccurate market forecast risk should be shared between both partners.
- Market demand change, contract, and financing risk have no explicit allocation strategy, as these depend on specific project circumstances.

Chan et al. (2011) conducted an empirical survey to identify 34 risks confronting construction projects in Hong Kong and to choose the party who is best capable of managing each of these risks, i.e. client, contractor or shared. They concluded that risk should be allocated as following:

A) Risk allocated to client:

1) Change in scope of work;
2) Errors and omissions in tender document;
3) Inaccurate topographical data at tender stage;

4) Insufficient design completion during tender invitation;
5) Poor build-ability/constructability of project design;
6) Lack of involvement of main contractor in design development process;
7) Unforeseeable design development risks at tender stage;
8) Consequence of delayed payment to contractor.

B) Risks to be allocated to contractor

1) Difficult for main contractor to have back-to-back contract terms with nominated or domestic subcontractors;
2) Responsibility for quality;
3) Delay in availability of labour, materials and equipment;
4) Low productivity of labour and equipment;
5) Selection of subcontractors with unsatisfactory performance;
6) Change in interest rate on main contractor's working capital.

C) Risk to be shared between client and contractor and these risks divided into two categories :

C. 1) Risks out of both parties' control:

2) Inflation beyond expectation;
3) Global financial crisis;
4) Force majeure (Act of God)
5) Inclement weather;
6) Change in government regulations.

C. 2) Risks which both parties have potential to generate.

1) Delay in resolving contractual disputes
2) Disagreement over evaluating the revised contract price after submitting an alternative design by main contractor
3) Difficult to agree on a sharing fraction of saving/overrun of budget at pre-contract award stage
4) Lack of experience of contracting parties throughout TCC/GMP process

Ke et al. (2010) conducted comprehensive analysis of different allocation schemes by many scholars as shown in table no. 2.3.3 J

Risk factor		Lam et al. (2007)	Ng and Loosemore (2007)	Li et al. (2005)	Arndt (1998)	Wang and Tiong (2000)	NTSA (2004)	VDTF (2001)	Same
Political	Termination of concession by Government		Public			Public	Public		√
	Expropriation and nationalization		Private	Public		Public	Public		×
	Political opposition			Public			Public		√
	Change in law	Share	Private	Share	Share	Share	Share	Public	×
	Unstable government	Public		Public					√
	Project approval and permit	Private	Share		Share			Private	×
	Influential economic events			Private				Private	√
	Changes in industrial code of practices			Private	Share		Share	Private	×
Construction	Availability of finance			Private	Private			Private	√
	Improper design	Private	Private	Private	Private	Private	Private	Private	√
	Insolvency of subcontractors	Private		Private	Private	Private	Private		√
	Quality risk	Private	Private	Private	Private	Private	Private	Private	√
	Site safety	Private			Private				√
	Availability of labor/materials	Private		Private		Public			×
	Ground conditions	Public	Private	Private				Private	×
	Site availability	Public	Private	Public	Share			Private	×
	Construction/design changes	Private	Public				Public	Public	×
	Labor disputes and strikes	Private				Private		Private	√
	Land use		Public	Public			Public		√
	Waste of materials		Private	Private	Private				√
	Construction cost overrun		Private	Private	Private	Private	Private	Private	√
	Construction completion		Private	Private	Private	Private	Private	Private	√
	Supporting utilities risk		Public		Share	Share			×
	High financial cost			Private	Private	Private			√
	Unproven engineering techniques			Private	Private	Private	Private	Private	√
	Protection of geological and historical objects					Private		Private	√
Operation	Operation cost overrun		Private	Private	Private		Private		√
	Operator default		Private		Private	Private		Private	√
	Quality of operation		Private		Private	Private	Private	Private	√
	High maintenance cost			Private	Private		Private	Private	√
	Frequency of maintenance			Private	Private		Private	Private	√
	Low operating productivity			Private	Private	Private	Private		√
	Residual assets risk				Private		Private	Public	×
	Condition of facility					Private		Private	√
Legal	Contractual risk	Public				Share			×
	Third party tort liability	Public		Private					×
	Ownership assets		Private			Share	Private	Share	×
	Insolvency of Concession company					Private	Private		√
Market	insufficient income			Private	Private	Private			√
	Fluctuation of material cost (by government)		Public			Public	Public	Public	√
	Fluctuation of material cost (by private sector)		Private			Private	Private	Private	√
	Tariff change		Private	Private		Private	Private	Private	√
	Market demand change		Private	Private	Share	Private	Share		×
	Exclusivity					Share		Private	×
Economic	Inflation risk	Share	Share	Private		Share	Share	Share	×
	Interest rate		Share	Private		Share	Private		×
	Foreign currency exchange					Public	Private		×
Other	Force majeure		Share	Share	Share		Share	Share	√
	Residual risk		Public	Private					×
	Weather	Share		Private	Public		Public		×

Table no. 2.3.3J Comparative Analysis of Risk Allocation Preferences from Different Literature adopted from Ke et al. (2010)

Ke et al. (2010) conducted a survey and presented the survey feedback in table no. 2.3.3 K they concluded that no risk should be solely allocated to the private partner.

Allocation	ID	Category	Risk factor
Risks to be solely allocated to the public sector	3	Country	Expropriation and nationalization
Risks to be mostly allocated to the public sector	4	Country	Government's reliability
	2	Country	Government's intervention
	12	Country	Poor political decision-making
	13	Project	Land acquisition
	1	Country	Corruption
	14	Country	Approval and permit
	27	Project	Supporting facilities risk
	29	Country	Uncompetitive tender
	23	Project	Competition (exclusive right)
	8	Country	Change in law
	33	Country	Tax regulation changes
	7	Country	Immature juristic system
Risks to be equally shared by both parties	6	Country	Public/political opposition
	25	Project	Tariff change
	31	Country	Force majeure
	26	Project	Payment risk
	34	Country	Environmental protection
	37	Project	Insufficient financial audit
	36	Project	Subjective evaluation
	15	Project	Improper contracts
	11	Market	Inflation
	10	Market	Foreign exchange and convertibility
	21	Country	Ground/weather conditions
	24	Market	Market demand change
	5	Project	Third party reliability
	9	Market	Interest rate
Risks to be mostly allocated to the private sector	17	Project	Construction/operation changes
	28	Project	Residual assets risk
	32	Project	Organization and coordination risk
	30	Project	Consortium inability
	35	Project	Private investor change
	19	Project	Delay in supply
	18	Project	Construction completion
	16	Project	Financial risk
	22	Project	Operation cost overrun
	20	Project	Technology risk

Table no. 2.3.3 K Preferred Allocation of Risk Factors adopted from Ke et al. (2010)

Alireza et al. (2014a) tabulated 43 significant risks and allocated them based on survey results conducted for Malaysian PPP projects.

No.	Type of risk significant	Responses rate (%)			Allocation
		Private	Shared	Public	
1	Third party delays	14	64	22	Share
2	Shortfall in service quality	63	12	25	Private
3	Higher maintenance cost/frequent maintenance	69	12	19	Private
4	Operating cost overrun	71	6	23	Private
5	Low operating productivity	64	14	22	Private
6	Operational revenues below expectation	11	21	68	Public
7	Residual transfer value	23	56	21	Share
8	Poor contract management	13	67	20	Share
9	Changes in law & legislation	12	6	82	Public
10	Industrial regulatory change	30	13	57	Public
11	Changes in tax regulation	23	13	64	Public
12	Excessive contract variation	18	5	77	Public
13	Influential economic events	22	14	64	Public
14	Inflation	23	68	9	Share
15	Interest rates	12	20	68	Public
16	Poor financial market	24	61	15	Share
17	Delay in resolving contractual dispute	6	90	4	Share
18	Availability of material/labor	34	56	10	Share
19	Unproven engineering techniques	29	13	58	Public
20	Failure of commissioning test	13	68	19	Share
21	Failure to meet performance criteria	59	12	29	Private
22	Design default	68	23	9	Private
23	Construction cost overrun	84	10	6	Private
24	Construction completion delay	71	12	17	Private
25	Environment	14	64	22	Share
26	Force majeure	15	68	17	Share
27	Weather	22	73	5	Share
28	Inadequate experience in PPP/PFI	25	62	13	Share
29	Lack of coordination & commitment	10	58	32	Share
30	Availability of project finance	15	63	22	Share
31	Sponsor suitability risk	13	64	23	Share
32	Delay in resolving litigation or arbitration dispute	9	77	14	Share
33	Changes in ownership	0	18	82	Public
34	Expropriation/nationalization of assets	22	14	64	Public
35	Poor public decision-making process	0	9	91	Public
36	Unstable government	2	14	84	Public
37	Strong political opposition & interference	11	13	76	Public
38	Changes in demand for output	23	56	21	Share
39	Public opposition to project	18	14	68	Public
40	Land use	9	32	59	Public
41	Site/Geotechnical conditions	21	64	15	Share
42	Site availability & preparation	32	64	4	Share
43	Customs and import restrictions	23	68	9	Share

Table no. 2.3.3 L The Identified Significant Risks and Allocation in Malaysian PPP Projects. Adopted from Alireza et al. (2014a)

- **Overview of Risk Allocation Criteria**

According to the literature review the following criteria are proposed by scholars for optimum risk allocation and summarized in the following table.

No.	Authors / Criteria	Abednego & Ogunlana (2006).	Yelin, Chan & Yeung (2010)	Alireza et al. (2014b)	Boussabaine (2014)	Jin (2010)	Bing et al. (2005)	Jin & Doloi (2008)	World Bank (1997)	Alzahrani (2015)	**Total**
1	Partner Ability in terms of Technical & financial capability to control the chance of risk & loss	1	1	1	1		1		1		**6**
2	Risk Attitude	1	1	1							**3**
3	Incentive mechanism/return		1		1						**2**
4	Lowest or Best Risk price			1			1		1		**3**
5	Risk cost				1					1	**2**
6	Commercial/competitive advantages				1						**1**
7	Transaction cost economics (TCE) and the resource-based view (RBV)					1					**1**
8	Maturity of Partners' risk management:							1			**1**
9	Private Partner's risk management routines							1			**1**
10	Cooperation history between partners							1			**1**
11	Partner's risk management commitment:							1			**1**

Table no. 2.3.3 M: Risk Allocation Criteria

According to the above table, the most preferred criteria for assessing risk allocation are: Partners' ability, Risk attitude, Risk Return, Best Risk Price and Risk Cost.

2.3.4 Challenges Encounter Risk Allocations in PPP

Although many risk allocation techniques have been suggested to allocate risk appropriately in PPP projects, still these models cannot be generalized because risks have to be analyzed and managed based on a project-by-project basis (Carbonara et al. (2015).

And they recommend we need to focus on a specific PPP sector, i.e. transportation projects, and define a list of significant risks in this PPP sector, prepare a practical risk allocation framework and identify the most suitable mitigation strategies.

The second challenge is that risk allocation changes continuously according to the project context. Therefore the partnership should relays on the mutual trust and benefit which is more critical than drawing attention toward the optimal risk allocation. The project participators should pay more attention to the overall balance of risks and benefit (Xu et al. 2011).

Efficient risk allocation can be attained when the risks are limited or past experiences are available for the parties. This indicates that PPP is suitable for traditional projects, i.e. prison services and educational services, and less likely to deliver highly innovative or complex projects where uncertainties are high (Lossa & Martimort (2012). Alireza et al. (2014b) identified three barriers for optimal risk allocation, which are: lack of efficient risk allocation mechanism, not realizing the optimum risk benefits, and different information about project risks. Many other authors discussed other barriers such as insufficient negotiation, lack of good communication, and lack of trust, cooperation and teamwork (Alireza et al. 2014b).

2.4 Risk Estimation in PPP Projects

We need to understand the relationship between risk allocation and risk estimation and how they impact the VfM. We need first to understand some related terminologies: Risk contingency is an extra cost that adds to the project's estimated budget to cover future cost overruns. There are many techniques for quantifying construction risk, including: Deterministic methods, Probabilistic methods, and Fuzzy Logic. (Baccarini 2006 in Makovšek & Moszoro, 2016).

Construction contingency is estimated subjectively by experts who assign risks, probabilities and impacts, although it is the common method to calculate the risk cost but it is difficult to measure the accuracy of contractors' perceptions of the risk.

Makovšek & Moszoro (2016) stated that many scholars analyze PPP projects and support the claim there is trouble in risk pricing in PPP projects, e.g:

- Vecchi, Hellowell, and Gatti (2013) analyzed 77 PPP hospital projects in UK, and found out the ex post facto revenues were above the expected returns with an average of 9.3% (range from 4.5% to 17.4%).
- Blanc-Brude, Goldsmith, and Valila (2009) reviewed construction cost for 162 traditionally procured projects and 65 PPP projects in Western Europe and concluded that PPP projects were 24% more costly.
- Daito and Gifford (2014) found the PPP project cost 64% more than traditionally procured projects in USA.

In addition, the excessive allocated budget for risks on VfM analysis has come under auditing in Ontario by the Provincial Auditor General. The auditor concluded that the costs of risk allocation were exaggerated when comparing the government estimation of risk transfer for a hospital project as 13% project budget to past similar projects with 5% of the contract value. Siemiatycki & Farooqi, (2012).

The conclusions above imply that risk pricing in PPP is notably inefficient. Figure no. 2.4 shows a comparison between the construction costs for traditionally procured and PPP projects. The unexplained cost difference results from insufficient risk allocation.

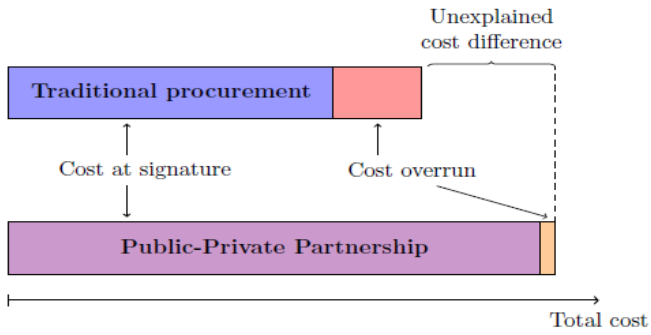


Figure no. 2.4A: Comparison of Construction Cost Between Traditional Procurement and PPP adopted from Makovšek & Moszoro 2016

Makovšek & Moszoro (2016) justified the higher costs in PPP projects than for equivalent traditional procurement due to the failure in quantifying risk, insufficient competition and inadequately transferring the PPP risk, which implied competition and embedded a high risk premium. They determined the elements for efficient risk pricing in PPP projects:

(i) The level of competition between bidders: this can be evaluated easily as the information is available from the consortium's bidding.

(ii) How the investors/lenders understand and price risk: it is difficult to evaluate because of the complexity and diversity of the risk within the PPP consortium.

Zou et al. (2008) illustrate the relationship of risk allocation, project efficiency and project cost as shown in the figure below.

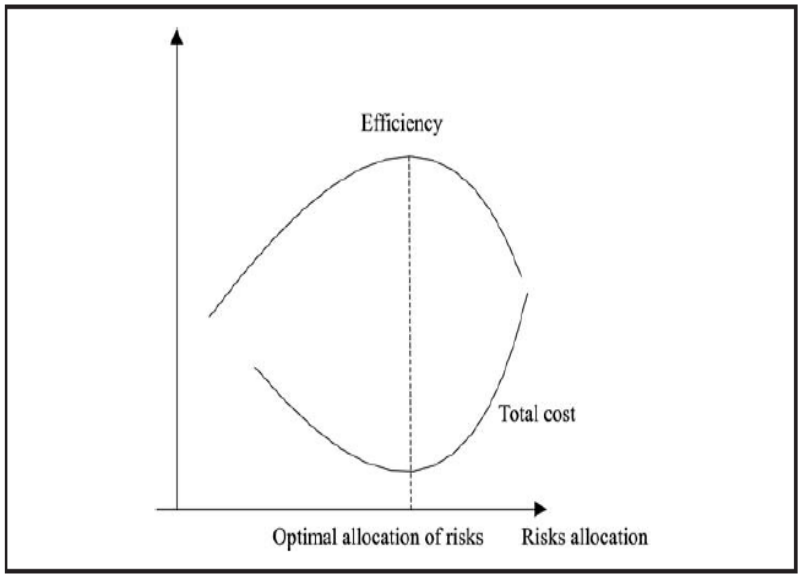


Figure no. 2.4 B : Risk Allocation Versus Project Efficiency and Total Cost adopted from Zou et al. (2008)

The following elements are essential to enhance the risk estimation in PPP:

1- Availability of the state's estimation of enhanced bidders' readiness to lower their contingencies and generally winning bids were reduced by 11% for risky projects, e.g. when Oklahoma's Department of Transportation announced the internal estimates during the tendering stage (Flyvbjerg 2009 in Siemiatycki & Farooqi 2012).

2- Proper risk transferring will reduce transaction costs (Zaghloul and Hartman, 2003 in Jin & Zhang 2011). Transaction costs are the running costs of the economic system (Arrow, 1969 in Jin & Zhang 2011). So improper risk allocation increases the transaction cost as following:

I. Bidders will increase the contingency fund in the bid price.
II. Client needs more resources to monitor the risks.
III. Additional costs for improving bad quality work for a given price.

IV. The contractors increase safeguards against opportunistic exploitation of one party's risk management service by another.
V. Contractor will devote a staff to file and manage claims related to the miss-allocated risk.
VI. Additional costs due to disputes or litigation resulted from the misallocated risk.

2.5 Summary

Despite PPP's numerous benefits PPP projects encounter a high degree of risk and many scholars claim there are concerns regarding risk pricing. This leads to PPP projects becoming more costly in comparison to traditionally procured projects. Risk allocations have been debated by a large number of authors over many years and substantial numbers of studies were devoted to seek appropriate approaches to facilitate risk allocation. As a result, many models have been developed which face numerous challenges; they cannot be generalized and risk allocation can be uncertain and can change continuously.

Risk allocation is defined as a process of assigning the responsibility of a specific risk to one party or more in the contract. Whereas optimal risk allocation is defined as transferring the risk to the party who is best able to manage it at least cost. Efficient risk allocation can be attained when the risks are limited or the parties have past experience; this indicates that PPP is suitable for traditional projects and less suitable for highly innovative or complex projects. The VfM in PPP projects can be mainly achieved by transferring risks effectively from the public to the private sector; but in reality the private sector overestimates the risks associated with the project which leads to higher project costs, so the benefit from VfM is lost.

As such in this chapter a list of risk events and a list of evaluation criteria necessary for optimum risk allocation in PPP projects have been devolved. As well as that, we have taken an in-depth look at risk allocation models and strategy.

3. Conceptual Framework

Reaching an agreement for risk allocation between the public and the private sectors is a complex procedure which results in longer negotiation periods and higher transaction cost. This thesis proposes a conceptual framework illustrated in Figure no. 3.1 to allocate all risks effectively in PPP projects according to the proposed criteria.

The conceptual framework is a written or visual presentation that "explains either graphically, or in narrative form, the main things to be studied – the key factors, concepts or variables and the presumed relationship among them" (Miles & Huberman 1994, p18). Hence, this model is constructed to be used during the tendering stage to enable the parties to reach a consensus in risk allocation and to avoid long renegotiation.

The first step as per the proposed model is to identify all risk events related to the project (Refer to Table no. 2.2.4), then to determine the main criteria to achieve optimum risk allocation (Table no. 2.3.3 M), where the partners need to analyse each risk according to:

1. Risk Cost Impact: As proposed by Alzahrani (2015) and Boussabaine (2014). The potential level: High cost, Medium cost and Low cost.
2. Lowest Risk Pricing: The range is whether the cost is accepted by public partner or not. As proposed by Alireza et al. (2014b), Bing et al. (2005), World Bank (1997).
3. Best partner able to manage: As proposed by Abednego & Ogunlana (2006). Yelin, Chan & Yeung (2010) ,Alireza et al. (2014b), Bing et al. (2005), World Bank (1997) and Boussabaine (2014). The potential response: Public, Private and Sharing.
4. Return: As proposed by Yelin, Chan & Yeung (2010) and Boussabaine (2014). The potential return: Negative Return, Low Return and High Return.
5. Risk Attitude: As proposed by Abednego & Ogunlana (2006). Yelin, Chan & Yeung (2010) and Alireza et al. (2014b). The potential attitude: Risk Neutral, Risk Prone and Risk Averse.

The study's scope will be limited to study three criteria out of five: cost of risk, partner's ability and partner attitude. According to the survey feedback we will determine optimum risk allocation according to these three criteria.

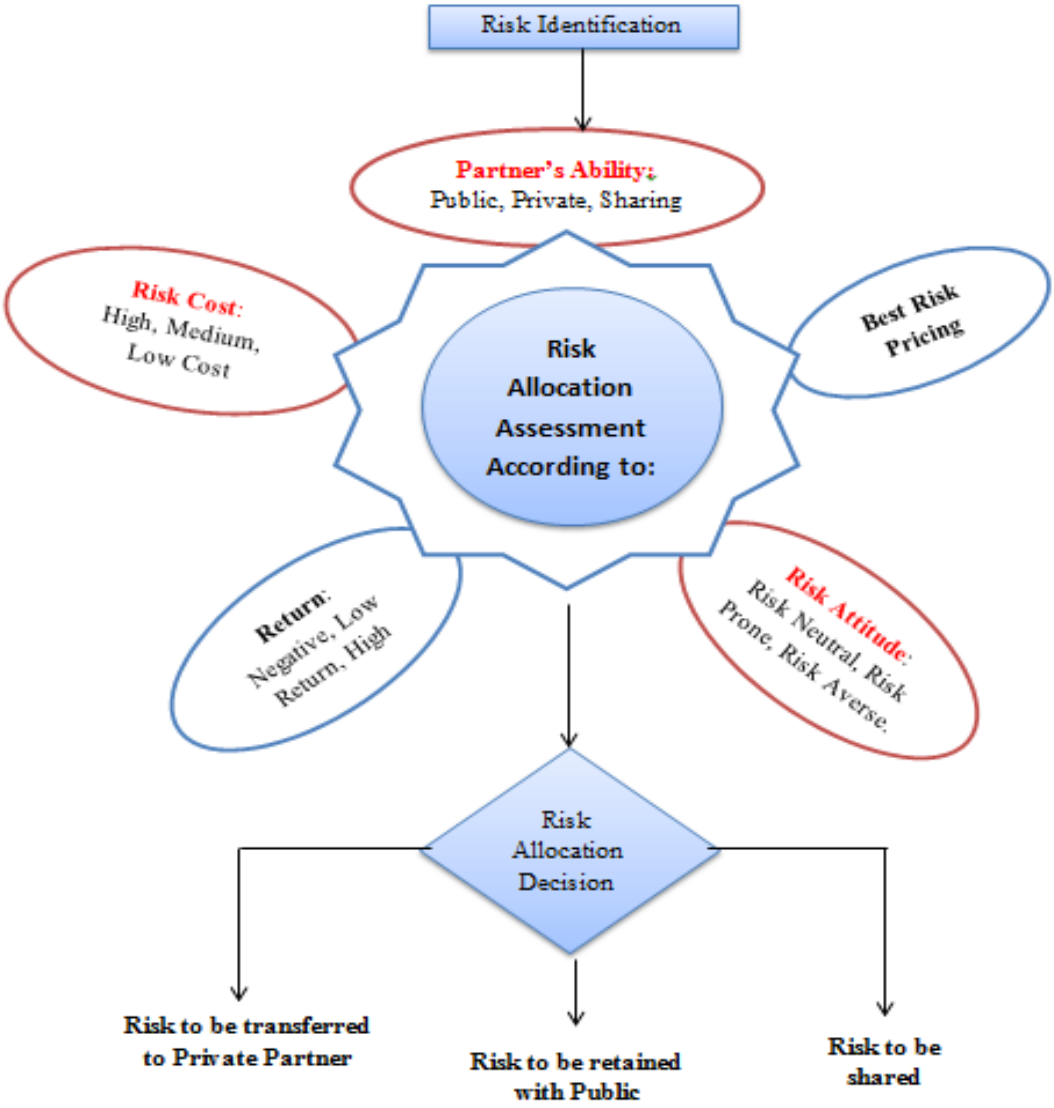


Figure no 3.1 : Study Proposed Conceptual Framework.

4. Research Methodology

4.1 Introduction

The research methodology is critical to the success of any research work (Bell 2005). In general, there are two research paradigms used in research namely: qualitative, quantitative paradigms, or by employing hybrid techniques, which is called triangulation (Park & Park 2016). Yao (2004 in Alzahrani, 2015) and Flick (2009, p. 405) stated that hybrid techniques improve the strength of any research.

At the outset, we need to understand three terminologies: Research; Quantitative technique; and Qualitative technique. Research is "a systematic process of critical enquiry leading to valid propositions and conclusions that are communicated to interest others" (McLeod 1994). Quantitative research refers to systematic empirical investigation of phenomena using statistical, mathematical or computational techniques. Qualitative research generally deals in words, images and the subjective (Flick, 2009, p. 41). In qualitative studies, research questions typically orient to cases or phenomena, seeking patterns of unanticipated as well as expected relationships. In quantitative studies, the research question seeks out a relationship between a small numbers of variables (Flick, 2009, p. 41). The quantitative technique is useful for questions of 'what?'(e.g. what number or percentage of…) . In contrast, qualitative is associated with 'why?' questions (Barnham, 2016). Table .4.1 shows brief comparison between quantitative and qualitative research:

	Quantitative	Qualitative
Principal orientation to the role of theory in relation to research	Deductive; testing theory	Inductive; generation of theory
Epistemological orientation	Natural science model, in particular positivism	Interpretivism
Ontological orientation	Objectivism	Constructivism

Table 4.1: Differences Between Quantitative and Qualitative Research, adopted from Bryman and Bell, 2011, p. 27.

In this chapter, we will describe the adopted methodology and the procedures for data collection to answer the research questions. The quantitative and qualitative paradigms have been employed for this study. The critical review and comparative analysis are used to develop a comprehensive risks register and list of criteria impacting risk allocation, while the quantitative paradigms is used to reflect the consensus between the PPP experts in each risk allocation as the empirical feedback is used as a proof for optimum risk allocation. Kothari (2004, p.8) emphasizes the importance of justifying the selected research method, and clarifying why a particular technique has been employed for the research will enable the author and scholars to evaluate the study's results.

4.2 Research Methodology Flow

The flow of the research methodology for this study is schematically illustrated in Figure no. 4.2; the study consists of four phases:

1- Literature review: Where we have an introduction about the PPP, VfM and risks in PPP, then the study identified all potential risks in PPP projects and reviewed many risk allocation schemes, models and criteria. Last subsection is to understand the relationship between risk allocation and risk estimation.
2- Comparative analysis to identify all risk events faces PPP projects and the main criteria of risk allocation.
3- Questionnaire survey: In this task the questionnaire survey was developed in order to gather experts' views & feedback.
4- Analyzing data from the completed returned questionnaire with simple statistical techniques using the heat map and percentage of responses for each criteria.

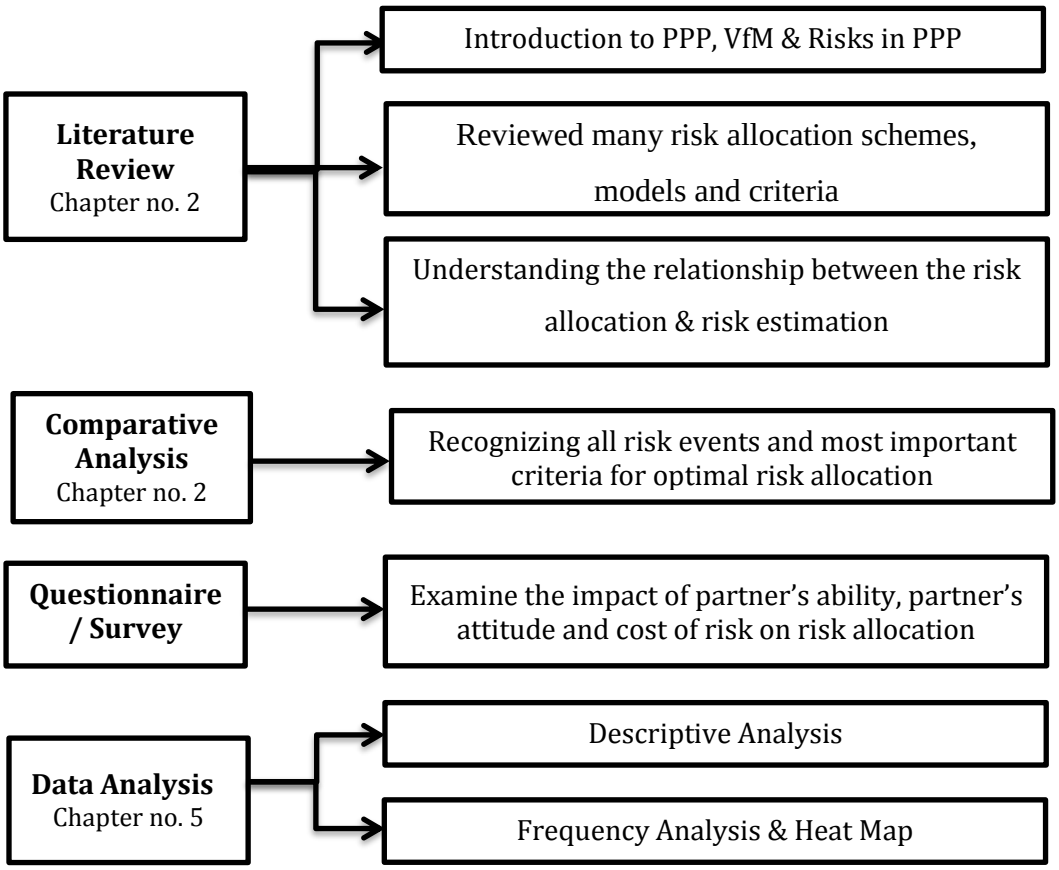


Figure 4.2: Research Flow.

4.3 Questionnaire

This study aims to outline the relationship between the cost of risk, risk attitude and partner ability with risk allocation. As such, a quantitative research approach was selected by the author to analyze the collected data from PPP projects in the UAE to ensure data validity and allows for generalizing the results. The survey/questionnaire is one of the best methods of quantitative techniques which are used to describe the specific characteristics of a large group of persons, objects, or institutions and to understand present conditions, rather than the effects of a particular intervention. The survey can be carried out by mail, telephone, face-to-face, and web-based-survey (Park & Park 2016). The topic needs deep knowledge and experience in PPP projects, therefore the author has selected to distribute the survey via email and LinkedIn in order to control sending the questionnaire and receiving the responses to/from PPP experts ONLY.

In general, the internet survey/questionnaire has many advantages as stated by Wright (2005). The Internet provides access to people who would be difficult, if not impossible, to reach through other channels. It enables the researcher to get many responses in a short period and it offers cuts down on costs. Fricker & Schonlau (2002) added that internet surveys are conducted more quickly, effectively, cheaply, and/or easily than surveys conducted via conventional modes. However, there are some disadvantages: for example, relatively little may be known about the characteristics of the participants (Wright 2005).

This e-mail questionnaire consists of four parts (as shown in Appendix no. 2):

- Firstly, background questions about the respondents.
- 2nd, 3rd and 4th sections are designed to explore the influence of the partner's ability, cost of risk and partner's attitude in risk allocation in PPP according to the respondent's experience and knowledge. These variables are called Categorical variables - Nominal scale.

4.4 Research Sampling

Purposive sampling can be applied when the population is too small for a random sample (Tran & Perry 2003 in Tongco 2007). Since PPP experts (the population of this study) are scarce in the UAE, the author has selected purposive random sampling for data gathering. And as the entirety of the questionnaire respondents are experts in PPP projects, the validity of the collected data can be reasonably inferred (Bing et al. 2005).

Purposive sampling is an informant selection tool, also called judgment sampling. It is a nonrandom technique deliberately chosen by the author as the study needs certain feedback from particular people who can provide the information by virtue of their knowledge or experience (Bernard 2002). Tongco (2007) asserted the bias in the purposive sampling and the interpretation of results is limited to the population under study, as such, it is essential to clearly affirm the bias in the study results to avoid inferring general conclusions (Bernard 2002).

Both random and purposive sampling may be combined to produce a powerful method of sampling (Albertin & Nair 2004). Such sampling was used by Zhen et al. (2006 in

Tongco, 2007) as they purposively chose four communes for their study and for each commune they randomly chose one village per commune to respond to their survey. Similarly for this study, we chose 33 companies that are involved in PPP projects in the UAE but the participants were randomly selected from each company.

4.5 Delivering/Collecting the Questionnaire

The research instrument was sent out to 33 companies which have participated in PPP projects and more than 400 professionals working in the UAE. The participants were well briefed on the survey's purpose and the privacy and anonymity of the participants and companies was guaranteed.

The survey was completed and returned by 23 participants with a response rate of nearly 5% which was slightly lower than that achieved by an earlier survey dealing with PPP which was around 10% (IPPR 2000). Bing et al. (2005) argue that a response rate of 10% is not untypical of comparable research and the collected data was considered sufficient for descriptive analysis. Finally, the participants' profile and experience are provided in the subsequent chapter in section (5.2) "Descriptive Statistic".

4.6 Data Analysis

The questionnaire is intended to determine the impact of risk cost, partners' attitude and partners' abilities on risk allocation. As mentioned earlier those three criteria have been identified based on the literature review. Analysis of the collected data consists of two tasks: Frequency Analysis and Heat Map. Further descriptions about those analyses are mentioned in the following sub-sections. All these analyses will be handled using the Statistical Package for Social Sciences (SPSS) and Microsoft Excel.

4.6.1 Descriptive Statistics

The descriptive analysis is used to graphically represent the demographic data of respondents. For this study the frequency distribution table and bar chart will be employed to organize and summarize the general information of participants. This analysis can be

conducted by the Statistical Package for the Social Sciences (SPSS) by following the commands: *Analyse < Descriptive Analysis < Frequencies……..*

4.6.2 Frequency Analysis

The participants were requested to allocate the risk events to the Private partner, Public partner or Sharing according to the three criteria mentioned earlier. Then the total score of each allocation options for each risk was calculated in order to relatively rank the options according to the respondents' preference. The ranking method enables an objective assessment.

Frequency analysis is used for multiple choice questions, by calculating the percentage of respondents. The percentage will reveal the unity in opinion amongst the participants. The percentage is calculated as following:

Percentage of respondent = $\frac{\text{Frequency of Responses}}{\text{Total of Respondents}} \times 100\%$ Alireza et al. (2014a)

Then the data will be reflected in a Frequency Distribution Table. A subjective presumption should be adopted by specifying a minimum response rate. The minimum response rate of 55% is adopted from previous studies (Kangari 1995; Kartam and Kartam 2001; Andi 2006; and El-Sayegh 2008 in Alireza et al., 2014a).

4.6.3 Heat Map

The heat map is a popular technique for displaying the ranking and frequency analysis. Zhao, et al. (2014) defined the Heat Map as "a graphical representation of data where the individual values contained in a matrix are represented as colours", Wilkinson and Friendly (2009) defined the cluster heat map as:

"[A]n ingenious display that simultaneously reveals row and column hierarchical cluster structure in a data matrix. It consists of a rectangular tiling, with each tile shaded on a color scale to represent the value of the corresponding element of the data matrix".

Also, they stated that the cluster heat map is created by statisticians in late 19th century, and it is most used for bioinformatics displays, this affirmed by Cerdas et al. (2017) as well. It consists of several rectangles that are shaded on a colour scale to represent the collected data (Wilkinson & Friendly 2009).

Rajaram and Oono (2010) confirm that the clustered heat map has become yet the most widespread visualization technique. They justified this popularity because the heat map helps to understand and represent large amount of information simply by two variables, which facilitates exploring the hypothesis between the variables. On the other hand, it has some major flaws as it uses cluster analysis which always disrespect the intrinsic relations in the data and that sometimes leads to incorrect conclusions.

In this study, after completing the frequency analysis we will develop the required heat map for all proposed criteria to explore their impact on risk allocation in PPP projects. The advantage of the visualization feature is to directly find out the criteria's influence on risk allocation by observing the different colours of each rectangle, as similar values or vastly different values are easily visible (Wilkinson & Friendly 2009).

4.7 Summary

The quantitative and qualitative paradigms have been employed for this study, by including critical review, comparative analysis and questionnaire. The author has selected purposive random sampling for data gathering as the study needs certain feedback from PPP experts. To achieve that the email survey was selected in order to ensure that all respondents are experts in PPP.

The study response rate is nearly 5% that is not untypical of comparable research as the response rate is 10%. Moreover, as the entirety of the respondents is PPP experts, the validity of the collected data is reasonably inferred. The collected data will be analysed using frequency analysis and a heat map which will be discussed further in the following chapter.

5 Finding and Data Analysis

5.1 Introduction

In this chapter we will analyse the collected data and assess the impacts of the proposed criteria in risk allocation in PPP projects based on the respondents' position, experience, job title, and type of PPP contracts. The following analyses have been selected to achieve the study aim by employing frequencies and heat maps.

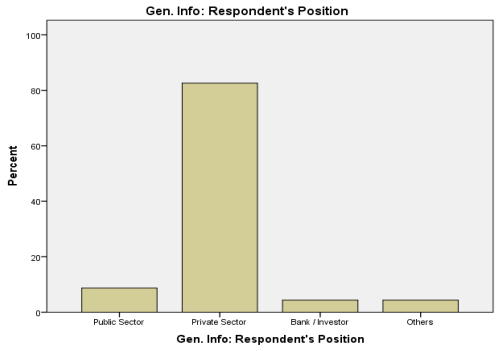
5.2 Descriptive Statistics

From Part 1 of the questionnaire, four main general characteristics about the participants have been collected. The Frequency Distribution Table below shows these demographic data and respective frequencies:

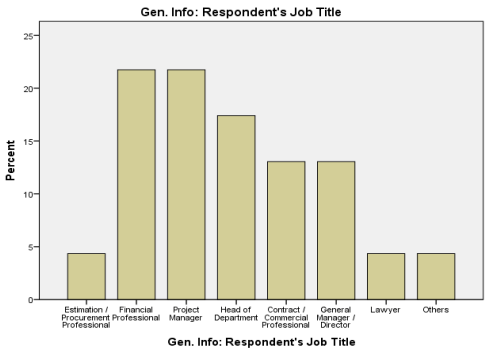
	Characteristic	Respondent's Position	Job Title	Experience in PPP	Type of PPP
1.1	Public Sector	8.7%			
1.2	**Private Sector**	**82.6%**			
1.3	Bank / Investor	4.3%			
1.4	Others	4.3%			
2.1	Estimation/ Procurement Professional		4.3%		
2.2	Project Manager		21.7%		
2.3	Contract/ Commercial Professional		13.0%		
2.4	Financial Professional		21.7%		
2.5	Head of Department		17.4%		
2.6	General Manager / Director		13.0%		
2.7	Others		8.6%		
3.1	Less than 3 years			21.7%	
3.2	3 -10 years			21.7%	
3.3	11 – 15 years			26.1%	
3.4	More than 15 years			30.4%	
4.1	**Build, Operate & Transfer**				**65.2%**
4.2	**Design, Build, Finance & Operate**				**73.9%**
4.3	Service Contract				39.1%
4.4	Leasing Contract				26.1%
4.5	Management Contract				30.4%
4.6	Others				4.3%

Table no. 5.2 A : Frequencies Distribution Table for Respondents' Characteristics – Self generated

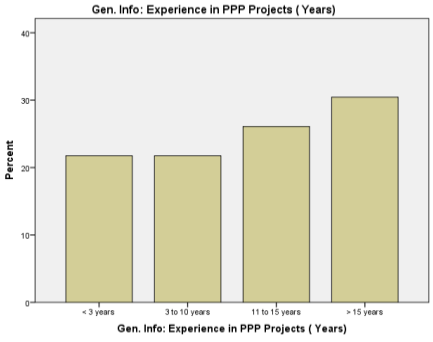
According to the descriptive analysis, the majority of respondents are working in the private sector (a percentage of 82.6% as highlighted above). Such a high percentage of private-sector respondents can explain the shift in the respondent's perspectives and lead to imbalance in the assessment of risk allocation and influence of the proposed criteria. Moving into the 2nd & 3rd characteristics, namely job titles and experience in PPP, the frequencies of job titles and experience are evenly distributed and no one category dominates the study results. Finally, more than two-thirds of participants are expert in BOT and DBFO projects, and about a quarter are expert in other types of contracts. The following bar chart illustrates the frequencies of each characteristic:



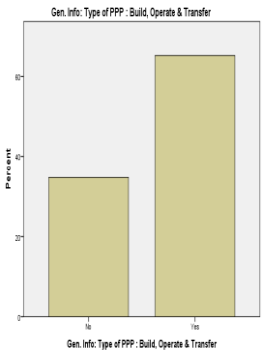
Respondents' Position



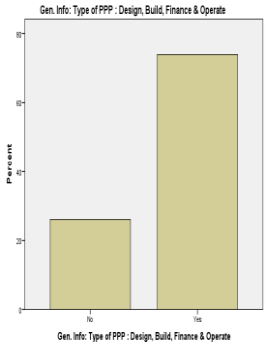
Respondents' Job Title



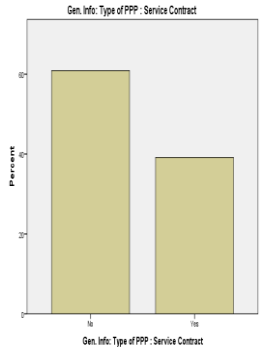
Experience in PPP



PPP Type: BOT



PPP Type: DBFO



PPP Type: Service Contract

Figure no. 5.2 B: Bar Chart for Respondent's General Information

5.3 Data Frequencies Analysis and Heat Map

The influence of each proposed criteria in risk allocation will be analysed using SPSS and Microsoft Excel to develop the frequencies distribution tables according to the respondents' frequencies that have been collected in 2nd, 3rd and 4th parts of the questionnaire.

5.3.1 Impact of "Cost of Risk" on Risk Allocation

In this section, we will investigate the impact of risk cost on risk allocation in PPP projects based on data collected in part 2 of the questionnaire. The data then is summarized in a matrix format for each risk. In every cell in the matrix, the percentage of responses for each risk cost and allocation is computed by SPSS in order to develop the frequency distribution table. The result of this exercise is described in details for Design Risk: Change in Output Specification, then an overall table is developed in the next step.

Design Risk: Changes in output specification

Risk Cost	Frequency of Risk Allocation			Total	Risk Allocation		Does Cost Impact Risk Allocation
	Public	Private	Sharing		1st Pref	2nd Pref	
Low	13.0%	8.7%	0.0%	**21.7%**	Public		**No**
Medium	13.0%	4.3%	8.7%	**26.1%**	Public		
High	43.5%	8.7%	0.0%	**52.2%**	Public		
Total	**69.6%**	**21.7%**	**8.7%**				

The above table reveals that 43.5% of respondents believe that this risk could cause a High cost and should be allocated to the Public partner. 13% believe it could result in a Medium or Low cost and should be allocated to the Public partner. As such, overall 69.6% of participants agree that this risk should be allocated to the Public partner regardless of cost. Hence, the cost has no or minimal impact on risk allocation of this risk as declared in the last column. The 2nd preference risk allocation is provided to recognize any significant response contrary to the trend as for "Change in Scope". Accordingly, complete analysis has been done for all risks events in Appendix (5) and the following table summarizes the results:

No.	Risk Description	Summary of Risk Allocation According to Cost of Risk			Impacted Yes / No
		Low Cost	Medium Cost	High Cost	
1	**Design Risk**				
1.1	Change Output specifications	Public	Public	Public	No
1.2	Innovative design	Private	Private	Sharing	**Yes**
1.3	Design complexity	Private	Private	Sharing	**Yes**
1.4	Defects in design	Private	Private	Private	No
2	**Construction Risk**				
2.1	Change in scope	Public	Public / Sharing	Public	**Yes**
2.2	Constructability	Private	Private	Private	No
2.3	Failure/delay in material delivery	Private	Private	Private	No
2.4	labour availability	Private	Private	Private	No
2.5	Defects in construction / Quality	Private	Private	Private	No
2.6	Construction Cost Overrun	Private	Private	Private	No
2.7	Delay in Completion	Inclusive	Private	Private/ Sharing	**Yes**
2.8	Construction technology risk	Private	Private	Private	No
2.9	Failure to meet the criteria	Private	Private	Private	No
2.10	Failure/delay in commissioning test	Private	Private/ Sharing	Private	**Yes**
3	**Operational Risk**				
3.1	Operating cost overrun	Private	Private/ Sharing	Private	**Yes**
3.2	Delay /interruption in operation	Private	Private/ Sharing	Private	**Yes**
3.3	Shortfall in service quality	Private	Private	Private	No
3.4	Maintenance cost overrun	Private	Private	Private	No
3.5	Obsolete technology	Sharing	Private	Sharing / Private	**Yes**
3.6	Waste of material	Private	Private	Inclusive	No
3.7	Asset service Level Risk	Private	Private	Inclusive	No
3.8	Poor performance	Private	Private/ Sharing	Sharing / Private	**Yes**
3.9	Inability of partners to honour financial obligations	Private	Sharing	Sharing	**Yes**
3.10	Acceptability risk (aesthetics)	Sharing / Private	Sharing	Inclusive	**Yes**
3.11	Theft	Sharing / Private	Sharing	Inclusive	**Yes**

Table No 5.3.1: Analysis of Cost of Risk on Risk Allocation

We can conclude from the table above and Appendix (5) that only one risk is allocated to the Public partner regardless of the cost which is "Change in Output specifications" with a 69.5%. On the other hand, 12 risks are allocated to the Private partner regardless of the cost of risk. Out of these 12 risks 10 are strongly allocated to the Private partner with more than an 82% consensus between respondents, i.e. "Construction Cost Overrun" and "Construction Technology Risk". It is worth mentioning that no risk is absolutely allocated to Sharing Risk.

In terms of risk cost, 65% of respondents agreed that the cost of the following risks is Medium: "Design Complexity", "Failure/delay in material delivery", "Shortfall in service quality" and "Maintenance cost overrun". An equal number of respondents agreed that the following risks incur a Low cost: "Waste of material", "Acceptability risk" and "Theft". On the other hand, the cost of several risks were not confidently determined, i.e. the cost of "Obsolete Technology" estimated by 34.7% of respondents as Low, 34.8% as Medium and 30.4% at High. Cost of "Labour Availability" estimated as Low by 43.4% and Medium by 47.8% of participants, likewise, with less than 10% variances in respondents' responses between different levels of risk cost for "Defects in construction / Quality", "Construction Cost Overrun", "Delay in Completion", "Construction technology risk" and "Asset service Level Risk".

Finally, we will highlight below the influence of risk cost on risk allocations, which is the particular aim of this section:

Innovative Design: 56.5% (=30.4% + 26.1%) of respondents believe that this risk should be allocated to the Private partner at Low and Medium cost, but when it causes High cost it should be Shared between partners as reported by 13% of respondents. Similarly, for Design Complexity risk, 65.2% of respondents allocated this risk to Private partner at Low and Medium cost, and they recommend at High cost to Share this risk.

There is no consensus between the respondents neither about the risk cost nor the best allocation for risk of "Change in Scope"; equally 21.7% of respondents allocates this risk to the Public partner and Sharing at Medium cost, similarly 21.7% of participants value it as High and allocates this risk to the Public partner. This implies that in addition to the cost there are other criteria influence the risk allocation.

Delay in Completion: 69.5% of participants agree that this risk should be borne by the Private partner regardless of cost. However, 13% of respondents believe that this risk should be Shared at High cost. Likewise, for "Failure in commissioning test", Operating Cost Overrun" and "Delay/interruption in Operation" most of the respondents allocate the risk to the Private partner but few allocate to Sharing at Medium cost with percentages of 17.4%, 13% and 21.7% in respective. This indicates that the allocation of this risk depends on other criteria in addition to the cost of the risk.

Obsolete Technology: 21.7% of respondents believe that this risk should be Shared at Low cost, whereas at Medium cost it should be allocated to the Private sector with 26.1%. At High cost respondents allocate the risk to Sharing and Private with 17.4% and 13% respectively. It is remarkable that the respondents allocate this risk, regardless of the cost, to Sharing with 39.1% and 47.8% to the Private partner.

Poor performance: 52.2% (17.4% + 34.8%) of respondents believe that this risk should be allocated to the Private partner at Low and Medium cost; in contrast, 17.4% of respondents recommend Sharing the risk at Medium cost. The respondents allocate equally this risk to Private and Sharing at High cost. The 3rd preference frequency indicates that the cost of risk influences the risk allocation.

Inability of partners to honour financial obligations: 13% of respondents believe that this risk should be allocated to the Private partner at Low cost, but at Medium and High cost it should be Shared between partners as reported by 65.2% of respondents.

Acceptability risk and Theft: 65% of respondents estimate these risks at Low cost and allocate them to the Private partner and Sharing with 34.8% and 30.4% respectively. At Medium cost, respondents allocate "Acceptability risk" to Sharing while the risk of "Theft" is allocated to the Private partner. Almost none of respondents evaluate these risks at High cost, the percentage of allocating these risks to Private and Sharing are very close and vary between 40%-50%.

5.3.2 Impact of "Partners' Ability" on Risk Allocation

In this section, we will investigate the impact of partners' ability on risk allocation in PPP projects based on data collected in part 3 of the questionnaire. The result of this exercise is described in detail for Construction Risk: Delay in Completion, as an example, then an overall analysis table is developed in the next step.

Construction Risk: Delay in Completion

Partner Ability	Frequency of Risk Allocation			Total	Risk Allocation		Does Ability Impact Risk Allocation
	Public	Private	Sharing		1st Pref.	2nd Pref.	
Public	0.0%	0.0%	0.0%	**0.0%**	**Inc.**		**Yes**
Private	0.0%	56.5%	4.3%	**60.9%**	**Private**		
Both	0.0%	17.4%	21.7%	**39.1%**	**Sharing**	**Private**	
Total	**0.0%**	**73.9%**	**26.1%**	**78.2 %**			

The table above reveals that 78.2% risk allocation is explained by the partner's ability which equals to 56.5% (for ability by Private and allocated to Private) plus 21.7% (for ability by both and allocated to Sharing). Risk allocation according to the 2nd Preference shows that 17.4% of respondents dissent the trend, even if they are both able to manage it together but it seems that many participants think this risk should still be the Private partner's responsibility to manage and control. Accordingly, the complete analysis has been done for all risks events in Appendix (6) and in table 5.3.2 we summarize the results:

No.	Risk Description	Summary of Risk Allocation According to Partner's Ability			Impacted Yes / No
		Public	Private	Both	
1	**Design Risk**				
1.1	Change Output specifications	Public	Private & Public	Sharing	Yes
1.2	Innovative design	Inc.	Private	Sharing	Yes
1.3	Design complexity	Inc.	Private	Private	Yes
1.4	Defects in design	Inc.	Private	Sharing	Yes
2	**Construction Risk**				
2.1	Change in scope	Public	Sharing	Sharing	Yes
2.2	Constructability	Inc.	Private	Sharing	Yes
2.3	Failure/delay in material delivery	Inc.	Private	Sharing	Yes
2.4	labour availability	Inc.	Private	Sharing	Yes
2.5	Defects in construction / Quality	Inc.	Private	Inc.	Yes
2.6	Construction Cost Overrun	Inc.	Private	Private / Sharing	Yes
2.7	Delay in Completion	Inc.	Private	Sharing / Private	Yes
2.8	Construction technology risk	Inc.	Private / Sharing	Inc.	Yes
2.9	Failure to meet the criteria	Inc.	Private	Private / Sharing	Yes
2.10	Failure/delay in commissioning test	Inc.	Private / Sharing	Inc.	Yes
3	**Operational Risk**				
3.1	Operating cost overrun	Inc.	Private	Sharing	Yes
3.2	Delay /interruption in operation	Inc.	Private / Sharing	Sharing	Yes
3.3	Shortfall in service quality	Sharing	Private	Sharing	Yes
3.4	Maintenance cost overrun	Inc.	Private	Sharing	Yes
3.5	Obsolete technology	Inc.	Private	Sharing	Yes
3.6	Waste of material	Inc.	Private	Sharing	Yes
3.7	Asset service Level Risk	Sharing	Private	Sharing & Private	Yes
3.8	Poor performance	Inc.	Private	Sharing	Yes
3.9	Inability of partners to honour financial obligations	Inc.	Private	Sharing	Yes
3.10	Acceptability risk (aesthetics)	Inc.	Private	Sharing	Yes
3.11	Theft	Sharing	Private	Sharing	Yes

Table No 5.3.2 : Impact of Partner's Ability on Risk Allocation

The analysis according to ability is completely different; here our target is to achieve best allocation based on partner's ability. Two risks are allocated to the Public partner according to ability "Change in Output specifications" and "Change in scope" with percentage of 34.8%. On the other hand, 24 risks are allocated to the Private partner according to ability. Out of these 24 risks 19 are strongly allocated to the Private partner with more than 52% of consensus between respondents, i.e. "Construction Cost Overrun" and "Construction Technology Risk". While there are 20 risks weakly allocated to Sharing with a low percentage of respondents. It is worth mentioning that one risk is absolutely allocated to the Private partner, which is "Defects in construction / Quality". This can be justified as the Private partner is the cause of defect in workmanship and hence best able to manage this risk.

In terms of ability, the respondents believe that the Public partner is able to manage only the risks of "Change in Output specifications" and "Change in scope" with a percentage of 47.8%. They think that the Private partner is more capable to manage 23 risks with a percentage of 52% up to 91.3%. This high confidence in the ability of the Private partner could be due to the fact that most of the respondents (82%) are from the private sector or it could be due to the type of risks as most of them are related to construction and operation. The best able to manage risk of "Inability of partners to honour financial obligations" was notably split between respondents, with 43.4% reported to be allocated to the Private partner while 52.2 % of respondents think that both partners together should be able to overcome this risk.

Finally, the aim of this section is to highlight the impact of risk allocations by partner's ability, all of these risks are notably driven by ability with consensus between respondents with a percentage of 65.2 % and more. So, we will discuss the only deviation from the trend as follows:

Change in Output Specification: A total of 56.5% of respondents allocate this risk to the Public partner while only 34.8% of respondents believe the Public partner is best able to manage this risk. And 13.0% of respondents think the Private partner is best able to manage but they allocate this risk to the Public partner. Besides, 13.0% of respondents agreed that the Public partner is best able to manage this risk whereas they allocate this risk to Sharing. Likewise, for Change in scope 43.4% of respondents allocate this risk to

the Public partner while only 34.8% of respondents think the Public partner is able to manage this risk. As well, 47.8% of respondents allocate this risk to Sharing while only 26.1% of respondents think that both partners are able to manage this risk.

Other deviations are noted in several risks such as Delay in completion, where 17.4% of participants allocate it to the Private partner despite them believing that both are able to manage it. Another example is Construction Technology Risk, where 21.1% think the Private partner is the most able party to manage it even though they recommend sharing the risk.

5.3.3 Impact of "Partners' Attitude" on Risk Allocation in PPP

In this section, we will investigate the impact of public partners' attitude and private partner's attitude on risk allocation in PPP projects based on data collected in part 4 of the questionnaire. The result of this exercise is described in details for operation Risk: Theft.

Operation Risk: Theft According to Public Partner Attitude

Public Attitude	Frequency of Risk Allocation			Total	Risk Allocation		Does Ability Impact Risk Allocation
	Public	Private	Sharing		1st Pref.	2nd Pref.	
Averse	9.1 %	27.3 %	31.8 %	68.2 %	Sharing	Private	Yes
Neutral	0.0%	9.1 %	13.6 %	22.7 %	Sharing	Private	
Prone	0.0%	4.5 %	4.5 %	9.1%	Inc.		
Total	9.1 %	40.9 %	50.0	100%			

Operation Risk: Theft According to Private Partner Attitude

Private Attitude	Frequency of Risk Allocation			Total	Risk Allocation		Does Ability Impact Risk Allocation
	Public	Private	Sharing		1st Pref.	2nd Pref.	
Averse	4.5 %	4.5 %	18.2 %	27.3 %	Sharing		Yes
Neutral	0.0 %	9.1 %	22.7 %	31.8 %	Sharing		
Prone	4.5 %	27.3 %	9.1 %	40.9 %	Private		
Total	9.1 %	40.9 %	50.0 %	100%			

The table above reveals that 68.2% of respondents believe that the public is averse to taking this risk and respondents recommended that this risk should be either allocated to the Private partner with 27.3% or Shared with 31.8 %. In case the Public partner is neutral toward this risk, it should be Shared.

In the same manner, if the Private partner is prone to the risk, then the respondents advise to allocate the risk to the Private partner with 27.3%. While if the Private partner is Averse or Neutral to this risk it should be Shared, with 40.1 % of respondents. Refer to Appendix (7) & Appendix (8) for complete analysis. Table 5.3.3 shows the results for Public' Attitude with Risk Allocation.

Form Table 5.3.3, we observe that the only risk allocated to the Public partner regardless of the public partner's attitude is "Change in Scope" with a percentage of 68.2%, where "Change in Output specifications" is allocated to the Public partner when the Public partner's attitude is Prone to with 45.5% and to the Private partner when the Public partner's attitude is Averse with 13.6%. On the other hand, six risks are allocated to the Private partner regardless of the Public partner's attitude to the risks. Eighteen risks are allocated to the Private partner and Sharing in proportion to the Public partner's Attitude. It is worth mentioning that no risk is absolutely allocated to Sharing.

In terms of the Public partner's attitude, 59% of respondents agreed that the Public partner is prone to the following risks: "Change in Scope" and "Change in Output specifications". Many operational risks are allocated to the Public partner when the Public partner is prone to these risks. The Public partner is averse to 17 risks as reported by more than 50% of respondents. The Public partner is neutral to the risk of "Constructability" as stated by 63.6% of respondents.

No.	Risk Description	Summary of Risk Allocation According to Public's Attitude			Impacted Yes / No
		Averse	Neutral	Prone	
1	**Design Risk**				
1.1	Change Output specifications	Private	Inc.	Public	Yes
1.2	Innovative design	Private	Private / Sharing	Sharing	Yes
1.3	Design complexity	Private / Sharing	Private	Inc.	Yes
1.4	Defects in design	Private	Private	Private	No
2	**Construction Risk**				
2.1	Change in scope	Inc.	Public	Public	No
2.2	Constructability	Private	Private / Sharing	Inc.	Yes
2.3	Failure/delay in material delivery	Private	Private	Private	No
2.4	labour availability	Private	Private / Sharing	Sharing	Yes
2.5	Defects in construction / Quality	Private	Private	Inc.	No
2.6	Construction Cost Overrun	Private	Private	Private	No
2.7	Delay in Completion	Private / Sharing	Private	Inc.	Yes
2.8	Construction technology risk	Private	Private	Private	No
2.9	Failure to meet the criteria	Private / Sharing	Private	Inc.	Yes
2.10	Failure/delay in commissioning test	Private / Sharing	Private	Inc.	Yes
3	**Operational Risk**				
3.1	Operating cost overrun	Private / Sharing	Private	Sharing	Yes
3.2	Delay /interruption in operation	Private / Sharing	Private	Sharing	Yes
3.3	Shortfall in service quality	Private	Private	Private	No
3.4	Maintenance cost overrun	Private	Private	Sharing	Yes
3.5	Obsolete technology	Private / Sharing	Private / Sharing	Private / Sharing	Yes
3.6	Waste of material	Private	Private	Sharing	Yes
3.7	Asset service Level Risk	Private	Private	Sharing	Yes
3.8	Poor performance	Private / Sharing	Private	Sharing	Yes
3.9	Inability of partners to honour financial obligations	Private / Sharing	Private / Sharing	Sharing	Yes
3.10	Acceptability risk (aesthetics)	Private / Sharing	Private / Sharing	Sharing	Yes
3.11	Theft	Private / Sharing	Private / Sharing	Inc.	Yes

Table No 5.3.3 A: Impact of Public's Attitude on Risk Allocation

Finally, 18 risks might be influenced by the Public's attitude as following:

Risk of Change in Output specification: 45.5% allocate to the Public partner when the Public partner is Prone to this risk and 13.6% allocate to the Private partner when the Public partner is Averse to this risk. For Design Complexity, strongly equal respondents (with 31.8%) allocate to the Private partner when the Public partner is Averse to the risk, and allocate to the Private partner when the Public partner is Neutral to the risk. In contrast, 18.4% allocate to Sharing when the Public partner is Neutral to the risk. Similarly, other risks impact on the Public partner's attitude such as, Constructability, Labour Availability, Delay in Completion and others. It is worth mentioning that the relationship between risk allocation and the Public partner's attitude is ambiguous for the following risks: Innovative Design, Obsolete Technology, Acceptability risk and Theft as 40% to 50% of respondents allocate these risks between Sharing and Private.

Regarding the Private partner's attitude to risk allocation, refer to Table 5.3.3 B:

The only risk allocated to the Public partner regardless of the Private partner's attitude is "Change in Scope" with 68.2%, where "Change in Output specifications" is allocated to the Public partner when the Private partner's attitude is "Averse to" with 45.5% and to Sharing when the Private partner is "Prone to" with 18.2%. On the other hand, seven risks are allocated to the Private partner regardless of the Private partner's attitude to the risks, and six of them are also not impacted by Public partner's attitude as mentioned earlier. Eighteen risks are allocated to the Private partner and Sharing based upon the Private partner's attitude. We reiterate that no risk is absolutely allocated to Sharing.

In terms of the Private partner's attitude, the Private partner is averse to risk of "Change in Scope" and "Change in Output specifications" as reported by 68.2% and 59.1% respectively. The survey reveals that the Private partner is Prone to 20 risks as stated by 50% of respondents.

No.	Risk Description	Summary of Risk Allocation According to Private's Attitude			Impacted Yes / No
		Averse	Neutral	Prone	
1	**Design Risk**				
1.1	Change Output specifications	Public	Public	Sharing	Yes
1.2	Innovative design	Inc.	Sharing / Private	Private / Sharing	Yes
1.3	Design complexity	Private	Private	Private / Sharing	Yes
1.4	Defects in design	Private	Inc.	Private	No
2	**Construction Risk**				
2.1	Change in scope	Public	Inc.	Public	No
2.2	Constructability	Private / Sharing	Sharing	Private / Sharing	Yes
2.3	Failure/delay in material delivery	Private	Inc.	Private / Sharing	Yes
2.4	labour availability	Sharing	Sharing	Private / Sharing	Yes
2.5	Defects in construction / Quality	Private	Private	Private	No
2.6	Construction Cost Overrun	Private	Inc.	Private	No
2.7	Delay in Completion	Private	Private / Sharing	Private	Yes
2.8	Construction technology risk	Private	Private	Private	No
2.9	Failure to meet the criteria	Private / Sharing	Private	Private	Yes
2.10	Failure/delay in commissioning test	Private	Sharing	Private	Yes
3	**Operational Risk**				
3.1	Operating cost overrun	Private / Sharing	Private	Private / Sharing	Yes
3.2	Delay /interruption in operation	Sharing	Inc.	Private / Sharing	Yes
3.3	Shortfall in service quality	Private	Inc.	Private	No
3.4	Maintenance cost overrun	Private	Inc.	Sharing / Private	Yes
3.5	Obsolete technology	Sharing	Sharing	Private / Sharing	Yes
3.6	Waste of material	Private	Private	Private	No
3.7	Asset service Level Risk	Private / Sharing	Private / Sharing	Private / Sharing	Yes
3.8	Poor performance	Private / Sharing	Inc.	Private / Sharing	Yes
3.9	Inability of partners to honour financial obligations	Sharing	Sharing	Sharing / Private	Yes
3.10	Acceptability risk (aesthetics)	Private / Sharing	Sharing	Private / Sharing	Yes
3.11	Theft	Sharing	Sharing	Private	Yes

Table No 5.3.3 B : Impact of Private's Attitude on Risk Allocation

Finally, 18 risks might be influenced by the Private partner's attitude as follows:

Risk of Change in Output specification: 50.0% allocate to the Public partner when the Private partner is averse to this risk and 18.2% allocate to Sharing when the Private partner is prone to this risk. For Innovative design the allocation is to the Private partner and Sharing with a very close percentage of respondents. 68.2 % allocate Design Complexity to the Private partner when the Private partner is prone to the risk, however, 21.7% allocate to Sharing when the Private partner is prone to the risk as well. Many other risks also impacted on the Private partner's attitude such as, Constructability, Labour Availability, Delay in Completion and others. It is worth mentioning the relationship between risk allocation and the Private partner's attitude, likewise the Public partner's attitude, is ambiguous for the following risks: Innovative Design, Obsolete Technology, Acceptability risk and Theft as 40% to 50% of respondents allocate these risks between Sharing and Private.

Many risks are allocated to the Private partner when the Public partner is averse or neutral to certain risks, while 18 risks are allocated to the Private partner despite the Private partner being averse to these risks. That indicates that the Public partner's attitude is more powerful than the Private partner's attitude on risk allocation.

5.4 Overall Observation

The participants' overall perspectives on the proposed criteria and their impact on risk allocation are shown in Table 5.4 A.

We can see from the table that eleven out of 25 risks are impacted by all proposed criteria, and five risks are impacted only by the partner's ability. The rest of the risks are impacted by two or three of the proposed criteria. As such, we can conclude that the proposed criteria do not impact all risks similarly and each risk should be analysed separately.

No.	Risk Description	Impact of Proposed Criteria on Risk Allocation				Response Varaition According to the Criteria	% of Repondant for final allocation	Final allocation
		Cost of Risk	Partner Ability	Public Attitude	Private Attitude			
1	**Design Risk**							
1.1	Change in Output Specification	No	Yes	Yes	Yes	39.1%	60.9%	Public
1.2	Innovative design	Yes	Yes	Yes	Yes	43.5%	56.5%	Private
1.3	Design complexity	Yes	Yes	Yes	Yes	39.1%	69.6%	Private
1.4	Defects in design	No	Yes	No	No	8.0%	85.5%	Private
2	**Construction Risk**							
2.1	Change in scope	Yes	Yes	No	No	47.8%	53.6%	Public
2.2	Constructability	No	Yes	Yes	Yes	30.4%	69.6%	Private
2.3	Failure/delay in material delivery	No	Yes	No	Yes	8.7%	89.9%	Private
2.4	labor availability	No	Yes	Yes	Yes	26.1%	75.4%	Private
2.5	Defects in construction / Quality	No	Yes	No	No	8.7%	88.4%	Private
2.6	Construction Cost Overrun	No	Yes	No	No	17.4%	88.4%	Private
2.7	Delay in Completion	Yes	Yes	Yes	Yes	30.4%	71.0%	Private
2.8	Construction technology risk	No	Yes	No	No	21.7%	82.6%	Private
2.9	Failure to meet the criteria	No	Yes	Yes	Yes	21.7%	82.6%	Private
2.10	Failure/delay in commissioning test	Yes	Yes	Yes	Yes	30.4%	79.7%	Private
3	**Operational Risk**							
3.1	Operating cost overrun	Yes	Yes	Yes	Yes	47.8%	63.8%	Private
3.2	Delay /interruption in operation	Yes	Yes	Yes	Yes	43.5%	63.8%	Private
3.3	Shortfall in service quality	No	Yes	No	No	21.7%	78.3%	Private
3.4	Maintenance cost overrun	No	Yes	Yes	Yes	17.4%	76.8%	Private
3.5	Obsolete technology	Yes	Yes	Yes	Yes	21.7%	47.8% 44.9%	Sharing Private
3.6	Waste of material	No	Yes	Yes	No	21.7%	85.5%	Private
3.7	Asset service Level Risk	No	Yes	Yes	Yes	30.4%	65.2%	Private
3.8	Poor performance	Yes	Yes	Yes	Yes	8.7%	68.1%	Private
3.9	Inability of partners to honor financial obligations	Yes	Yes	Yes	Yes	21.7%	63.8%	Sharing
3.10	Acceptability risk (aesthetics)	Yes	Yes	Yes	Yes	17.4%	50.7% 47.8%	Sharing Private
3.11	Theft	Yes	Yes	Yes	Yes	13.0%	47.8% 44.9%	Sharing Private
Total No. of Risks impacted by the criteria		**12**	**25**	**18**	**18**			

Table No 5.4 A : Overall Impact of Proposed Criteria on Risk Allocation

Another observation from the table is the variation of responses according to the criteria as shown in Column no. 7. The percentage of respondents who reallocate the risk according to the criterion vary from 8% to 47.8% (at maximum) regardless of the number of criteria that impact each risk allocation, which means that 50% to 92% of respondents stick to a particular risk allocation for each risk. This indicates that more criteria are impacting the risk allocation, this in line with Zhang et al. (2002), Lam et al. (2007) and Yelin, Chan & Yeung (2010) who point out that risk transference is complicated and depends on many factors, these additional criteria could as follow:

- The nature of risk
- Approach for repaying as claimed by Siemiatycki & Farooqi, (2012)
- The root causes of the risk whether it is attributable to the Public partner, Private partner or others as suggested by some respondents.
- Types of contract as suggested by some respondents
- Or might Partner's ability prevails over the proposed criteria

The last two columns show the overall risk allocations for each risk according to all responses as follows:

- Two risks allocated to the Public partner with percentages of 60.9 and 53.6 which are "Change in output specification" and "Change in scope".
- 19 risks allocated to the Private partner with a minimum frequency of 56.5%.
- The only risk allocated to Sharing is "Inability of partners to honour financial obligations".
- "Obsolete technology", "Acceptability risk" and "Theft" are equally allocated to Private and Sharing with very close frequencies between 45% - 50%.

5.5 Risk Re-Allocation Matrixes

At this subsection we will focus on how the risks are re-allocated according to all criteria in combined as summarised in following matrix.

We can observe from the matrix below (for Change in output specification) that this design risk is, in general, allocated to the Public partner; this is not the final allocation, as it could be reallocated as following:

- Allocated to Private when: Ability by Private and Public is Averse to the risk.
- Allocate to Sharing when: Ability by Both and Private is Prone to the risk.

High	X		
Medium	X		
Low	X		
Public	X		
Private	X	X	
Both			X
Public Averse		X	
Public Neutral			
Public Prone to	X		
Private Averse	X	X	
Private Neutral	X		
Private Prone to			X
Change in Output Specification	**Public Sector**	**Private Sector**	**Sharing**

Table 5.4 B: Risk Re-Allocation Matrix **1st Preference, 2nd Preference**

Low		X	
Medium		X	
High			X
Public			
Private		X	
Both			X
Public Averse		X	
Public Neutral		X	X
Public Prone to			X
Private Averse			
Private Neutral		X	X
Private Prone to		X	X
Innovative Design	**Public Sector**	**Private Sector**	**Sharing**

Table 5.4 C: Risk Re-Allocation Matrix **1st Preference, 2nd Preference**

We can observe from matrix 5.4 C that this design risk is allocated to the Private partner, but the proposed criteria have a significant impact as they can alter the allocation to Sharing if:

1- Risk cost is high.
2- Ability by Both.
3- Public is Prone to the risk.
4- Private is Prone/Neutral to the risk.

Low		X	
Medium		X	
High		X	
Public			
Private		X	
Both			X
Public Averse		X	
Public Neutral		X	
Public Prone to		X	
Private Averse		X	
Private Neutral			
Private Prone to		X	X
Failure/delay in material delivery	**Public Sector**	**Private Sector**	**Sharing**

Table 5.4 D: Risk Re-Allocation Matrix **1st Preference, 2nd Preference**

The above construction risk is allocated to the Private partner, but there is a faint trend to reallocate the risk to Sharing when:

2) Ability is by Both as reported by 8.7% of respondents.

3) Private is Prone as a 2nd preference with percentage of 13.6%.

We conclude here that the proposed criteria have limited influence on risk allocation of Failure/delay in material delivery risk. The last example is the risk of "Waste material":

Low		X	
Medium		X	
High			
Public			
Private		X	
Both			X
Public Averse		X	
Public Neutral		X	
Public Prone to			X
Private Averse		X	
Private Neutral		X	
Private Prone to		X	
Waste of material	**Public Sector**	**Private Sector**	**Sharing**

Table 5.4 E: Risk Re-Allocation Matrix **1st Preference, 2nd Preference**

This operation risk is allocated to the Private partner, but it could be reallocated to Sharing if: Ability is by Both or Public is Prone to the risk. Accordingly, matrixes for all risks events are provided in Appendix (9).

5.6 Summary

In this chapter we discussed and analysed the 23 responses we got from PPP experts in the UAE who are working in the private sector (82% of all respondents). The analyses show that some risks are influenced by one criterion, whereas others are influenced by all criteria. In summary, all risks are impacted by the Partner's ability, 18 risks are influenced by the Partner's ability, and only 12 risks are impacted by cost of risk. Also the analysis reveals that Public attitude is more powerful than Private attitude on risk allocation.

50% to 92% of respondents stick to their selected risk allocation regardless of the number of criteria impacting these risk allocations. This could indicate that other criteria are more significant in risk allocation than the proposed criteria i.e. the risk nature, approach for repaying, the root causes of the risk, and type of contracts. Furthermore, the study found out the final risk allocation for each risk regardless of the criteria in order to compare the risk allocation by UAE experts with international perceptions.

Finally, we highlighted some examples of conditions that alter the risk allocation as for the risk of "Innovative Design" which is in general allocated to the Private partner; but reallocated to Sharing when the Risk cost is high, Ability by Both, Public is Prone to the risk and Private is Prone/Neutral to the risk.

6 Discussion

6.1 Introduction

This study distinguishes from previous research as it examines the risk allocation and reallocation according to the proposed criteria, therefore it will be somewhat difficult to discuss and compare the study's findings with the related theories and models. In the first part, we will discuss the impact of those criteria in the allocation of design risks, and then the construction risk events. Finally, the third part concerns how these criteria affect the risk allocation of operation risks.

6.2 Allocation of Design Risks

1.1 Change in Output specifications

In reference to the findings in Tables 5.3.1, 5.3.2, 5.3.3 A, 5.3.3 B and 5.4 the respondents, overall, allocated this design risk to the Public partner which supports Iossa et al.'s (2007 in Alzahrani 2015) findings. What the study added is that the level of risk cost (whether it is low, medium or high) does not alter the risk allocation. In contrary, the Partner's ability has significant impact on allocating this risk and this supports many scholars' views that the risk should be allocated to the partner best able to manage (Cooper et al. 2005, Abednego & Ogunlana 2006, Yelin, Chan & Yeung 2010, Alireza et al. 2014b, Boussabaine 2014, Jin 2010, Bing et al. 2005, Jin & Doloi 2008, World Bank 1997, Alzahrani 2015, Xu et al. 2011, Jin & Zhang 2011).

As well, the public partner's attitude is to reallocate this risk to the Private partner if the Public partner is averse to this risk. According to the Private partner's attitude, this risk could be Shared when the private partner is prone to this risk. This agrees with previous findings by Abednego & Ogunlana (2006), Yelin, Chan & Yeung (2010) and Alireza et al. (2014b) that the partner attitude impact the risk allocation.

1.2 Innovative Design

1.3 Design Complexity

According to the survey feedback as summarized in the findings tables, the overall allocations of these design risks are to the Private partner and this is in line with the findings of (Smyth and Edkins 2007, Asian Development Bank 2008, and Jang 2011) in Alzahrani (2015) who affirm that the Private partner will be responsible for the design risk in general. However, this is in disagreement with Iossa et al. (2007 in Alzahrani 2015) who stated that the Public partner should be responsible for the design risks.

In addition, the study examines the influence of proposed criteria and finds out that during the following conditions these two risks should be shifted from Private to Sharing at High cost and ability by Both. This is similar to the Alzahrani (2015) findings, as he stated that the design complexity should be allocated to Sharing at high cost as the third preference allocation. In accordance to the Partners' attitude, risk allocations fluctuate between Private partner and Sharing.

1.4 Defects in Design

Likewise, this risk overall is allocated to the Private partner. This research finding agrees with Smyth and Edkins 2007, Asian Development Bank 2008, Jang 2011 in Alzahrani 2015. And Lam et al. 2007, Ng and Loosemore 2007, Li et al. 2005, Arndt 1998, Wang and Tiong 2000, NTSA 2004, and VDTF 2001 in Ke et al. 2010. However, this is in disagreement with Chan et al. (2011) and Iossa et al. (2007 in Alzahrani 2015) to allocate it to the Public partner.

This risk allocation is not impacted by the cost of risk nor the partners' attitude. Alzahrani (2015) also allocated this risk to the Private at the expected cost reported by his study's respondents. The only criterion that amends the risk allocation is the partners' ability as it should be shifted from Private to Sharing at ability by Both.

6.3 Allocation of Construction Risks

2.1 Change in Scope

In reference to the findings tables, the overall allocation of the construction risk is to the Public partner. This is consistent with the findings by Chan et al. (2011) and Ng and Loosemore (2007), NTSA (2004 in Ke et al. 2010) and inconsistent with Lam et al. (2007). Furthermore, according to the survey Sharing this risk occurs in the following cases: the risk cost is medium, ability by Private or ability by Both. In contrast, the study reveals that partners' attitudes have no effect on the allocation of this risk.

2.2 Constructability

According to the survey respondents, the overall allocation of this risk is to the Private partner; this dissent with the view of Chan et al. (2011) who proposed to allocate this risk to the client. However, the risk should be Shared if the ability is by Both, and the Public partner is Neutral to the risk or the Private partner is Neutral /Averse to this risk, whereas the cost of the risk has no impact on risk allocation.

2.3 Failure/delay in Material Delivery

The study findings support other scholars in the overall allocation of this risk to the Private partner such as Chan et al. (2011), Lam et al. (2007), and Li et al (2005) in Ke et al. (2010). However, this is in contrast to Alireza et al. (2014a) who allocate this risk to Sharing and Wang and Tiong (2000) in Ke et al. (2010) who allocate this risk to the Public partner.

In terms of the impact of the proposed criteria, the cost of risk and the public partner's attitude have no effect on risk allocation, which is supported by Alzahrani (2015) who allocates the risk to the Private partner whatever the cost. Whereas the ability and private partner's attitude might affect the risk allocation as recommended by some respondents, which is in line with Ke et al. (2010) who propose to mostly allocate, not solely allocate, this risk to the Private partner.

2.4 Labour Availability

The overall allocation of this risk is to the Private partner, which is similar to the findings by Chan et al. (2011), Lam et al. (2007), and Li et al (2005) in Ke et al. (2010). However,

this is in contrast to Alireza et al. (2014a) and Wang and Tiong (2000) in Ke et al. (2010) who allocate this risk to Sharing and Public respectively. This risk might be allocated to Sharing if the ability is by Both, the Public partner is Prone/Neutral to the risk or the Private partner is Neutral /Averse to this risk, which is in line with Ke et al. (2010) who proposed to mostly allocate, not solely allocate, this risk to the Private partner. Whereas the cost of the risk has no impact on risk allocation and this is supported by Alzahrani (2015) as he allocates the risk to the Private partner whatever the cost.

2.5 Defects in Construction/Quality

In reference to the respondents' feedback, this risk should be allocated to the Private partner along with most of the construction risks. This is in concordance with Chan et al. (2011), Lam et al. (2007), Ng and Loosemore (2007), Li et al (2005), Arndt (1998), Wang and Tiong (2000), NTSA (2004), and VDTF (2001) in Ke et al. (2010). This risk allocation is not impacted by the proposed criteria excepting the partners' ability.

2.6 Construction Cost Overrun

According to this study, this risk should be allocated to the Private partner, which is in concordance with Carbonara et al. (2015), Alireza et al. (2014a), Ng and Loosemore (2007), Li et al (2005), Arndt (1998), Wang and Tiong (2000), NTSA (2004), and VDTF (2001) in Ke et al. (2010). The risk allocation is not impacted by the proposed criteria but the partners' ability.

2.7 Delay in Completion

According to the findings tables, the respondents allocate this construction risk to the Private partner and that supports previous studies done by Alireza et al. (2014a), Ng and Loosemore (2007), Li et al. (2005), Arndt (1998), Wang and Tiong (2000), NTSA (2004), and VDTF (2001) in Ke et al. (2010). As well, the study supports the findings of Alzahrani (2015) to allocate the risk to the Private partner based on the risk cost, although some of the survey's participants believe that it should be Shared at High cost. Furthermore, it should be Shared if the ability is by Both, the Public partner is Averse or the Private partner is Neutral to the risk. This is in line with Ke et al. (2010) who proposed to mostly, not solely, allocate this risk to the Private partner.

2.8 Construction Technology Risk

According to the findings tables the overall risk allocation is to the Private sector, likewise with the construction risks. This is in concordance with previous research by Ke et al. (2010) and Alzahrani (2015). This risk allocation is not impacted by the proposed criteria excepting the partners' ability.

2.9 Failure to Meet the Criteria

The overall allocation of this risk is to the Private partner, and this supports Alireza et al's (2014a) findings. However, this risk is allocated to Sharing if the ability by Both (as reported by 8% of respondents). If the Public partner is Averse to this risk or the Private is Averse to this risk, the cost of risk has no impact on risk allocation.

2.10 Failure/Delay in Commissioning Test

The overall allocation is to the Private partner but this in opposition to the conclusions of Alireza et al. (2014a). Moreover, some of the participants believe that it should be Shared if Medium cost, ability by Private partner, Public partner is Averse, or Private partner is Neutral to the risk.

6.4 Allocation of Operation Risks

3.1 Operating Cost Overrun

This risk should be allocated to the Private partner as per overall respondents. This is in line with Alireza et al. (2014a), Ng and Loosemore (2007), Li et al (2005), Arndt (1998), and NTSA (2004) in Ke et al. (2010). Some of participants believe that it should be Shared at: Medium cost, ability by Private partner, Public partner is Prone/Averse, or Private partner is Prone/Averse to the risk.

3.2 Delay/Interruption in Operations

The risk of delay and interruption in operations is recommended to be allocated to the Private partner by respondents overall. This supports the findings by Ng and Loosemore (2007), Arndt (1998), and Wang and Tiong (2000) in Ke et al. (2010). Some of the

participants believe that it should be Shared at Medium cost, ability by Private partner, Public is Prone/Averse, or Private is Prone/Averse to the risk.

3.3 Shortfall in Service Quality

This risk is allocated to the Private partner as affirmed by Alireza et al. (2014a), Ng and Loosemore (2007), Arndt (1998), Wang and Tiong (2000), NTSA (2004), and VDTF (2001) in Ke et al., 2010). Besides, this risk allocation is not impacted by the cost of risk nor the partners' attitude. The only criterion that amends the risk allocation is partners' ability as it should be shifted from the Private partner to Sharing once the ability is by Both.

3.4 Maintenance Cost Overrun

The overall allocation of this risk is to the Private partner, similar to most of the operational risks, and this concurs with the results reported by Alireza et al. (2014a), Li et al. (2005), Arndt (1998), NTSA (2004), and VDTF (2001) in Ke et al., 2010). The allocation can be amended to Sharing if the ability is by Both, the Public partner is Prone to the risk or the Private is Prone to the risk, while the cost of the risk has no impact on risk allocation.

3.5 Obsolete Technology

The allocation of this risk was contentious as the participants allocated it equally between the Private partner and Sharing. According to the risk cost, the risk is allocated to Sharing at Low cost, Private partner at Medium cost, and it is allocated between Sharing and Private partner at High cost. In terms of ability, the risk is allocated to the Private partner when the Private partner is best able to manage, and is allocated to Sharing when the ability is by Both.

In terms of the partners' attitude, the relationship between the Public partner's attitude and risk allocation is ambiguous. Half of the respondents think it should be allocated to Sharing regardless of the Private partner's attitude, but there was also a strong different view (41% of participants) which asserted that the risk should be allocated to the Private partner if the Private partner is prone to this risk.

3.6 Waste Material

In agreement with previous studies by Ng and Loosemore (2007), Li et al (2005), Arndt (1998) in Ke et al. (2010), the study findings concluded to allocate this risk to the Private partner.

In terms of the impact of proposed criteria, the cost of risk and the Private partner's attitude have no effect on risk allocation whereas ability and the Public partner's attitude might impact as recommended by some respondents.

3.7 Asset Service Level Risk

As with other operational risks this risk is allocated to the Private partner, which is in line with the following studies, Smyth and Edkins (2007), Jang (2011), Odebode (2004) Murphy (2008), and Haarmeyer and Mody (1998) in Alzahrani (2015), all of whom affirm that the Private partner will be responsible for the operation risks.

In addition, the allocation can be changed to Sharing if the ability by Both or the Public partner is prone to the risk. Regarding the Private partner's attitude, there is a significant disagreement between respondents about the impact of the Private partners' attitude and risk allocation. Finally, the cost of risk has no impact on this risk allocation.

3.8 Poor Performance

This risk is allocated to the Private partner, which is similar to the findings of Alireza et al. (2014a) and Li et al (2005), Arndt (1998), Wang and Tiong (2000), and NTSA (2004) in Ke et al. (2010). However, according to the risk cost, some of the participants believe that it should be allocated to Sharing at high cost but there is a dissenting opinion with some thinking it should be kept with the Private partner. Besides, the risk allocation might be amended if the ability by Private or Public is prone to the risk. The impact of the Private partner's attitude and risk allocation is vague.

3.9 Inability of partners to honour financial obligations

This is the only risk allocated to Sharing. This dissents with the findings reported by Smyth and Edkins (2007), Jang (2011), Odebode (2004), Murphy (2008), and Haarmeyer and Mody (1998) in Alzahrani (2015) who affirm that the Private sector will be responsible for the operation risks.

According to the risk cost, the risk could be allocated to the Private partner only when the cost is Low. In terms of ability, the risk should be allocated to the Private partner when the Private partner is best able to manage. In respect to partners' attitude, the impact of the Public partner's attitude to risk allocation is uncertain. When the Public partner is Neutral/Averse the risk is allocated indecisively to Sharing and Private. Most of the respondents think it should be allocated to Sharing regardless of the Private partner's attitude but there is also a significant dissenting view (27.3% of participants) who assert that the risk should be allocated to the Private partner if the Private partner is prone to this risk

3.10 Acceptability Risk

3.11 Theft

The allocations of these two risks are equally allocated to the Private partner and Sharing. According to the risk cost, the risk is closely allocated to Sharing and Private at Low cost, at Medium cost the Acceptability Risk is allocated to Sharing, whereas Theft is allocated to Private. In terms of ability, the risk is allocated to the Private partner when the Private partner is best able to manage, and is allocated to Sharing when ability is by Both.

According to the partners' attitude, the relationship between partners' attitude and risk allocation is ambiguous; as half of the respondents think these two risks should be allocated to Sharing regardless of the Public partner's attitude, but also the other half assert that these risks should be allocated to the Private partner regardless of the Public partner's attitude. The impact of the Private partner's attitude on risk allocation for the risk of Theft is clearer in comparison to the Acceptability Risk as the risk of Theft is allocated to the Private partner if the private partner is prone to this risk, otherwise, to be shared.

6.5 Summary

All risks, examined under this study, are impacted by partners' ability and this is in agreement with previous studies that the risk should be allocated to the partner best able to manage: Cooper et al. (2005), Abednego & Ogunlana (2006), Yelin, Chan & Yeung (2010), Alireza et al. (2014b), Boussabaine (2014), Jin (2010), Bing et al. (2005), Jin &

Doloi (2008),World Bank (1997), Alzahrani (2015), Xu et al (2011), and Jin & Zhang (2011).

In terms of risk cost, there are only two design risks, three construction risks and seven operation risks which are reallocated according to the risk cost and these findings agree, to a certain degree, with the previous study of Alzahrani (2015).

In the same way, the risk allocation of three design risks out of four, six construction risks out of ten and ten operation risks out of eleven are affected by public and/or private's attitudes. This almost supports previous research done by Abednego & Ogunlana (2006), Yelin, Chan & Yeung (2010) and Alireza et al. (2014b). Roumboutsos & Anagnostopoulos (2008) justified the relation between the partners' attitude and risk allocation as Partners' attitude depends on the risk consequences so that when the risk impact is high the participants tend to be averse to risk while with small consequences the parties are prone to taking more risks. Risk assessment by identifying the risks and evaluating their impacts is the primary measure to assign the risks between the parties.

Overall, the risk allocation should never be considered as a static process and will never overstate the process. Therefore, risks should be re-allocated during the performance of the contract according to the proposed criteria and the project's circumstances. This is in disagreement with scholars who proposed a fixed risk allocation scheme/matrix such as Carbonara et al. (2015), Xu et al. (2011), Su et al (2011), Chan et al. (2011), Alireza et al. (2014a), Lam et al. 2007, Ng and Loosemore 2007, Li et al. 2005, Arndt 1998, Wang and Tiong 2000, NTSA 2004, and VDTF 2001 in Ke et al. 2010.

Finally, nineteen out of 25 risks are allocated to the Private partner. This is in accordance with Bing et al. (2005) who conclude that 70% of the project risks should be allocated to the private partner. Keep in mind the private partner overestimates the risks which lead to higher project costs, as affirmed by Siemiatycki & Farooqi (2012)

7 Conclusion and Recommendation

This concluding section includes the following subsections: the study's conclusions, the study's limitations, the implications of the findings, and recommendations for further studies.

7.1 Conclusions

Despite PPP's numerous benefits PPP projects encounter a high degree of risk, and risk allocation can lead to much negotiation and disagreement prior to the signing of a PPP contractual agreement. Thus, the need for establishing an effective method for risk allocation is becoming a critical for the success of PPP projects. Academics show considerable interest in this debate and numerous studies have been carried out to discuss and analyse this core subject. In a different approach to previous studies, this study aims to resolve this issue by examining the risk allocation based on the level of risk cost, the partners' abilty, partner's attitude, return, and best price.

This study developed a comprehensive list of risk events that might encounter a typical PPP project. This was the first aim of the study and the first step to achieve optimum risk allocation as affirmed by Xenidis & Angelides (2005). The next aim was to develop a list of criteria that might impact the risk allocation, and finally allocate each risk in accordance to these criteria. This was to realize the second and third aims of the study. As the risk events differ (in terms of effort to manage, cost of impact, time of impact, sequences, etc.) from one project to another, from one contract to another , and might be altered during a project, hence generalizing the risk allocation is not practical and this is supported by Bing et al. (2005) as he point outs that projects may entail circumstances that are difficult to assign as risk in general. Therefore the study concludes that the risk allocation in PPP in the UAE should be flexible and amended according to the risk conditions to allow the decision makers to re-allocate the risk properly in order to achieve optimum risk allocation and to realize best VfM. This is in consistent with Xu et al. 2011 claim that risk allocation in PPP projects can change continuously according to the actual context of the project and with the findings of Zou et. al (2008): "Putting efforts on a

continuous life-cycle of risk identification and allocation is never overstated." Also this is inconsistent with Ya-ling & Yi-linit (2012), who found that institutional attribution of risk allocation has been neglected and considered as a static process. As such, they argue that risk allocation is divided into two associated processes:

I. Risk allocation in the contract.
II. Risk reallocation during the performance of the contract.

This study investigates the relations between the proposed criteria and risk allocation in the UAE. The findings show that all risks are impacted by the partner's ability, eighteen risks are influenced by the partner's attitude, and only twelve risks are impacted by cost. Further more, during the study the author observes more critira impact the risk allocation and this is in line with this Zhang et al. (2002), Lam et al. (2007) and Yelin, Chan & Yeung (2010) as the risk transference is complicated and depends on many factors. Then, the study reveals how the risk allocation should be reallocated based on the criteria, i.e. the risk of "Innovative Design" which in general is allocated to the Private partner, but, as reported by respondents, to re-allocate this risk to Sharing when the Risk cost is high, Ability by Both, Public is Prone to the risk and/or Private is Prone/ Neutral to the risk.

It is very interesting to note that the most common proposed re-allocation position is "Sharing", according to the study. This supports Faulkner (2004) in Jin & Zhang (2011) who asserts that sharing risks instead of transferring them will create a win-to-win mutual profit, which is the feature of ideal PPPs. Jin & Doloi (2008) argue that if the private sector is enforced to bear a certain risk, then the private partner will show inappropriate commitment, inefficiently manage the risk, and end up charging unnecessarily high premiums, even with excellent risk management capability. Hence, it may well be more effective for the public sector to retain most or all the risks. The public partner should not transfer as much risk as they wish; otherwise, the project may result in higher than necessary cost.

7.2 Research Implications and Contributions

It was concluded in the study that some risks should be allocated to the partners according to the proposed criteria. In addition, some risk allocations should be adjustable according to the changes of these criteria. Giving such flexible attributes to the risk allocation will minimize the contract negotiations and reduce disputes between the partners during the tendering stage, this will help both partners to balance their interests and protect both from bearing alone the consequences of risk.

The study assists PPP experts in the UAE to accept the idea that risk allocation in PPP projects is not a rigid process, and to distinguish between the risks that should be inevitably allocated to a particular partner and the risks that might be re-allocated to different partners based on the risk's characteristics and the circumstances surrounding the project. This should assist both partners to better understand the risk allocation to achieve effective contract negotiations.

7.3 Research Limitations

As is common, no research is free from limitations. In particular, this study has the following limitations:

1. The sample size consists of 23 respondents and that may not be enough to represent the diverse nature of PPP projects. Few responded to the survey despite the author distributed more than 400 invitations to PPP experts in the UAE. Moreover, the lack of official records of PPP projects in the UAE hindered the collection of empirical data.
2. The paper's scope is limited to examining three proposed criteria out of five. And it investigates the impact of these selected criteria on only three categories of risk which are: design risks, construction risks, and operation risks.
3. The respondents are unequally distributed among the partners as more than 80% of respondents are from the Private sector. This might induce a bias in the responses.
4. More than 65% of respondents are experts on Build, Operate & Transfer projects and Design, Build, Finance & Operate projects, hence the study's findings cannot be generalized to other type of PPP contracts, such as Service Contracts.

5. The study was limited to exploring the impact of the criteria on risk allocation theoretically; therefore the next step is to analyze a real case study.

7.4 Recommendations for Further Research

Further studies are necessary to overcome the above-mentioned limitations. The following are some possible recommendation for improving the paper:

1. To examine the influence of the proposed criteria on different risk categories, for example, political risks, financial risks, etc.
2. To study the impacts of the rest of the criteria: Return and Risk pricing.
3. To identify the interaction between the proposed criteria and to understand how this interaction is affecting the risk allocation, then to rank the criteria according to their level of influence and power.
4. To analyze practically the proposed criteria and their impacts on risk allocation for real case studies.
5. As the sample size is small, more data needs to be collected from PPP experts in the UAE. This will help to have respondents more evenly distributed among both types of partners and PPP contract types to minimize the bias in response.
6. To study other criteria impacting the risk allocation: the nature of risk, approach for repaying, types of contract, and the root causes of the risks.

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9 Appendixes

9.1 Appendix (1) : VfM Appraisals Comparison

Adopted from Siemiatycki & Farooqi, (2012) Go Back

Table 1. Comparison of public–private partnerships and traditional procurement costs for 28 Ontario projects.

Project name	PPP model	Date of VfM (M/Y)	PSC base cost ($M)	PSC retained risk ($M)	PSC transaction costs ($M)	Retained risk as % of base costs	PPP base cost ($M)	PPP retained risk ($M)	PPP transaction costs ($M)
Montfort Hospital	BF	01-07	177.4	59.0	3.0	33%	188.8	24.5	6.6
Quinte Health Care	BF	03-07	68.3	24.8	1.2	36%	72.2	9.9	3.5
St. Joseph's Health, London	BF	05-07	31.0	9.3	0.6	30%	32.2	2.7	1.6
Sudbury Regional Hospital	BF	05-07	120.6	41.7	7.8	35%	131.9	11.2	10.3
Trillium Health	BF	05-07	96.5	28.9	2.1	30%	104.1	5.0	4.2
Youth Justice Facil.	BF	06-07	86.3	25.7	0.1	30%	93.2	7.5	1.9
Sunnybrook Health	BF	06-07	129.0	36.0	2.7	28%	142.0	6.7	5.4
Rouge Val. Health	BF	10-07	60.4	26.2	1.5	43%	63.9	10.1	3.0
Bluewater Health	BF	10-07	211.6	50.3	1.9	24%	214.1	15.5	6.0
Hamilton Health	BF	11-07	42.1	18.4	0.7	44%	45.0	6.8	2.1
Runnymede Health	BF	11-07	62.8	24.9	1.2	40%	62.5	9.9	3.3
Ottawa Hospital Cancer Program	BF	01-08	46.5	19.4	1.5	42%	46.7	7.8	2.8
Credit Valley Hosp.	BF	06-08	152.3	65.3	6.1	43%	162.8	25.6	9.3
Kingston General Hospital	BF	07-08	129.6	58.5	4.7	45%	142.1	22.6	8.3
London Health Sciences	BF	07-08	204.9	87.4	4.3	43%	211.8	31.1	7.9
Toronto Rehab Inst	BF	10-08	109.9	46.4	2.0	42%	112.1	19.0	5.2
Lakeridge Health	BF	02-09	83.2	35.9	4.0	43%	91.5	14.4	6.4
Royal Victoria Hospital, Barrie	BF	03-09	249.7	108.9	1.9	44%	258.5	39.6	6.4
Windsor Hospital	BF	06-09	83.3	34.4	1.8	41%	91.7	13.7	4.5
North Bay Regional Health Centre	BFM	03-07	404.6	229.9	5.6	57%	551.7	22.2	18.0
Sault Area Hospital	BFM	08-07	325.8	220.7	4.7	68%	407.8	38.8	11.5
Woodstock General Hospital	BFM	12-08	218.0	182.2	5.1	84%	290.7	35.1	10.7
Durham Courthouse	DBFM	04-07	247.0	157.0	8.0	64%	334.0	25.0	17.0
New Data Centre	DBFM	04-08	266.0	175.7	2.2	66%	352.0	26.4	7.2
Niagara Health	DBFM	05-09	658.6	485.5	5.9	74%	851.4	197.5	16.1
Bridgepoint Hospital	DBFM	10-09	452.0	427.3	6.2	95%	728.4	74.9	16.9
Toronto South Detention Centre	DBFM	11-09	479.6	350.7	7.6	73%	708.4	63.3	16.7
Waterloo Court	DBFM	03-10	304.4	235.1	11.5	77%	458.7	43.0	15.2
Total			5,501.4	3,265.5	105.9	49%	6,950.2	809.8	227.8

Note: BF = build-finance; BFM = build-finance-maintain; DBFM = design-build-finance-maintain; PPP = public–private partnership; PSC = public sector comparator; VfM = value for money.

Source: Data from Infrastructure Ontario value for money reports: http://infrastructureontario.org/en/projects/index.asp

9.2 Appendix (2) : Data Collection Form

Go Back

Section no.1: General Info about the Participants

Respondent's Position:

- ☐ Public Sector
- ☐ Private Sector
- ☐ Bank / Investor
- ☐ Others: .....

Job Title:

- ☐ Estimation/ Procurement Professional
- ☐ Financial Professional
- ☐ Project Manager
- ☐ Head of Department
- ☐ Contract/ Commercial Professional
- ☐ Others: .....

Experience in PPP Projects:

- ☐ Less than 3 years
- ☐ 11 years – 15 years
- ☐ 3years - 10 years
- ☐ More than 15 years

Type of PPP you are involved in/ expert with:

- ☐ Build, Operate & Transfer
- ☐ Leasing Contract
- ☐ Design, Build, Finance & Operate
- ☐ Management Contract
- ☐ Service Contract
- ☐ Others: .....

Risk Allocation in PPP Projects Page 1/4

Section no.2: Impact of "Cost of Risk" on Risk Allocation in PPP Projects:

In this section we aim to get your opinion about the impact of "Cost of Risk" in achieving optimum risk allocation in PPP. *For example: The expected cost of **Risk X** is "Medium" and this risk should be "shared by both Partners".* So please advise expected cost of risk in the Green Column and best risk allocation in the Yellow Column.

No	Risk Description	Cost of Risk			Risk to be allocated to (to be undertaken by)		
		Low Cost	Medium Cost	High Cost	Public	Private	Sharing
	Example : Risk X		√				√
1	**Design Risk**						
1.1	Changes in output specification						
1.2	Innovative design						
1.3	Design complexity						
1.4	Defects in design						
2	**Construction risk**						
2.1	Change in scope						
2.2	Constructability						
2.3	Failure/delay in material delivery						
2.4	labour availability						
2.5	Defects in construction / Quality						
2.6	Construction Cost Overrun						
2.7	Delay in Completion						
2.8	Construction technology risk						
2.9	Failure to meet the criteria						
2.10	Failure/delay in commissioning test						
3	**Operational Risk**						
3.1	Operating cost overrun						
3.2	Delay /interruption in operation						
3.3	Shortfall in service quality						
3.4	Maintenance cost overrun						
3.5	Obsolete technology						
3.6	Waste of material						
3.7	Asset service Level Risk						
3.8	Poor performance						
3.9	Inability of partners to honour financial obligations						
3.10	Acceptability risk (aesthetics)						
3.11	Theft						

Section no. 3: Impact of "Partners' Ability to manage risks" with Risk Allocation in PPP:

We analyze here the relationship between "Partners' Ability in managing and controlling risks" in achieving optimum risk allocation in PPP. Green Column refers to Partners' who can better manage risks and Yellow Column refers to party preference for risk allocation. *For example: The Public is best able to manage **Risk Y** but this risk should be "Shared"*. So please identify the party who can better manage the following risks and the party who should undertake the risk.

No	Risk Description	Ability to Manage and Control the Risks			Risk to be allocated to (to be undertaken by)		
		Public	Private	Both	Public	Private	Sharing
	Example : Risk Y	√					√
1	**Design Risk**						
1.1	Changes in output specification						
1.2	Innovative design						
1.3	Design complexity						
1.4	Defects in design						
2	**Construction risk**						
2.1	Change in scope						
2.2	Constructability						
2.3	Failure/delay in material delivery						
2.4	labour availability						
2.5	Defects in construction / Quality						
2.6	Construction Cost Overrun						
2.7	Delay in Completion						
2.8	Construction technology risk						
2.9	Failure to meet the criteria						
2.10	Failure/delay in commissioning test						
3	**Operational Risk**						
3.1	Operating cost overrun						
3.2	Delay /interruption in operation						
3.3	Shortfall in service quality						
3.4	Maintenance cost overrun						
3.5	Obsolete technology						
3.6	Waste of material						
3.7	Asset service Level Risk						
3.8	Poor performance						
3.9	Inability of partners to honour financial obligations.						
3.10	Acceptability risk (aesthetics)						
3.11	Theft						

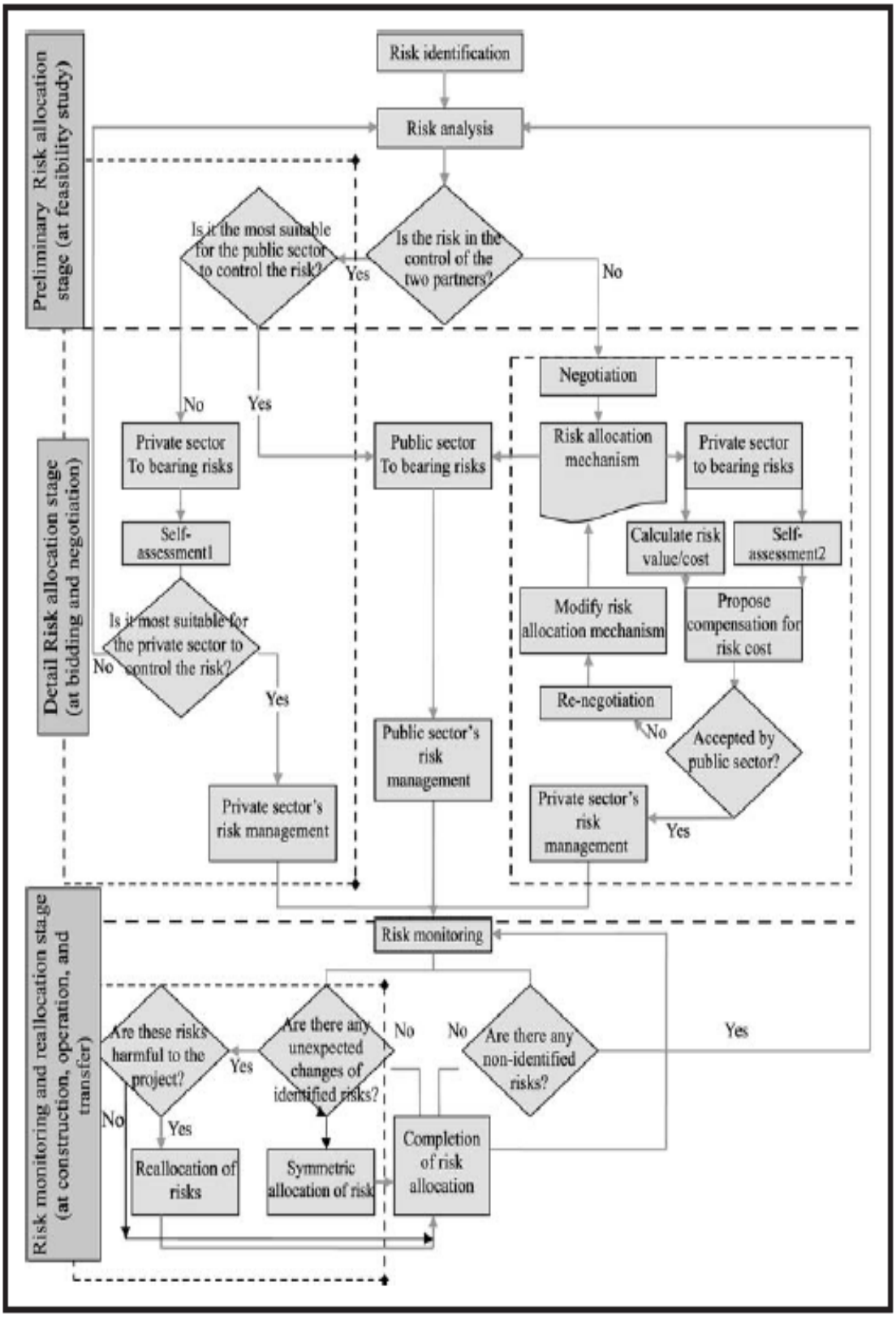
Section 4: Relation of "Partners' Attitude" on Risk Allocation in PPP:

We seek in this section to get your feedback about the "Partners' Attitude to undertaking risks" and Risk Allocation. Green Column refers to Partners' attitude and Yellow Column refers to preference risk allocation. *For example: Public partner is Neutral to undertaken **Risk Z** but Private partner is **Prone** to, and the risk should be undertaken by Private Partner.* Please identify the partners' Attitude towards undertaking the below risks and who should undertake those risks.
A: Avers to undertake a risk, **N**: Neutral to undertake a risk, **P**: Prone to undertake a risk.

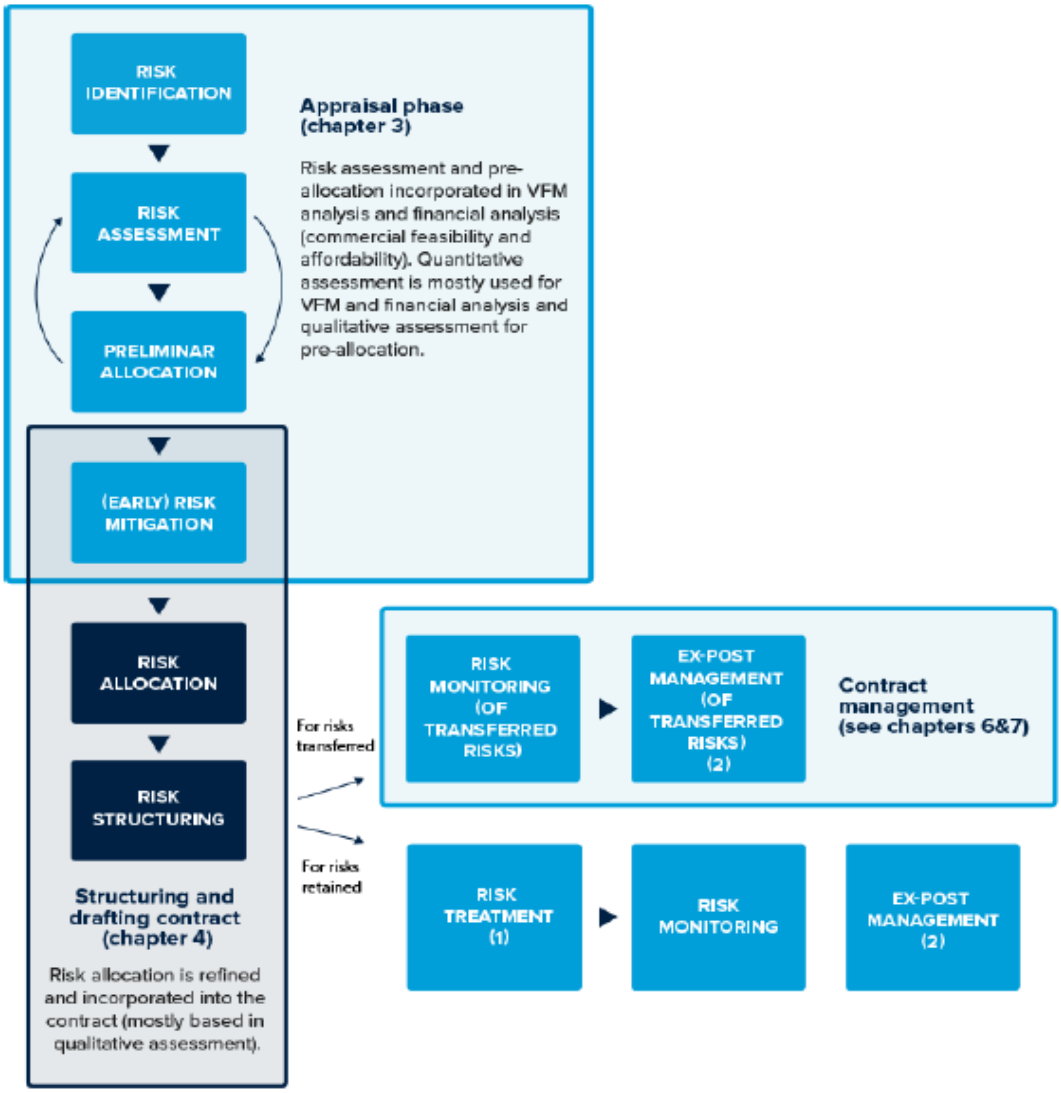
No	Risk Description	Public's Attitude to Risks			Private's Attitude to Risks			Risk to be allocated to		
		A	N	P	A	N	P	Public	Private	Sharing
	Example : Risk Z		√				√		√	
1	**Design Risk**									
1.1	Changes in output specification									
1.2	Innovative design									
1.3	Design complexity									
1.4	Defects in design									
2	**Construction risk**									
2.1	Change in scope									
2.2	Constructability									
2.3	Failure/delay in material delivery									
2.4	labour availability									
2.5	Defects in construction/ Quality									
2.6	Construction Cost Overrun									
2.7	Delay in Completion									
2.8	Construction technology risk									
2.9	Failure to meet the criteria									
2.10	Failure/delay in commissioning test									
3	**Operational Risk**									
3.1	Operating cost overrun									
3.2	Delay /interruption in operation									
3.3	Shortfall in service quality									
3.4	Maintenance cost overrun									
3.5	Obsolete technology									
3.6	Waste of material									
3.7	Asset service Level Risk									
3.8	Poor performance									
3.9	Inability of partners to honour financial obligations.									
3.10	Acceptability risk (aesthetics)									
3.11	Theft									

9.3 Appendix (3): Risk Management Lifecycle

Adopted from Zou, et al (2008) GO BACK



Another example for Risk Management Lifecycle Adopted from PPP Guid (2016)



9.4 Appendix (4): Risk Allocation According to the Cost

Adopted from Alzahrani (2015) GO BACK

	Public Sector	Private Sector	Share
Very High			RP24;
High	RP13;	RP13; RP34; RP12; RP35; RP36; RP46; RP47; RP48; RP52	RP24; RP12; RP1
Medium	RP3; RP31; RP2; RP4; RP7; RP31; RP37;	RP15;RP34; RP47; RP48; RP52; RP18; RP24; RP27; RP33; RP35; RP36; RP43; RP45; RP46; RP49; RP50; RP51; RP53; RP54; RP3; RP9; RP17; RP39; RP40; RP41; RP63	RP12; RP16; RP24; RP54; RP57; RP61; RP63; RP11; RP14; RP21; RP22; RP23; RP56; RP57; RP59; RP62; RP2; RP13; RP18; RP25; RP26; RP31; RP50; RP55; RP58; RP60
Low	RP1; RP2; RP4; RP6;RP7; RP15; RP30; RP42; RP3; RP5; RP8; RP9; RP28; RP29; RP37; RP10; RP21; RP40; RP41	RP10; RP17; RP18; RP19; RP27; RP29; RP33; RP35; RP36; RP37; RP38; RP39; RP40; RP41; RP43; RP45; RP46; RP49; RP50; RP51; RP53; RP55; RP56; RP16; RP20; RP26; RP47; RP48; RP52; RP54; RP60; RP63; RP4; RP6; RP7; RP8; RP11; RP20; RP25; RP32; RP34; RP57; RP59; RP61; RP62; RP64; RP65	RP11; RP12; RP13; RP14; RP21; RP22; RP23; RP25; RP26; RP32; RP57; RP58; RP59; RP60; RP62; RP63; RP17; RP18; RP19; RP26; RP27; RP38; RP55; RP58; RP61; RP64; RP15; RP16; RP19; RP28; RP33; RP42; RP43; RP45; RP54; RP56; RP65
Very Low	RP5; RP8; RP9; RP28; RP1; RP4; RP6; RP42; RP30	RP20; RP65; RP10; RP15; RP17; RP26; RP30; RP33; RP39; RP40; RP41; RP43; RP45; RP50; RP56; RP18; RP23; RP24; RP27; RP37; RP38; RP42; RP46; RP49; RP51; RP53; RP64	RP64; RP25; RP32; RP65; RP5; RP14; RP22; RP29; RP59

1st preference ** 2nd preference3rd preference**

No.	Risk Description	No.	Risk Description
RP1	Change in law	RP33	Availability of finance
RP2	Delay in project approvals and permits	RP34	Inaccurate estimates
RP3	Poor public decision making process	RP35	High finance cost
RP4	Government intervention	RP36	High bidding costs
RP5	Unstable government	RP37	Delay in payment of annuity
RP6	Government reliability	RP38	Financial attraction of investors
RP7	Inconsistencies in government policies	RP39	Lack of creditworthiness
RP8	Strong political opposition /hostility	RP40	Delay in financial closures
RP9	Expropriation/nationalization of assets	RP41	Inability to service debt
RP10	Inability of concessionaire	RP42	Lack of government guarantees
RP11	Change in tax regulation	RP43	Financer unwilling to take high risk
RP12	Corruption and lack of respect for law	RP45	Construction time delay
RP13	Legislation change	RP46	Material availability
RP14	Import / Export restrictions	RP47	labour availability
RP15	Rate of return restrictions	RP48	Poor quality of workmanship
RP16	Industrial regulatory change	RP49	Default of sub-contractors or suppliers
RP17	Interest rate volatility	RP50	Design & construction complexity
RP18	Inflation rate volatility	RP51	Design deficiency
RP19	Foreign exchange and convertibility	RP52	Late design change
RP20	Poor financial market	RP53	Construction technology risk
RP21	Force majeure	RP54	Contractual risk
RP22	Environment	RP55	Contractor failure
RP23	Weather	RP56	Quality risk
RP24	Geotechnical condition	RP57	Different working method between partners
RP25	Tariff change	RP58	Inadequate experience in PPP
RP26	Market demand	RP59	Lack of commitment from public/private sector
RP27	Fluctuation of material cost by public/private	RP60	Organisation and coordination risk
RP28	Public opposition to projects	RP61	Inadequate distribution of responsibility and risk
RP29	Uncompetitive tender	RP62	Inadequate negotiation period prior to initiation
RP30	Level of demand for the project	RP63	Conflict between project's participants
RP31	Land acquisition	RP64	Workers strike
RP32	Competition risk	RP65	Cultural differences between main stakeholders

9.5 Appendix (5): Impact of Risk Cost on Risk Allocation

GO BACK

No.	Risk Description	Cost of Risk	Risk Allocation Heat Map			Risk Allocation		Does Cost Impact Risk Allocation
			Public	Private	Sharing	1st Pref.	2nd Pref.	
1	**Design Risk**							
1.1	Change in Output Specification	Low	13.0%	8.7%	0.0%	Public		No
		Medium	13.0%	4.3%	8.7%	Public		
		High	43.5%	8.7%	0.0%	Public		
		Total	**69.5%**	**21.7%**	**8.7%**			
1.2	Innovative design	Low	0.0%	30.4%	0.0%	Private		**Yes**
		Medium	8.7%	26.1%	13.0%	Private		
		High	4.3%	4.3%	13.0%	Sharing		
		Total	**13.0%**	**60.8%**	**26.0%**			
1.3	Design complexity	Low	0.0%	8.7%	0.0%	Private		**Yes**
		Medium	0.0%	56.5%	8.7%	Private		
		High	4.3%	8.7%	13.0%	Sharing		
		Total	**4.3%**	**73.9%**	**21.7%**			
1.4	Defects in design	Low	0.0%	8.7%	0.0%	Private		No
		Medium	0.0%	34.8%	0.0%	Private		
		High	4.3%	47.8%	4.3%	Private		
		Total	**4.3%**	**91.3%**	**4.3%**			
2	**Construction Risk**							
2.1	Change in scope	Low	8.7%	0.0%	0.0%	Public		**Yes**
		Medium	21.7%	8.7%	21.7%	Public	Sharing	
		High	21.7%	4.3%	13.0%	Public		
		Total	**52.1%**	**13.0%**	**34.7%**			
2.2	Constructability	Low	4.3%	17.4%	4.3%	Private		No
		Medium	0.0%	43.5%	4.3%	Private		
		High	0.0%	17.4%	8.7%	Private		
		Total	**4.3%**	**78.3%**	**17.3%**			

No.	Risk	Cost	Public	Private	Sharing	1st Pref.	2nd Pref.	Impact
2.3	Failure/delay in material delivery	Low	0.0%	21.7%	4.3%	Private		No
		Medium	0.0%	65.2%	0.0%	Private		
		High	0.0%	8.7%	0.0%	Private		
		Total	**0.0%**	**95.6%**	**4.3%**			
2.4	labour availability	Low	0.0%	39.1%	4.3%	Private		No
		Medium	0.0%	39.1%	8.7%	Private		
		High	0.0%	8.7%	0.0%	Private		
		Total	**0.0%**	**86.9%**	**13.0%**			
2.5	Defects in construction / Quality	Low	4.3%	13.0%	4.3%	Private		No
		Medium	0.0%	39.1%	4.3%	Private		
		High	0.0%	30.4%	4.3%	Private		
		Total	**4.3%**	**82.5%**	**12.9%**			
2.6	Construction Cost Overrun	Low	0.0%	8.7%	0.0%	Private		No
		Medium	0.0%	43.5%	0.0%	Private		
		High	0.0%	39.1%	8.7%	Private		
		Total	**0.0%**	**91.3%**	**8.7%**			
2.7	Delay in Completion	Low	4.3%	4.3%	4.3%	Inc.		**Yes**
		Medium	0.0%	30.4%	8.7%	Private		
		High	0.0%	34.8%	13.0%	Private	Sharing	
		Total	**4.3%**	**69.5%**	**26.0%**			
2.8	Construction technology risk	Low	0.0%	34.8%	0.0%	Private		No
		Medium	0.0%	43.5%	0.0%	Private		
		High	0.0%	17.4%	4.3%	Private		
		Total	**0.0%**	**95.7%**	**4.3%**			
2.9	Failure to meet the criteria	Low	0.0%	13.0%	0.0%	Private		No
		Medium	0.0%	43.5%	8.7%	Private		
		High	0.0%	26.1%	8.7%	Private		
		Total	**0.0%**	**82.6%**	**17.4%**			

No.	Risk	Cost	Public	Private	Sharing	1st Pref.	2nd Pref.	Impact
2.10	Failure/delay in commissioning test	Low	0.0%	26.1%	0.0%	Private		Yes
		Medium	0.0%	39.1%	17.4%	Private	Sharing	
		High	0.0%	17.4%	0.0%	Private		
		Total	**0.0%**	**82.6%**	**17.4%**			
3	**Operational Risk**							
3.1	Operating cost overrun	Low	0.0%	13.0%	0.0%	Private		**Yes**
		Medium	8.7%	30.4%	13.0%	Private	Sharing	
		High	4.3%	21.7%	8.7%	Private		
		Total	**13.0%**	**65.1%**	**21.7%**			
3.2	Delay /interruption in operation	Low	0.0%	13.0%	4.3%	Private		**Yes**
		Medium	4.3%	30.4%	21.7%	Private	Sharing	
		High	0.0%	21.7%	4.3%	Private		
		Total	**4.3%**	**65.1%**	**30.3%**			
3.3	Shortfall in service quality	Low	4.3%	13.0%	4.3%	Private		No
		Medium	0.0%	56.5%	8.7%	Private		
		High	0.0%	8.7%	4.3%	Private		
		Total	**4.3%**	**78.2%**	**17.3%**			
3.4	Maintenance cost overrun	Low	0.0%	13.0%	0.0%	Private		No
		Medium	4.3%	56.5%	4.3%	Private		
		High	4.3%	13.0%	4.3%	Private		
		Total	**8.6%**	**82.5%**	**8.6%**			
3.5	Obsolete technology	Low	4.3%	8.7%	21.7%	Sharing		**Yes**
		Medium	8.7%	26.1%	0.0%	Private		
		High	0.0%	13.0%	17.4%	Sharing	Private	
		Total	**13.0%**	**47.8%**	**39.1%**			
3.6	Waste of material	Low	0.0%	56.6%	8.7%	Private		No
		Medium	0.0%	30.4%	4.3%	Private		
		High	0.0%	0.0%	0.0%	Inc		
		Total	**0.0%**	**87.0%**	**13.0%**			

No.	Risk	Cost	Public	Private	Sharing	1st Pref.	2nd Pref.	Impact
3.7	Asset service Level Risk	Low	8.7%	26.1%	8.7%	Private		No
		Medium	4.3%	39.1%	4.3%	Private		
		High	0.0%	4.3%	4.3%	Inc		
		Total	**13.0%**	**69.5%**	**17.3%**			
3.8	Poor performance	Low	0.0%	17.4%	4.3%	Private		**Yes**
		Medium	0.0%	34.8%	17.4%	Private	Sharing	
		High	0.0%	13.0%	13.0%	Private	Sharing	
		Total	**0.0%**	**65.2%**	**34.7%**			
3.9	Inability of partners to honour financial obligations	Low	0.0%	13.0%	0.0%	Private		**Yes**
		Medium	0.0%	4.3%	26.1%	Sharing		
		High	4.3%	13.0%	39.1%	Sharing		
		Total	**4.3%**	**30.3%**	**65.2%**			
3.10	Acceptability risk (aesthetics)	Low	0.0%	34.8%	30.4%	Private	Sharing	**Yes**
		Medium	0.0%	13.0%	21.7%	Sharing		
		High	0.0%	0.0%	0.0%	Inc		
		Total	**0.0%**	**47.8%**	**52.1%**			
3.11	Theft	Low	0.0%	34.8%	30.4%	Private	Sharing	**Yes**
		Medium	0.0%	17.4%	13.0%	Private		
		High	4.3%	0.0%	0.0%	Inc		
		Total	**4.3%**	**52.2%**	**43.4%**			

9.6 Appendix (6): Impact of Partner Ability on Risk Allocation

GO BACK

No.	Risk Description	Partner Ability	Risk Allocation Heat Map			Risk Allocation		Does Ability Impact Risk Allocation
			Public	Private	Sharing	1st Pref.	2nd Pref.	
1	**Design Risk**							
1.1	Change in Output Specification	Public	34.8%	0.0%	13.0%	Public		**Yes**
		Private	13.0%	17.4%	0.0%	Private	Public	
		Both	8.7%	0.0%	13.0%	Sharing		
		Total	**56.5%**	**17.4%**	**26.0%**	**65.2%**		
1.2	Innovative design	Public	4.3%	0.0%	0.0%	Inc.		**Yes**
		Private	4.3%	52.2%	13.0%	Private		
		Both	0.0%	0.0%	26.1%	Sharing		
		Total	**8.6%**	**52.2%**	**39.1%**	**82.6%**		
1.3	Design complexity	Public	4.3%	8.7%	0.0%	Private		**Yes**
		Private	8.7%	56.5%	0.0%	Private		
		Both	0.0%	0.0%	21.7%	Sharing		
		Total	**13.0%**	**65.2%**	**21.7%**	**82.5%**		
1.4	Defects in design	Public	4.3%	4.3%	0.0%	Inc.		**Yes**
		Private	0.0%	73.9%	0.0%	Private		
		Both	0.0%	4.3%	13.0%	Sharing		
		Total	**4.3%**	**82.5%**	**13.0%**	**91.2%**		
2	**Construction Risk**							
2.1	Change in scope	Public	34.8%	4.3%	8.7%	Public		**Yes**
		Private	4.3%	4.3%	13.0%	Sharing		
		Both	4.3%	0.0%	26.1%	Sharing		
		Total	**43.4%**	**8.6%**	**47.8%**	**65.2%**		
2.2	Constructability	Public	0.0%	4.3%	0.0%	Inc.		**Yes**
		Private	4.3%	60.9%	13.0%	Private		
		Both	0.0%	0.0%	17.4%	Sharing		
		Total	**4.3%**	**65.2%**	**30.4%**	**78.3%**		

No.	Risk	Ability	Public	Private	Sharing	1st Pref.	2nd Pref.	Impact
2.3	Failure/delay in material delivery	Public	0.0%	4.3%	0.0%	Inc.		**Yes**
		Private	0.0%	82.6%	4.3%	Private		
		Both	0.0%	0.0%	8.7%	Sharing		
		Total	**0.0%**	**86.9%**	**13.0%**	**91.3%**		
2.4	labour availability	Public	4.3%	0.0%	0.0%	Inc.		**Yes**
		Private	0.0%	69.6%	4.3%	Private		
		Both	0.0%	8.7%	13.0%	Sharing		
		Total	**4.3%**	**78.3%**	**17.3%**	**86.9%**		
2.5	Defects in construction / Quality	Public	4.3%	0.0%	0.0%	Inc.		**Yes**
		Private	0.0%	87.0%	4.3%	Private		
		Both	0.0%	4.3%	0.0%	Inc.		
		Total	**4.3%**	**91.3%**	**4.3%**	**91.3%**		
2.6	Construction Cost Overrun	Public	0.0%	0.0%	0.0%	Inc.		**Yes**
		Private	0.0%	82.6%	0.0%	Private		
		Both	0.0%	8.7%	8.7%	Private	Sharing	
		Total	**0.0%**	**91.3%**	**8.7%**	**91.3%**		
2.7	Delay in Completion	Public	0.0%	0.0%	0.0%	Inc.		**Yes**
		Private	0.0%	56.5%	4.3%	Private		
		Both	0.0%	17.4%	21.7%	Sharing	Private	
		Total	**0.0%**	**73.9%**	**26.0%**	**78.2%**		
2.8	Construction technology risk	Public	0.0%	0.0%	0.0%	Inc.		**Yes**
		Private	0.0%	69.6%	21.7%	Private	Sharing	
		Both	0.0%	4.3%	4.3%	Inc.		
		Total	**0.0%**	**73.9%**	**26.0%**	**73.9%**		
2.9	Failure to meet the criteria	Public	0.0%	4.3%	0.0%	Inc.		**Yes**
		Private	0.0%	69.6%	8.7%	Private		
		Both	0.0%	8.7%	8.7%	Private	Sharing	
		Total	**0.0%**	**82.6%**	**17.4%**	**78.3%**		

No.	Risk	Ability	Public	Private	Sharing	1st Pref.	2nd Pref.	Impact
2.10	Failure/delay in commissioning test	Public	0.0%	0.0%	0.0%	Inc.		**Yes**
		Private	0.0%	78.3%	13.0%	Private	Sharing	
		Both	0.0%	0.0%	8.7%	Private		
		Total	**0.0%**	**78.3%**	**21.7%**	**87.0%**		
3	**Operational Risk**							
3.1	Operating cost overrun	Public	0.0%	0.0%	0.0%	Inc.		**Yes**
		Private	4.3%	60.9%	13.0%	Private		
		Both	4.3%	0.0%	17.4%	Sharing		
		Total	**8.6%**	**60.9%**	**30.4%**	**78.3%**		
3.2	Delay /interruption in operation	Public	0.0%	0.0%	4.3%	Inc.		**Yes**
		Private	0.0%	60.9%	17.4%	Private	Sharing	
		Both	0.0%	0.0%	17.4%	Sharing		
		Total	**0.0%**	**60.9%**	**39.1%**	**78.3%**		
3.3	Shortfall in service quality	Public	4.3%	0.0%	8.7%	Sharing		**Yes**
		Private	0.0%	73.9%	0.0%	Private		
		Both	0.0%	0.0%	13.0%	Sharing		
		Total	**4.3%**	**73.9%**	**21.7%**	**91.2%**		
3.4	Maintenance cost overrun	Public	0.0%	0.0%	4.3%	Inc.		**Yes**
		Private	0.0%	73.9%	4.3%	Private		
		Both	0.0%	0.0%	17.4%	Sharing		
		Total	**0.0%**	**73.9%**	**26.0%**	**91.3%**		
3.5	Obsolete technology	Public	0.0%	4.3%	4.3%	Inc.		**Yes**
		Private	4.3%	39.1%	13.0%	Private		
		Both	0.0%	0.0%	34.8%	Sharing		
		Total	**4.3%**	**43.4%**	**52.1%**	**73.9%**		
3.6	Waste of material	Public	0.0%	4.3%	0.0%	Inc.		**Yes**
		Private	0.0%	78.3%	8.7%	Private		
		Both	0.0%	0.0%	8.7%	Sharing		
		Total	**0.0%**	**82.6%**	**17.4%**	**87.0%**		

No.	Risk	Ability	Public	Private	Sharing	1st Pref.	2nd Pref.	Impact
3.7	Asset service Level Risk	Public	4.3%	0.0%	8.7%	Sharing		**Yes**
		Private	0.0%	52.2%	4.3%	Private		
		Both	0.0%	13.0%	17.4%	Sharing	Private	
		Total	**4.3%**	**65.2%**	**30.4%**	**73.9%**		
3.8	Poor performance	Public	4.3%	0.0%	0.0%	Inc.		**Yes**
		Private	0.0%	69.6%	8.7%	Private		
		Both	0.0%	0.0%	17.4%	Sharing		
		Total	**4.3%**	**69.6%**	**26.1%**	**91.3%**		
3.9	Inability of partners to honour financial obligations	Public	0.0%	0.0%	4.3%	Inc.		**Yes**
		Private	4.3%	34.8%	4.3%	Private		
		Both	0.0%	0.0%	52.2%	Sharing		
		Total	**4.3%**	**34.8%**	**60.8%**	**87.0%**		
3.10	Acceptability risk (aesthetics)	Public	0.0%	0.0%	4.3%	Inc.		**Yes**
		Private	0.0%	47.8%	13.0%	Private	Sharing	
		Both	0.0%	4.3%	30.4%	Sharing		
		Total	**0.0%**	**52.1%**	**47.7%**	**78.2%**		
3.11	Theft	Public	0.0%	0.0%	8.7%	Sharing		**Yes**
		Private	0.0%	43.5%	8.7%	Private		
		Both	4.3%	0.0%	34.8%	Sharing		
		Total	**4.3%**	**43.5%**	**52.2%**	**78.3%**		

9.7 Appendix (7): Impact of Public Attitude on Risk Allocation

GO BACK

No.	Risk Description	Public Attitude	Risk Allocation Heat Map			Risk Allocation		Does Attitude Impact Risk Allocation
			Public	Private	Sharing	1st Pref.	2nd Pref.	
1	**Design Risk**							
1.1	Change in Output Specification	Averse	4.5%	13.6%	9.1%	Private		**Yes**
		Neutral	4.5%	4.5%	4.5%	Inc.		
		Prone	45.5%	9.1%	4.5%	Public		
		Total	**54.5%**	**27.2%**	**18.1%**			
1.2	Innovative design	Averse	0.0%	22.7%	9.1%	Private		**Yes**
		Neutral	0.0%	22.7%	22.7%	Private	Sharing	
		Prone	0.0%	9.1%	13.6%	Sharing		
		Total	**0.0%**	**54.5%**	**45.4%**			
1.3	Design complexity	Averse	0.0%	31.8%	18.4%	Private	Sharing	**Yes**
		Neutral	0.0%	31.8%	9.1%	Private		
		Prone	4.5%	4.5%	0.0%	Inc.		
		Total	**4.5%**	**68.1%**	**27.5%**			
1.4	Defects in design	Averse	0.0%	63.6%	4.5%	Private		**No**
		Neutral	0.0%	9.1%	4.5%	Private		
		Prone	9.1%	9.1%	0.0%	Private		
		Total	**9.1%**	**81.8%**	**9.0%**			
2	**Construction Risk**							
2.1	Change in scope	Averse	4.5%	4.5%	0.0%	Inc.		**No**
		Neutral	18.2%	4.5%	9.1%	Public		
		Prone	45.5%	4.5%	9.1%	Public		
		Total	**68.2%**	**13.5%**	**18.2%**			
2.2	Constructability	Averse	4.5%	22.7%	4.5%	Private		**Yes**
		Neutral	0.0%	40.9%	22.7%	Private	Sharing	
		Prone	0.0%	0.0%	4.5%	Inc.		
		Total	**4.5%**	**63.6%**	**31.7%**			

No.	Risk	Pb Att.	Public	Private	Sharing	1st Pref.	2nd Pref.	Impact
2.3	Failure/delay in material delivery	Averse	0.0%	40.9%	9.0%	Private		**No**
		Neutral	0.0%	36.4%	0.0%	Private		
		Prone	0.0%	9.1%	4.5%	Private		
		Total	**0.0%**	**86.4%**	**13.5%**	**40.9%**		
2.4	labour availability	Averse	0.0%	27.3%	9.1%	Private		**Yes**
		Neutral	0.0%	31.8%	13.6%	Private	Sharing	
		Prone	0.0%	0.0%	18.2%	Sharing		
		Total	**0.0%**	**59.1%**	**40.9%**	**50.0%**		
2.5	Defects in construction / Quality	Averse	0.0%	50.0%	0.0%	Private		**No**
		Neutral	0.0%	36.4%	4.5%	Private		
		Prone	4.5%	4.5%	0.0%	Inc.		
		Total	**4.5%**	**90.9%**	**4.5%**			
2.6	Construction Cost Overrun	Averse	0.0%	45.5%	13.6%	Private		**No**
		Neutral	0.0%	22.7%	0.0%	Private		
		Prone	0.0%	13.6%	4.5%	Private		
		Total	**0.0%**	**81.8%**	**18.1%**			
2.7	Delay in Completion	Averse	0.0%	45.5%	18.2%	Private	Sharing	**Yes**
		Neutral	0.0%	18.5%	9.1%	Private		
		Prone	0.0%	4.5%	4.5%	Inc.		
		Total	**0.0%**	**81.8%**	**18.1%**			
2.8	Construction technology risk	Averse	0.0%	40.9%	4.5%	Private		**No**
		Neutral	0.0%	31.8%	9.1%	Private		
		Prone	0.0%	9.1%	4.5%	Private		
		Total	**0.0%**	**81.8%**	**18.1%**			
2.9	Failure to meet the criteria	Averse	0.0%	50.0%	13.6%	Private	Sharing	**Yes**
		Neutral	4.5%	27.3%	0.0%	Private		
		Prone	0.0%	4.5%	0.0%	Inc.		
		Total	**4.5%**	**81.8%**	**13.6%**			

No.	Risk	Pb Att.	Public	Private	Sharing	1st Pref.	2nd Pref.	Impact
2.10	Failure/delay in commissioning test	Averse	0.0%	45.5%	13.6%	Private	Sharing	**Yes**
		Neutral	0.0%	27.3%	4.5%	Private		
		Prone	4.5%	4.5%	0.0%	Inc.		
		Total	**4.5%**	**77.3%**	**18.1%**			
3	**Operational Risk**							
3.1	Operating cost overrun	Averse	4.5%	40.9%	13.6%	Private	Sharing	**Yes**
		Neutral	0.0%	18.2%	4.5%	Private		
		Prone	0.0%	4.5%	13.6%	Sharing		
		Total	**4.5%**	**63.6%**	**31.7%**			
3.2	Delay /interruption in operation	Averse	4.5%	36.4%	22.7%	Private	Sharing	**Yes**
		Neutral	0.0%	27.3%	0.0%	Private		
		Prone	0.0%	0.0%	9.1%	Sharing		
		Total	**4.5%**	**63.7%**	**31.8%**			
3.3	Shortfall in service quality	Averse	4.5%	63.6%	4.5%	Private		**No**
		Neutral	0.0%	9.1%	4.5%	Private		
		Prone	0.0%	9.1%	4.5%	Private		
		Total	**4.5%**	**81.8%**	**13.5%**			
3.4	Maintenance cost overrun	Averse	0.0%	50.0%	9.1%	Private		**Yes**
		Neutral	0.0%	18.2%	4.5%	Private		
		Prone	0.0%	4.5%	13.6%	Sharing		
		Total	**0.0%**	**72.7%**	**27.2%**			
3.5	Obsolete technology	Averse	4.5%	22.7%	18.2%	Private	Sharing	**Yes**
		Neutral	0.0%	13.6%	18.2%	Sharing	Private	
		Prone	0.0%	9.1%	13.6%	Sharing	Private	
		Total	**4.5%**	**45.4%**	**50.0%**			
3.6	Waste of material	Averse	0.0%	45.5%	0.0%	Private		**Yes**
		Neutral	0.0%	40.9%	4.5%	Private		
		Prone	0.0%	0.0%	9.1%	Sharing		
		Total	**0.0%**	**86.4%**	**13.6%**			

No.	Risk	Pb Att.	Public	Private	Sharing	1st Pref.	2nd Pref.	Impact
3.7	Asset service Level Risk	Averse	0.0%	40.9%	9.1%	Private		**Yes**
		Neutral	0.0%	22.7%	13.6%	Private		
		Prone	0.0%	0.0%	13.6%	Sharing		
		Total	**0.0%**	**63.6%**	**36.3%**			
3.8	Poor performance	Averse	0.0%	54.5%	13.6%	Private	Sharing	**Yes**
		Neutral	0.0%	18.2%	4.5%	Private		
		Prone	0.0%	0.0%	9.1%	Sharing		
		Total	**0.0%**	**72.7%**	**27.2%**			
3.9	Inability of partners to honour financial obligations	Averse	0.0%	18.2%	31.8%	Sharing	Private	**Yes**
		Neutral	0.0%	13.6%	13.6%	Sharing	Private	
		Prone	0.0%	4.5%	18.2%	Sharing		
		Total	**0.0%**	**36.3%**	**63.6%**			
3.10	Acceptability risk (aesthetics)	Averse	4.5%	31.8%	18.2%	Private	Sharing	**Yes**
		Neutral	0.0%	13.6%	13.6%	Private	Sharing	
		Prone	0.0%	0.0%	18.2%	Sharing		
		Total	**4.5%**	**45.4%**	**50.0%**			
3.11	Theft	Averse	9.1%	27.3%	31.8%	Sharing	Private	**Yes**
		Neutral	0.0%	9.1%	13.6%	Sharing	Private	
		Prone	0.0%	4.5%	4.5%	Inc.		
		Total	**9.1%**	**40.9%**	**49.9%**			

9.8 Appendix (8): Impact of Private Attitude on Risk Allocation GO BACK

No.	Risk Description	Private Attitude	Risk Allocation Heat Map			Risk Allocation		Does Attitude Impact Risk Allocation
			Public	Private	Sharing	1st Pref.	2nd Pref.	
1	**Design Risk**							
1.1	Change in Output Specification	Averse	45.5%	13.6%	0.0%	Public	Private	Yes
		Neutral	9.1%	4.5%	0.0%	Public		
		Prone	0.0%	9.1%	18.2%	Sharing		
		Total	**54.6%**	**27.2%**	**18.2%**			
1.2	Innovative design	Averse	0.0%	4.5%	4.5%	Inc.		Yes
		Neutral	0.0%	13.6%	18.2%	Sharing	Private	
		Prone	0.0%	36.4%	22.7%	Private	Sharing	
		Total	**0.0%**	**54.5%**	**45.4%**			
1.3	Design complexity	Averse	0.0%	9.1%	0.0%	Private		Yes
		Neutral	4.5%	13.6%	4.5%	Private		
		Prone	0.0%	45.5%	22.7%	Private	Sharing	
		Total	**4.5%**	**68.2%**	**27.2%**			
1.4	Defects in design	Averse	4.5%	13.6%	4.5%	Private		No
		Neutral	4.5%	4.5%	0.0%	Inc.		
		Prone	0.0%	63.6%	4.5%	Private		
		Total	**9.0%**	**81.7%**	**9.0%**			
2	**Construction Risk**							
2.1	Change in scope	Averse	50.0%	9.1%	9.1%	Public		No
		Neutral	4.5%	0.0%	4.5%	Inc.		
		Prone	13.6%	4.5%	4.5%	Public		
		Total	**68.1%**	**13.6%**	**18.1%**			
2.2	Constructability	Averse	4.5%	9.1%	9.1%	Private	Sharing	Yes
		Neutral	0.0%	4.5%	9.1%	Sharing		
		Prone	0.0%	50.0%	13.6%	Private	Sharing	
		Total	**4.5%**	**63.6%**	**31.8%**			

No.	Risk	Pr Att.	Public	Private	Sharing	1st Pref.	2nd Pref.	Impact
2.3	Failure/delay in material delivery	Averse	0.0%	27.3%	0.0%	Private		Yes
		Neutral	0.0%	0.0%	0.0%	Inc.		
		Prone	0.0%	59.1%	13.6%	Private	Sharing	
		Total	**0.0%**	**86.4%**	**13.6%**	**13.6%**		
2.4	labour availability	Averse	0.0%	9.1%	18.2%	Sharing		Yes
		Neutral	0.0%	0.0%	9.1%	Sharing		
		Prone	0.0%	50.0%	13.6%	Private	Sharing	
		Total	**0.0%**	**59.1%**	**40.9%**	**13.6%**		
2.5	Defects in construction / Quality	Averse	0.0%	18.2%	0.0%	Private		No
		Neutral	4.5%	13.6%	4.5%	Private		
		Prone	0.0%	59.1%	0.0%	Private		
		Total	**4.5%**	**90.9%**	**4.5%**			
2.6	Construction Cost Overrun	Averse	0.0%	31.8%	4.5%	Private		No
		Neutral	0.0%	4.5%	4.5%	Inc.		
		Prone	0.0%	45.5%	9.1%	Private		
		Total	**0.0%**	**81.8%**	**18.1%**			
2.7	Delay in Completion	Averse	0.0%	18.2%	9.1%	Private		Yes
		Neutral	0.0%	13.6%	13.6%	Private	Sharing	
		Prone	0.0%	36.4%	9.1%	Private		
		Total	**0.0%**	**68.2%**	**31.8%**			
2.8	Construction technology risk	Averse	0.0%	13.6%	4.5%	Private		No
		Neutral	0.0%	18.2%	9.1%	Private		
		Prone	0.0%	50.0%	4.5%	Private		
		Total	**0.0%**	**81.8%**	**18.1%**			
2.9	Failure to meet the criteria	Averse	0.0%	9.1%	9.1%	Private	Sharing	Yes
		Neutral	0.0%	18.2%	0.0%	Private		
		Prone	4.5%	54.5%	4.5%	Private		
		Total	**4.5%**	**81.8%**	**13.6%**			

No.	Risk	Pr Att.	Public	Private	Sharing	1st Pref.	2nd Pref.	Impact
2.10	Failure/delay in commissioning test	Averse	4.5%	18.2%	4.5%	Private		Yes
		Neutral	0.0%	4.5%	9.1%	Sharing		
		Prone	0.0%	54.4%	4.5%	Private		
		Total	**4.5%**	**77.1%**	**18.1%**			
3	**Operational Risk**							
3.1	Operating cost overrun	Averse	4.5%	13.6%	13.6%	Private	Sharing	Yes
		Neutral	0.0%	9.1%	0.0%	Private		
		Prone	0.0%	40.9%	18.2%	Private	Sharing	
		Total	**4.5%**	**63.6%**	**31.8%**			
3.2	Delay /interruption in operation	Averse	0.0%	4.5%	18.2%	Sharing		Yes
		Neutral	0.0%	4.5%	0.0%	Inc.		
		Prone	4.5%	54.5%	13.6%	Private	Sharing	
		Total	**4.5%**	**63.5%**	**31.8%**			
3.3	Shortfall in service quality	Averse	0.0%	13.6%	4.5%	Private		No
		Neutral	0.0%	4.5%	0.0%	Inc.		
		Prone	4.5%	63.6%	9.1%	Private		
		Total	**4.5%**	**81.7%**	**13.6%**			
3.4	Maintenance cost overrun	Averse	0.0%	13.6%	9.1%	Private		Yes
		Neutral	0.0%	4.5%	0.0%	Inc.		
		Prone	0.0%	54.5%	18.2%	Sharing	Private	
		Total	**0.0%**	**72.6%**	**27.3%**			
3.5	Obsolete technology	Averse	4.5%	4.5%	9.1%	Sharing		Yes
		Neutral	0.0%	0.0%	18.2%	Sharing		
		Prone	0.0%	40.9%	22.7%	Private	Sharing	
		Total	**4.5%**	**45.4%**	**50.0%**			
3.6	Waste of material	Averse	0.0%	18.2%	4.5%	Private		No
		Neutral	0.0%	13.6%	4.5%	Private		
		Prone	0.0%	54.5%	4.5%	Private		
		Total	**0.0%**	**86.3%**	**13.5%**			

No.	Risk	Pr Att.	Public	Private	Sharing	1st Pref.	2nd Pref.	Impact
3.7	Asset service Level Risk	Averse	0.0%	9.1%	9.1%	Private	Sharing	Yes
		Neutral	0.0%	22.7%	9.1%	Private	Sharing	
		Prone	0.0%	31.8%	18.2%	Private	Sharing	
		Total	**0.0%**	**63.6%**	**36.4%**			
3.8	Poor performance	Averse	0.0%	9.1%	9.1%	Private	Sharing	Yes
		Neutral	0.0%	4.5%	4.5%	Inc.		
		Prone	0.0%	59.1%	13.6%	Private	Sharing	
		Total	**0.0%**	**72.7%**	**27.2%**			
3.9	Inability of partners to honour financial obligations	Averse	0.0%	9.1%	31.8%	Sharing		Yes
		Neutral	0.0%	0.0%	9.1%	Sharing		
		Prone	0.0%	27.3%	22.7%	Sharing	Private	
		Total	**0.0%**	**36.4%**	**63.6%**			
3.10	Acceptability risk (aesthetics)	Averse	0.0%	9.1%	9.1%	Private	Sharing	Yes
		Neutral	0.0%	4.5%	18.2%	Sharing		
		Prone	4.5%	31.8%	22.7%	Private	Sharing	
		Total	**4.5%**	**45.4%**	**50.0%**			
3.11	Theft	Averse	4.5%	4.5%	18.2%	Sharing		Yes
		Neutral	0.0%	9.1%	22.7%	Sharing		
		Prone	4.5%	27.3%	9.1%	Private		
		Total	**9.0%**	**40.9%**	**50.0%**			

9.9 Appendix (9): Risk Allocation Matrixes

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Change in Output Specification	Risk Allocation	Risk Re-allocation Option no.1	Risk Re-allocation Option no.2
Low	X		
Medium	X		
High	X		
Public	X		
Private	X	X	
Both			X
Public Averse		X	
Public Neutral			
Public Prone to	X		
Private Averse	X	X	
Private Neutral	X		
Private Prone to			X
	Public	**Private**	**Sharing**
	1st preference, 2nd preference		

Innovative Design		Risk Allocation	Risk Re-allocation Option no.1
Low		X	
Medium		X	
High			X
Public			
Private		X	
Both			X
Public Averse		X	
Public Neutral		X	X
Public Prone to			X
Private Averse			
Private Neutral		X	X
Private Prone to		X	X
	Public	**Private**	**Sharing**
	1st preference, 2nd preference		

Design Complexity		Risk Allocation	Risk Re-allocation Option no.1
Low		X	
Medium		X	
High			X
Public			
Private		X	
Both			X
Public Averse		X	X
Public Neutral		X	
Public Prone to			
Private Averse		X	
Private Neutral		X	
Private Prone to		X	X
	Public	**Private**	**Sharing**
	1st preference, 2nd preference		

Defects in Design		Risk Allocation	Risk Re-allocation Option no.1
Low		X	
Medium		X	
High		X	
Public			
Private		X	
Both			X
Public Averse		X	
Public Neutral		X	
Public Prone to		X	
Private Averse		X	
Private Neutral			
Private Prone to		X	
	Public	**Private**	**Sharing**
	1st preference, 2nd preference		

Change in Scope	Risk Allocation		Risk Re-allocation Option no.1
Low	X		
Medium	X		X
High	X		
Public	X		
Private			X
Both			X
Public Averse			
Public Neutral	X		
Public Prone to	X		
Private Averse	X		
Private Neutral			
Private Prone to	X		
	Public	**Private**	**Sharing**
	1st preference, 2nd preference		

Constructability		Risk Allocation	Risk Re-allocation Option no.1
Low		X	
Medium		X	
High		X	
Public			
Private		X	
Both			X
Public Averse		X	
Public Neutral		X	X
Public Prone to			
Private Averse		X	X
Private Neutral			X
Private Prone to		X	X
	Public	**Private**	**Sharing**
	1st preference, 2nd preference		

Failure/delay in Material Delivery		Risk Allocation	Risk Re-allocation Option no.1
Low		X	
Medium		X	
High		X	
Public			
Private		X	
Both			X
Public Averse		X	
Public Neutral		X	
Public Prone to		X	
Private Averse		X	
Private Neutral			
Private Prone to		X	X
	Public	Private	Sharing

1st preference, 2nd preference

Labor Availability		Risk Allocation	Risk Re-allocation Option no.1
Low		X	
Medium		X	
High		X	
Public			
Private		X	
Both			X
Public Averse		X	
Public Neutral		X	
Public Prone to			X
Private Averse			X
Private Neutral			X
Private Prone to		X	X
	Public	Private	Sharing

1st preference, 2nd preference

Defects in Construction / Quality		Risk Allocation	
Low		X	
Medium		X	
High		X	
Public			
Private		X	
Both			
Public Averse		X	
Public Neutral		X	
Public Prone to			
Private Averse		X	
Private Neutral		X	
Private Prone to		X	
	Public	Private	Sharing

1st preference, 2nd preference

Construction Cost Overrun		Risk Allocation	Risk Re-allocation Option no.1
Low		X	
Medium		X	
High		X	
Public			
Private		X	
Both		X	X
Public Averse		X	
Public Neutral		X	
Public Prone to		X	
Private Averse		X	
Private Neutral			
Private Prone to		X	
	Public	Private	Sharing

1st preference, 2nd preference

Delay in Completion		Risk Allocation	Risk Re-allocation Option no.1
Low			
Medium		X	
High		X	X
Public			
Private		X	
Both		X	X
Public Averse		X	X
Public Neutral		X	
Public Prone to			
Private Averse		X	
Private Neutral		X	X
Private Prone to		X	
	Public	Private	Sharing

1st preference, 2nd preference

Construction Technology Risk		Risk Allocation	Risk Re-allocation Option no.1
Low		X	
Medium		X	
High		X	
Public			
Private		X	X
Both			
Public Averse		X	
Public Neutral		X	
Public Prone to		X	
Private Averse		X	
Private Neutral		X	
Private Prone to		X	
	Public	Private	Sharing

1st preference, 2nd preference

Failure to Meet the Criteria		Risk Allocation	Risk Re-allocation Option no.1
Low		X	
Medium		X	
High		X	
Public			
Private		X	
Both		X	X
Public Averse		X	X
Public Neutral		X	
Public Prone to			
Private Averse		X	X
Private Neutral		X	
Private Prone to		X	
	Public	Private	Sharing
	1st preference, 2nd preference		

Failure/Delay in Commissioning Test		Risk Allocation	Risk Re-allocation Option no.1
Low		X	
Medium		X	X
High		X	
Public			
Private		X	X
Both		X	
Public Averse		X	X
Public Neutral		X	
Public Prone to			
Private Averse		X	
Private Neutral			X
Private Prone to		X	
	Public	Private	Sharing
	1st preference, 2nd preference		

Operating Cost Overrun		Risk Allocation	Risk Re-allocation Option no.1
Low		X	
Medium		X	X
High		X	
Public			
Private		X	
Both			X
Public Averse		X	X
Public Neutral		X	
Public Prone to			X
Private Averse		X	X
Private Neutral		X	
Private Prone to		X	X
	Public	Private	Sharing
	1st preference, 2nd preference		

Delay /Interruption in Operation		Risk Allocation	Risk Re-allocation Option no.1
Low		X	
Medium		X	X
High		X	
Public			
Private		X	X
Both			X
Public Averse		X	X
Public Neutral		X	
Public Prone to			X
Private Averse			X
Private Neutral			
Private Prone to		X	X
	Public	Private	Sharing
	1st preference, 2nd preference		

Shortfall in Service Quality		Risk Allocation	Risk Re-allocation Option no.1
Low		X	
Medium		X	
High		X	
Public			X
Private		X	
Both			X
Public Averse		X	
Public Neutral		X	
Public Prone to		X	
Private Averse		X	
Private Neutral			
Private Prone to		X	
	Public	Private	Sharing
	1st preference, 2nd preference		

Maintenance Cost Overrun		Risk Allocation	Risk Re-allocation Option no.1
Low		X	
Medium		X	
High		X	
Public			
Private		X	
Both			X
Public Averse		X	
Public Neutral		X	
Public Prone to			X
Private Averse		X	
Private Neutral			
Private Prone to		X	X
	Public	Private	Sharing
	1st preference, 2nd preference		

Obsolete Technology		Risk Re-allocation Option no.2	Risk Re-allocation Option no.1
Low			X
Medium		X	
High		X	X
Public			
Private		X	
Both			X
Public Averse		X	X
Public Neutral		X	X
Public Prone to		X	X
Private Averse			X
Private Neutral			X
Private Prone to		X	X
	Public	**Private**	**Sharing**
	1st preference, 2nd preference		

Waste of Material		Risk Allocation	Risk Re-allocation Option no.1
Low		X	
Medium		X	
High			
Public			
Private		X	
Both			X
Public Averse		X	
Public Neutral		X	
Public Prone to			X
Private Averse		X	
Private Neutral		X	
Private Prone to		X	
	Public	**Private**	**Sharing**
	1st preference, 2nd preference		

Asset Service Level Risk		Risk Allocation	Risk Re-allocation Option no.1
Low		X	
Medium		X	
High			
Public			X
Private		X	
Both		X	X
Public Averse		X	
Public Neutral		X	
Public Prone to			X
Private Averse		X	X
Private Neutral		X	X
Private Prone to		X	X
	Public	**Private**	**Sharing**
	1st preference, 2nd preference		

Poor Performance		Risk Allocation	Risk Re-allocation Option no.1
Low		X	
Medium		X	X
High		X	X
Public			
Private		X	
Both			X
Public Averse		X	X
Public Neutral		X	
Public Prone to			X
Private Averse		X	X
Private Neutral			
Private Prone to		X	X
	Public	**Private**	**Sharing**
	1st preference, 2nd preference		

Inability of Partners to Honor Financial Obligations		Risk Re-allocation Option no.1	Risk Allocation
Low		X	
Medium			X
High			X
Public			
Private		X	
Both			X
Public Averse		X	X
Public Neutral		X	X
Public Prone to			X
Private Averse			X
Private Neutral			X
Private Prone to		X	X
	Public	**Private**	**Sharing**
	1st preference, 2nd preference		

Acceptability Risk		Risk Re-allocation Option no.2	Risk Re-allocation Option no.1
Low		X	X
Medium			X
High			
Public			
Private		X	X
Both			X
Public Averse		X	X
Public Neutral		X	X
Public Prone to			X
Private Averse		X	X
Private Neutral			X
Private Prone to		X	X
	Public	**Private**	**Sharing**
	1st preference, 2nd preference		

Theft		Risk Re-allocation Option no.2	Risk Re-allocation Option no.1
Low		X	X
Medium		X	
High			
Public			X
Private		X	
Both			X
Public Averse		X	X
Public Neutral		X	X
Public Prone to			
Private Averse			X
Private Neutral			X
Private Prone to		X	
	Public	**Private**	**Sharing**
	1st preference, 2nd preference		