ABSTRACT

Title of Document: DEVELOPING A FRAMEWORK FOR EX-POST VALUE FOR MONEY ANALYSIS IN PUBLIC PRIVATE PARTNERSHIP PROJECTS

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In recent years, Public Private Partnerships (PPPs) has emerged as a project delivery option for transportation projects in the US. This type of project delivery is generally a long term agreement between the public and private sectors for the purpose of delivering a project or service traditionally provided by the public sector. Some of the reasons for implementing PPPs are the ability to provide an overall lower life-cycle cost and to increase cost and schedule certainty. This is sometimes referred to as the ability to provide a better Value for Money, hence the use of Value for Money (VFM) analyses to compare overall financial impacts of PPP against those of a traditional delivery alternative. While the VFM analysis is considered as the best practice for selecting PPP approach, the primary challenge in conducting the analysis, however, is to validate the empirical results of these studies. Most of the previous studies have investigated ex-ante results and little has been done in regards to what can be considered ex-post studies. This study presents a framework for ex-post value for money analysis. Processes,

data requirement, and algorithms are developed to ensure an ex-post assessment can be performed at various stages of PPP project development including commercial close, substantial completion, during operation and maintenance phase, and final acceptance. The Presidio Parkway project in San Francisco will be used as a case study to illustrate the method and procedure of ex-post VFM analysis framework.

DEVELOPING A FRAMEWORK FOR EX-POST VALUE FOR MONEY ANALYSIS IN PUBLIC PRIVATE PARTNERSHIP PROJECTS

By

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Thesis submitted to the Faculty of the Graduate School of the
University of Maryland, College Park, in partial fulfillment
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2015

Advisory Committee:
Professor Qingbin Cui, Chair
Professor John Cable
Professor Ralph Bennett

Dedication

I dedicate this thesis to my parents, Farideh and Mehdi, and my sister, Lida, without their LOVE, LOVE, LOVE, and Support in my whole life I could not reach to this point. I want to say Thank you to them and say they are in my heart although they cannot participate in my defense meeting.

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Lastly, I offer my regards and blessings to all of those who supported me in any respect during the completion of the project. Many thanks go in particular to Mr. Bob Masys for his support and cooperation to collect data for Presidio Parkway case, and also to all employees of the San Francisco County Transportation without their help it would have not been possible to finish this study.

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Chapter 1: Introduction and Overview

1.1. Overview

Transportation agencies have increasingly considered the use of public private partnerships (PPPs) as an alternative project delivery method for public projects. This trend has been largely driven by a shortage of public funds, greater cost certainty and the perceived ability of PPPs to lower life-cycle costs–the ability to offer better value for money.

The Value for Money (VFM) analysis is typically used to compare aggregate benefits and costs of the PPP approach against those for the traditional public delivery alternative, which is typically Design-Bid-Build (DBB).

However, the effectiveness of PPP is not known; this is because, to date, only ex-ante VFM analysis has been performed, without validation from ex-post evaluation. The studies that have been completed in other countries show mixed and controversial performance of PPP practices. For instance, positive results were found for PPPs in terms of cost and time efficiency when Grimsey and Lewis (2005) examined major infrastructure projects in the United Kingdom and similar positive results for PPPs were reported from the comparison of 21 PPP projects in Australia by Raisbeck et al. (2010). However, other studies, such as Murphy (2008), Kakabadse et al. (2007), and de Neufville et al. (2010) illustrated numerous examples of PPPs failing to deliver value for money.

These early works reported on multiple projects and ignored the unique contextual aspects of each project. Because projects are greatly influenced by project specific

characteristics that go beyond procurement options, including, but not limited to location, organizational structure, technical complexity, and societal dimensions, it is important to consider these characteristics.

This thesis aims to give an overview of how ex-post value for money analysis can play an integral role in future decision making process for PPP projects and will outline several of the most important aspects of ex-post value for money Framework. The main purpose of this thesis is to provide a resource for public agencies on VFM analysis in PPPs by exploring the state of the practice.

The second chapter of the study provides quick overview on current VFM analysis. It then provides information regarding how other agencies have used a VFM assessment as a means of comparison with the base example. Next, chapter two provides a discussion of the debates and concerns regarding the use of VFM analysis in PPPs, addressing the existing shortcomings of the methodology and introduces the necessity of developing ex-post VFM framework. Afterward, chapter 3 provides a framework for ex-post VFM analysis by elaborating and assessing the VFM components at each of the milestone during the project lifecycle; and chapter 4 uses a case study, Presidio Parkway project, to conduct both ex-ante and ex-post VFM analysis.

1.2. Importance of the Topic

The majority of researches and studies on VFM of PPPs have focused on the ex-ante VFM analysis. Ex-ant VFM analysis basically analyzes the project before the public-sector receives the bids i.e., commercial close to define whether PPP alternative

can be an option for the project or not. So, it does not assess the value for money after commercial close which is really critical to track.

Therefore, there is a need to develop a new framework for VFM analysis to evaluate the PPP project during project lifecycle. Consequently, ex-post VFM analysis can be the answer to this need and it should be conducted by public and private sector to monitor the initial VFM analysis to see whether project still brings value for money or not.

1.3. Research Methodology

In this study, the research methodology consists of three sections. First, the current and previous studies about value for money will be reviewed to understand the whole concept of the value for money in PPP projects. Then, based on the concept of ex-ante, a new structure will be developed for value for money as an ex-post VFM analysis considering time, costs, risks, unforeseen elements, and financial parameters as principals which should be adjusted or updated at each milestone every time. Finally, a case study, Presidio Parkway, will be applied to investigate and study the concept of ex-post VFM analysis and compare the results of ex-post VFM analysis at different stages.

1.4. Thesis Outline

This thesis has five chapters; Chapter one is the introduction that establishes the research need and explains the methodology and structure of the thesis. The second chapter of the study provides quick overview on current VFM analysis. It then provides information regarding how other agencies have used a VFM assessment as a means of

comparison with the base example. Chapter two also provides a discussion of the debates and concerns regarding the use of VFM analysis in PPPs, addressing the existing shortcomings of the methodology and introduces the necessity of developing ex-post VFM framework to monitor the performance of PPP projects in term of value for money.

In Chapter three, the first step is to define different ex-post VFM at different stages of the project life cycle. Then, a framework for ex-post VFM analysis will be presented considering various major elements such as costs, risks, unforeseen factors, and financial parameters.

Chapter four provide background information for the Presidio Parkway project in San Francisco. Then, the project data will be applied to recreate ex-ante VFM analysis and conduct ex-post VFM analyses at different stages based on the availability of the data. Finally, Chapter five presents the conclusions and suggestions.

Chapter 2: Literature Review

2.1 Overview

Transportation agencies have increasingly considered the use of public private partnerships (PPPs) as an alternative project delivery method for public projects. This trend has been largely driven by a shortage of public funds, greater cost certainty and the perceived ability of PPPs to lower life-cycle costs—the ability to offer better value for money. The Value for Money (VFM) analysis is typically used to compare aggregate benefits and costs of the PPP approach against those for the traditional public delivery alternative, which is typically Design-Bid-Build (DBB). However, the effectiveness of PPP is not known. This is because, to date, only ex-ante VFM analysis has been performed, without validation from ex-post evaluation.

This chapter will review the literature and give a general understanding of PPPs and their benefits. It will focus on Value for Money (VFM) analysis, which is the topic of this study. Before considering the performance of VFM analysis, one should have a good understanding of different aspects of VFM. Reviewing what other scholars have found about VFM will help us to develop a better framework for the discussion. In particular, the literature review will focus on the performance of current practices of VFM, and the necessity of developing ex-post VFM for current and future PPP projects.

This chapter is organized as follows: Section 1 reviews different project delivery methods. Section 2 covers the different definitions of PPP project delivery, assessing the current PPP market in the US, especially at transportation projects, and the advantages and disadvantages of PPPs. Section 3 elaborates the definition of Value for Money Analysis; then, it presents a brief overview of VFM in PPP projects, talks about

the advantages and disadvantages of the current structure of VFM, and explains the necessity of developing the ex-post VFM analysis in PPP projects.

2.2 Different Types of Project Delivery

Cost, quality and time are three main parameters of each project essential to both the public and private sectors. Owner of the projects, which are mostly public-sector in infrastructure projects such as transportation, have been trying to enhance the quality, decrease the project cost, and compress the delivery period for their projects. As a result, different types of project delivery methods have been developed and applied in various projects, especially in transportation projects.

In fact, project delivery method is a term which is used to refer to all the contractual relations, roles, and responsibilities of the entities involved in a project. The Associated General Contractors of America (AGC) defines the project delivery method as “the comprehensive process of assigning the contractual responsibilities for designing and constructing a project" and it identifies the primary parties taking contractual responsibility for the performance of the work as the owner and contractor of the project”(Ohrn & Rogers, 2004).

In other study, Gransberg and Shane defined the project delivery as the way the contracts between the owner, the designer, and the builder are formed and the technical relationships that evolve between each party within those contracts (Gransberg & Shane, 2010). The term delivery method also refers to the approach used to organize the project team to manage the entire designing and building process. In other words, the owner decides which designers and contractors to use, when to hire them, and under what type of contract (Gloud, 2005).

Therefore, agencies or owners apply different project delivery methods to organize and finance different stages of projects including design, construction, and O&M at different type of projects from small building to mega projects like highway, airport and wastewater treatment plant. Touran (2009) mentioned that project delivery method is a process whereby the project is comprehensively designed and constructed for the client. It includes designer companies, constructors, contractors and various consulting firms; sequencing of design and construction operations; execution of design and construction; and closeout and start-up. Texas Department of Transportation (DOT) has defined project delivery method in another way: "A project delivery method equates to a procurement approach and defines the relationships, roles and responsibilities of project team members and sequences of activities required to complete a project" (Chasey, Gibson, & Pendyala, 2012).

Currently available project delivery methods have been created based on the traditional design-bid-build (DBB) method. Shortage in public funds is one of the reasons that the public-sector is interested in using the private sector in design, construction and even O&M via alternative project delivery methods such as construction management, design-build, and different types of public-private partnership (Brownstein et al., n.d.). Each of these project delivery methods will be elaborated in the following sections. Different delivery methods include:

- Design-Bid-Build (DBB);
- CM at Risk (CMR);
- Design-Build (DB); and
- Different types of Public-Private Partnership (PPP or P3).

For each of these delivery methods, the standardized definitions and a brief explanation with a graphic displaying the contractual relationships are included below (Gransberg & Shane, 2010).

Design-Bid-Build (DBB)

A conventional or traditional project delivery method is one in which an owner either completes the design using in-house design professionals or asks an outside designer to furnish complete design services. The owner then advertises and awards a separate construction contract based on the completed construction design documents. In other words, owners will assign two different contractors to the project. One is a designer contract, and the other is a builder contract in which designer and builder do not have any contract or responsibility to each other but just have a contract with the owner. In either case, the owner is responsible for the details of design and warrants the quality of the construction documents to the construction contractor. Figure 2.1 shows the general structure of DBB and illustrates the relations between the designer and the builder in the project delivery process.

In DBB, the owner "owns" the details of design during construction and as a result is financially liable for the cost of any errors or omissions encountered in construction (Touran, et al., 2009). In public DBB projects, the projects will be generally awarded on a low-bid basis. There is no contractual incentive for the builder to minimize the cost growth in this delivery system. Indeed, there can be an opposite effect: a builder who has submitted a low bid may need to review post-award changes as a means to make a profit on the project after bidding the lowest possible margin to win the project (Cushman, 1992) (Touran, et al., 2009)(Gransberg & Shane, 2010).

Gloud also mentioned that the traditional project delivery method is DBB, that is, an owner retains a designer to provide complete design services and then advertises and awards a separate construction contract that is based on the designer's completed construction documents. The owner is responsible for the details of design and warrants the quality of the construction design documents to the construction contractor (Gloud, 2005).

In summary, Design-Bid-Build involves:

- Separate contracts for design and construction
- Contractor selection based on lowest bid
- Design documents that are 100% complete
- No contract between designer and contractors

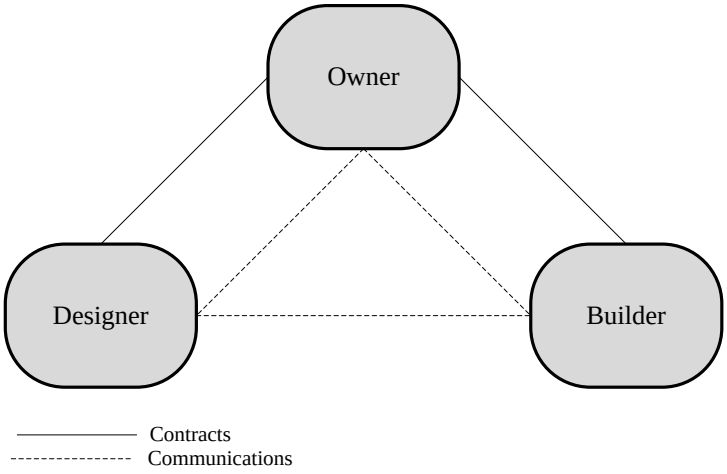

Figure 2.1-Design-Bid-Build Structure

One of the disadvantages of this method is that the contractor has no input until the bid award phase (Gloud, 2005).

Construction Manager at Risk (CMR)

CMR is a type of project delivery system in which an owner or client contracts with a construction manager, based on qualifications, experience, fees for management services, and target construction price, to manage and construct a project and transfer risks to CM (Caltrans, 2008; CDOT, 2008).

CMR is an integrated team approach to the planning, design, and construction of a project. It serves to help control the schedule and budget, and to ensure quality for the project owner. The team consists of the owner, the designer, and the at-risk construction manager (figure 2.2). A CMR contract includes preconstruction and construction services. The construction manager is usually selected earlier in the design process and collaborates with the owner and designer during all phases of the project, including but not limited to planning, design, third-party coordination, constructability reviews, cost engineering reviews, value engineering, material selection, and contract package development. The construction manager and the designer commit to a high degree of collaboration. This is especially important when the agency is using CMR to implement new construction technologies. A guaranteed maximum price (GMP) is established when the design of a specific feature of work is nearly complete (progressive GMP) or when the entire design is at a point where the CMR can reduce the magnitude of necessary contingencies. The construction manager warrants to the owner that the project will be built at a price not to exceed the GMP.

After the design is complete, the construction manager acts as the general contractor during the project construction phase. Strang describes the relationship change as follows: “The construction manager is an agent of the Owner in managing the design

process, but takes the role of a vendor when a total cost guarantee is given." (Gransberg & Shane, 2010; Strang, 2002).

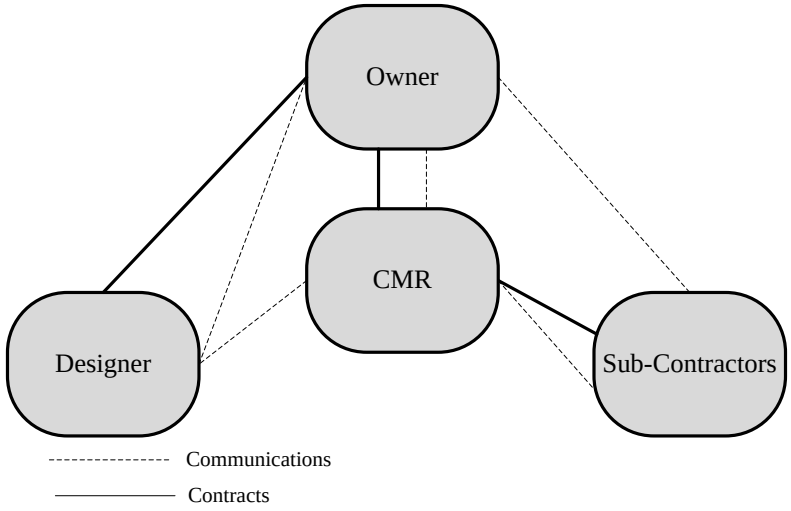

Figure 2.2-Construction at Risk Structure

Design-Build (DB)

Another project delivery method that has been used in many projects is Design-Build (DB). DB is a project delivery system in which a single entity performs the design and construction of a project.

DB is a project delivery method in which the owner procures both design and construction services in the same contract. The method typically uses request for qualifications (RFQ)/request for proposals (RFP) procedures rather than the DBB invitation for bids procedures. There are a number of variations on the DB process, but all involve three major components. First, the owner develops an RFQ/RFP that describes essential project requirements in performance terms. Next, proposals are evaluated. Finally, with evaluation complete, the owner engages in a process that leads to contracts being awarded for both design and construction services. The DB entity is liable for all design and construction costs and normally provides a firm, fixed price in

its proposal (Ibbs, Kwak, Ng, & Odabasi, 2003). This procurement model introduces the general concept of another project delivery, i.e., public private partnership, which will be discussed in detail.

Moreover, DB has its own advantages and disadvantages (CDOT, 2008). Among these advantages are: better risk allocation, clear project goals, reduced delivery time, better project feedback, single source of responsibility, enhanced innovation, partnering, early knowledge of project costs, integration of design and construction. Among the disadvantages are: potential culture change, cost estimation difficulties, contractors paying estimates during construction (lump sum), and overly fast (hasty) review of plans.

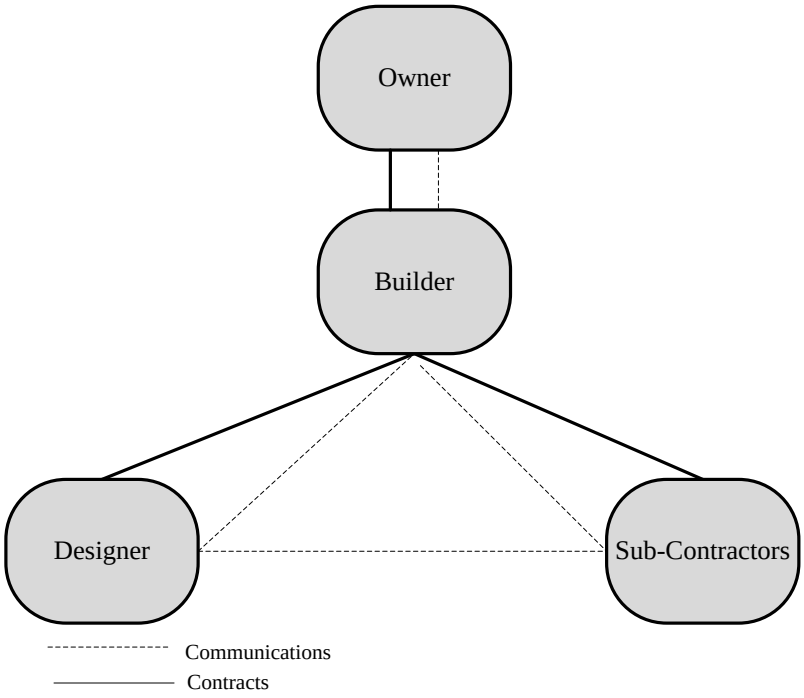

Figure 2.3-Design-Bid Structure

Figure 2.3 illustrates the general structure of DB procurement methods and the connections between different players.

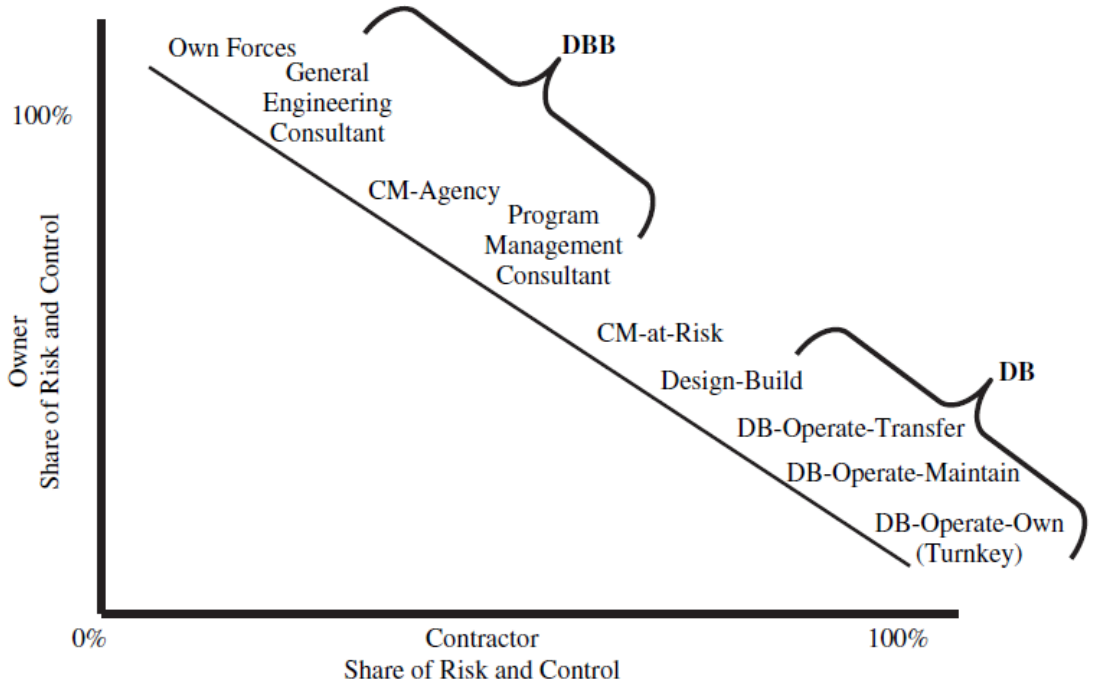

Figure 2.4-Project Delivery Methods Ranked by Risk/Control Shares (Gransberg & Shane, 2005)

Figure 2.4 is adapted from a FTA manual (Construction Project Management Handbook 2006) and summarizes the difference between variations on the three project delivery methods in terms of risk distribution and control between the owner and its contractors (Gransberg & Shane, 2010). Different types of DBB and DB are elaborated in the figure. It shows that there is a direct relationship between owner share risk and contractor share risk. By moving from DBB to DB the percentage of risk that the private-sector assumes increases. This means that the private-sector, or the contractor, has more responsibilities in handling the project.

2.3 Public-Private Partnership (PPP)

PPP projects are thought to have developed in the 1980s in the United Kingdom as a form of agreement between the public and private sector. It is possible to find concession models from the 15th century in which the King allowed navigators to explore unknown territory in return for rent. Since 1980, such a model has been extensively used, first in countries such as UK, Canada, Australia, Spain or Portugal, and more recently, throughout South America, Asia, Africa, and the United States (Cruz, 2013).

Each agency and country has its own conception of the fine points of PPP and there is no standard, internationally-accepted definition. The term is used to describe a wide range of agreements between public and private sector entities (WorldBank, 2014). But the general concept is really similar to the design-build delivery method which defines a partnership between public and private in different phases of the project. Unlike typical conventional procurement (DBB), PPPs are highly complex and involve high capital costs, long contract periods that create long term obligations and a greater sharing of responsibilities and risks between the private and public sectors (Minestry of Finance Singapore, 2012).

Public-Private Partnership (PPP) arrangements have emerged all around the world in response to infrastructure deficits and the need to renovate existing old infrastructure. For example, America's aging infrastructure, including roads, bridges, and tunnels, is in need of upgrading and expansion, but federal and state governments do not have enough funds to cover the cost of many of these upgrades. However, partnerships with the private sector in which governments use private companies' technical, managerial

and financial resources can partially fill the gap (Levy, 2011). The public and private sectors engage in a contractual, or institutional, relationship to ensure that a certain infrastructure and/or service is available to citizens.

Table 2.1-PPP Definitions from different agencies' point of view (Caltrans, 2013; European PPP Expertise Centre, 2012)

Agency	Definition
World Bank, Website	Typically a PPP is a contractual arrangement between a public entity or authority and a private entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility.
FHWA, Website	Public-private partnerships (P3s) are contractual agreements formed between a public agency and a private sector entity that allow for greater private sector participation in the delivery and financing of transportation projects
Caltrans, PPP Guidebook	A public-private partnership (P3) is a comprehensive development lease agreement formed between public and private sector partners that allows for more private sector participation than is seen in the conventional or traditional project delivery method, like design bid build, that is typically used by the Department to deliver a project.
Canadian Public Private Partnership: A Guide for Local Government	Public private partnerships (PPPs) are arrangements between government and private sector entities for the purpose of providing public infrastructure, community facilities and related services. Such partnerships are characterized by the sharing of investment, risk, responsibility and reward between the partners. The reasons for establishing such partnerships vary but generally involve the financing, design, construction, operation and maintenance of public infrastructure and services.
Ministry of Finance of Singapore, Website	PPP refers to long-term partnering relationships between the public and private sector to deliver services. It is an approach that Government has adopted to increase private sector involvement in the delivery of public services
UK local government procurement agency, Website	Public private partnerships (PPPs) are a generic term for the relationships formed between the private sector and public bodies often with the aim of introducing private sector resources and/or expertise in order to help provide and deliver public sector assets and services. The term PPP is used to describe a wide variety of working arrangements from loose, informal and strategic partnerships to design build finance and operate (DBFO) type service contracts and formal joint venture companies.
AECOM, 2012	A PPP is a performance-based contract between the public sector and the private sector to arrange financing, delivery and typically long term operations and maintenance of public infrastructure for citizens.

PPPs are generally used in such infrastructure projects as roads & highways, railways, ports, airports, water and wastewater, waste, energy, health, security and prisons. One of the main incentives that public-sectors have to use PPP is that this procurement method can be used to overcome public budget shortage and constraints while allowing for the use of the private sector expertise and know-how to deliver and manage public services. Although the main driver for developing PPP contracts should be a greater efficiency in the use of public money, the fact is that most PPP contracts are developed as a bypass to public budget constraints.

The public-private partnership delivery method has been defined in various ways and encompasses a wide range of partnerships between public and private. Different agencies have different explanations for this type of delivery method which will be illustrated and defined in table 2.1. PPPs encompass a variety of project delivery options, with varying levels of private sector participation, based on risk transferred (Buxbaum & Ortiz, 2009), (Cruz, 2013).

A PPP model is not a one size fits all structure; it is a delivery approach that includes a range of potential structures. The right structure selected for a PPP depends on many factors, such as complexity, public policy goals, private sector interest, and value for money. The desire and ability to transfer various risks to the private sector from the public sector is also key in determining the most appropriate structure. P3 structures include the following options (arranged from least risk transfer to most risk transfer) (AECOM, 2012):

- Design-Build-Finance (DBF)
- Design-Build-Operate-Maintain (DBOM)

- Design-Build-Finance-Maintain (DBFM)
- Design-Build-Finance-Operate-Maintain (DBFOM)
- Build-Own-Operate (BOO)

In a typical DBFOM contract, for example, the private sector agrees to design and build a new facility using some combination of debt (leveraged against future toll revenue in the case of toll roads) and equity, and then operates and maintains the facility for a specified period of time in exchange for the right to collect revenues from the use of the facility over the lease term.

2.3.1 PPP Delivery Method Structure:

A typical PPP project is formed by different stakeholders from public-sector to private-sector which has its own sub-sections.

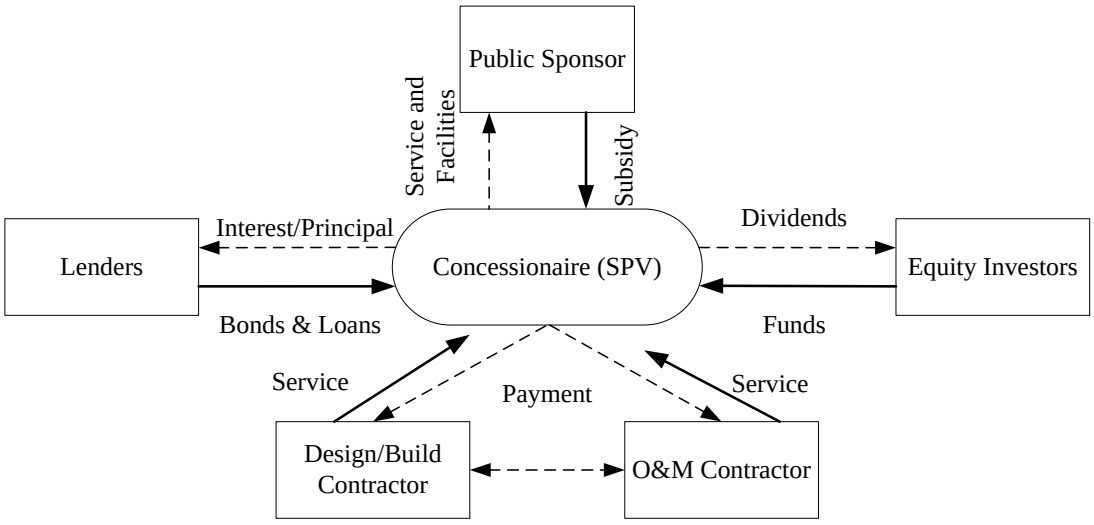

Figure 2.5-PPP Structure (FHWA, 2012; PWC, 2012)

Special Purpose Vehicle or SPV is formed by private sector promoters and equity investors like Meridian and HOTCHEIF in Presidio Parkway project in California (Boussabaine, 2014). These private companies will work under the Special Purpose

Vehicle (SPV) management to bid for the PPP project. These companies play the critical role of proposing innovative solutions to meet Government's objectives for the PPP project. In a typical PPP project, the SPV will manage its design, construction and operational and maintenance responsibilities, by subcontracting the construction, operations and equipment supply to suitable providers. These subcontractors may be the parent companies of the SPV. In addition, the SPV will also raise the financing it needs to build any asset required to deliver the services. It will need to explore the financing arrangements with potential equity and debt providers such as the amount of the debt and equity, the rates of returns required, and the tenure of the loan. When the SPV starts to deliver the services, it will use the service payment streams it receives from the procuring agency, or any third party revenue generated, to repay its debt and equity providers, as well as its suppliers and subcontractors (Ministry of Finance Singapore, 2012).

There are two mechanisms for the payment in PPP projects. One is based on toll revenue; in this model the toll collecting mechanism is applied to repay the expenditure of the project. In this case, public or private will collect the tolls. The second mechanism is availability payment in which the private sector or concessionaire will be paid based on the availability of the services or infrastructure to the public.

2.3.2 Advantages and Disadvantages of PPP Procurement Method

The partnerships between public and private sectors bring advantages and disadvantages to the table. PPP advantages include (European Comission, 2003):

- Acceleration of infrastructure provision
- Faster implementation
- Reduced whole life costs

- Better risk allocation
- Better incentives to perform
- Improved quality of service
- Generation of additional revenues
- Enhanced public management

In another study, Morallos and Amekuzi investigated several benefits and advantages of PPP. They elaborated that there are several driving factors which have motivated public agencies to pursue this type of procurement. First, PPPs enable public agencies to transfer a substantial amount of costs to the private sector. Second, the involvement of the private sector in these procurements helps to accelerate the implementation of projects while encouraging the development of innovations in the delivery of service and technology. Because of the performance-based structure of typical PPP agreements, a private agency will be unable to receive its payments until the service or facility is produced to the standards set by the public agency. Such agreements provide the private firm with an incentive to have shorter construction or delivery time frames. In addition, the presence of such incentives motivates improvements in the private consortium's overall quality of service and level of innovation it incorporates into these projects. Third, public agencies are attracted to the concept of PPPs for their ability to transfer a significant amount of project risk to the private sector. PPPs optimize risk allocation by transferring the risks to the party best able to manage them. The competency of the private sector in determining and handling these risks also leads to significant improvement in risk management strategies over traditional procurement methods (Morallos, Amekudzi, Ross, & Meyer, 2009). On the

other side, higher financing costs, higher capital costs and having a complex structure are some of the disadvantages of PPP project delivery method.

Consequently, it can be said that PPP is one of the solutions for public agencies to closing a widening gap between transportation infrastructure costs and available funding (Buxbaum & Ortiz, 2009).

2.3.3 Public-Private Partnership in the U.S. and other countries

Since the early 1990s, the PPP procurement model has been used in infrastructure development all around the world. Globally, Moody's says the use of public-private partnerships and private-finance initiatives has grown over the past 20 years, following the PPP model in the UK, Canada and Australia in the 1990s (Medina, 2014).

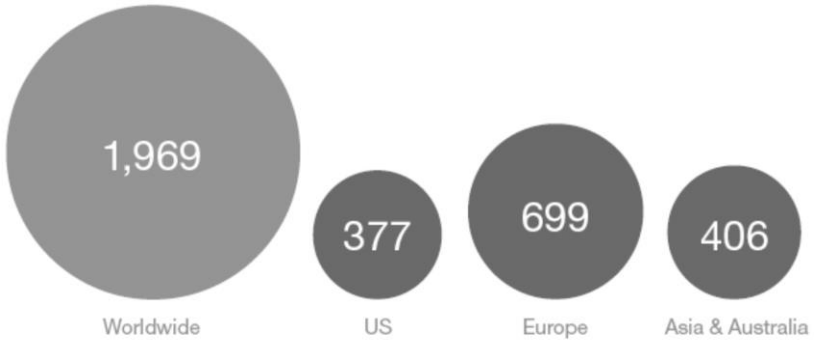

Figure 2.6-PPP Projects funded between 1985 and 2011 (PWC, 2012)

PWC reported that 1,969 PPP projects were funded worldwide between 1985 and 2011, but the US accounted for only 377, which is 19% of the total, according to the Public Works Financing's International Major Projects database. In contrast, 699 were funded in Europe, and 406 in Asia and Australia.

Cruz mentioned that with the 2008 financial crisis, PPP transactions have decreased in Europe on average, but have increased in other continents, mostly in Asia. In recent

years, growth in the use of PPP has been accelerated in countries across South America, Africa, Asia and the United States (figure 2.7) (Cruz, 2013).

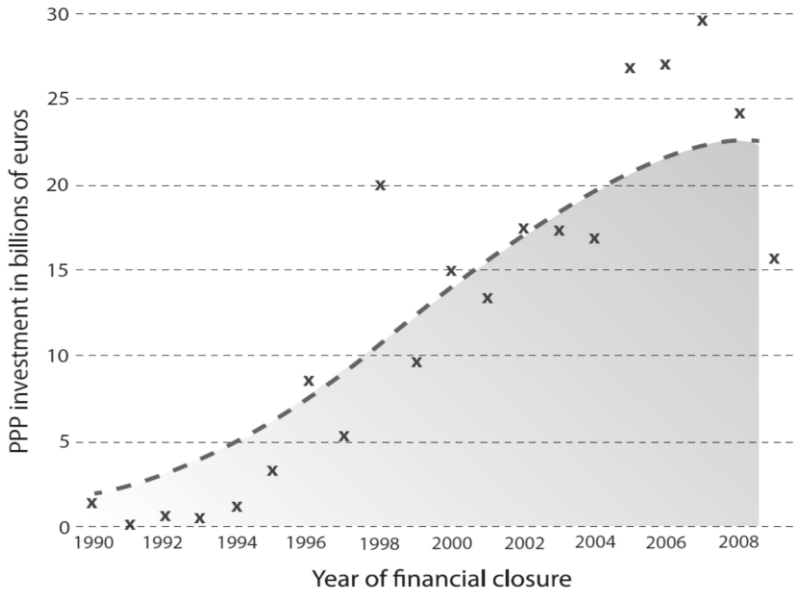

Figure 2.7-General Trend of Investment in PPP Project (World Bank, 2012)

Public-private partnerships for infrastructure projects have had an unsuccessful history in the U.S. Despite their success in Canada, Australia, the UK, and other countries, PPPs have encountered numerous obstacles in the US, most notably public and political opposition to the notion of private involvement in owning or operating such vital assets as roads and mass transit. Financial aspects are making the PPP procurement model more attractive to the public-sector because of both aged infrastructure and severe budget constraints. The World Economic Forum ranked the US 24th in the world for infrastructure quality, while the American Society of Civil Engineers (ASCE) gave the US a grade of "D" for infrastructure (ASCE, 2009; World Economic Forum, 2011). Theses analyses show how PPP can play an essential role in renovating the US infrastructure in the near future. Figure 2.8 shows which states have the legislation to apply PPP delivery methods in their infrastructure projects.

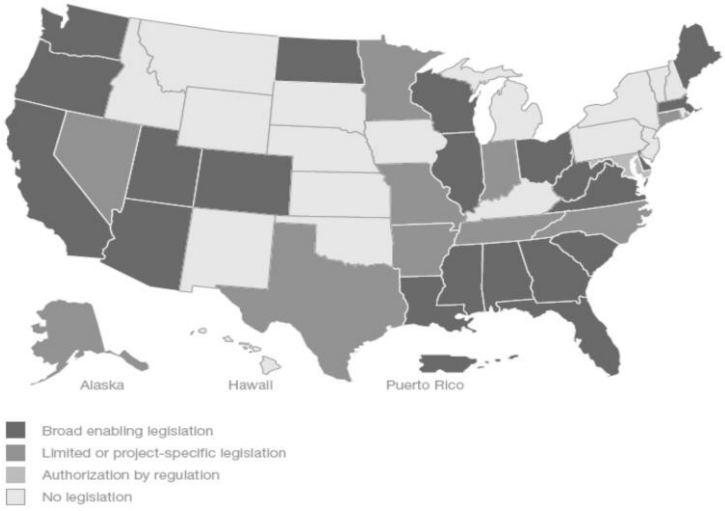

Figure 2.8-States with PPP enabling Legislation as of March 2012 (PWC, 2012)

The list of PPP projects in the US between 1991 and 2010 are presented in table 2.2 (Engel, Fischer, & Galetovic, 2011).

Table 2.2-PPP Project in the US since 1991

Project	State	Cost (US$ millions)	Financial Close
Presidio Parkway	CA	1,200	2011
IH 635 Managed Lanes	TX	2,800	2010
Eagle Commuter Rail Project	CO	2,100	2009
Port of Miami Tunnel	FL	914	2009
North Tarrant Express	TX	2,047	2009
I-595 Corridor	FL	1,814	2009
I-495 Beltway HOT Lanes	VA	1,998	2008
SH 130 Seg. 5-6	TX	1,358	2008
Northwest Parkway	CO	603	2007
Pocahontas Parkway	VA	611	2006
Indiana Toll Road	IN	3,850	2005
Chicago Skyway	IL	1,830	2005
South Expressway (SR 125)	CA	658	2003
Las Vegas Monorail	NV	650	2000
Rte. 3 Boston	MA	385	1999
Foley Beach Express	AL	44	1999
Greenville Southern Connector	SC	240	1998
JFK Terminal 4	NY/NJ	689	1997
Camino Colombia Toll Road	TX	85	1997
Dulles Greenway	VA	350	1993
SR 91 Express Lane	CA	130	1991

2.4 Value for Money Analysis (VFM)

There are several ways to do the feasibility study of infrastructure projects which consist of Value for Money (VFM) analysis or simple discounted cash flow (DCF), decision analysis and real option analysis. In PPP projects, the most common methodology which has been used to evaluate the project is VFM analysis. In this research, different parts of VFM analyses will be investigated in the following sections and chapter 3.

2.4.1 Definition & History of VFM analysis

One of the most important considerations related to PPP project proposal is how we can evaluate the project in terms of costs and benefits that PPP may bring for the public-sector. Although VFM may not necessarily be the conventional term used to describe this type of analysis, most public agencies conduct some sort of financial benefit–cost analysis when determining which procurement route to take. Therefore, VFM is the most common analysis used to evaluate PPP projects.

This concept refers to the extent to which the proposed PPP approach offers greater value to the public agencies than the traditional approach. This analytical tool is often used to determine the project cost savings of a PPP approach paid for with availability payments or shadow tolls by the sponsoring agency (AECOM, 2007). Different agencies and researchers have different descriptions for this concept. For example, the UK Treasury defines VFM as “an optimum combination of whole of life costs and quality of the good service to meet the user’s requirements” (Treasury, 2006); the term whole-of-life is used to refer to the lifecycle of the good or service. VFM is a tool that can assist governments in selecting between most conventional public delivery methods

i.e., DBB and private delivery (PPP) options such as DBFOM for infrastructure projects. A systematic analysis for PPP projects such as a VFM analysis can help not only pubic-sector in the process of decision making but also it can help private investors, banks, and other stakeholders seeking to invest and deliver PPP projects. Table 2.3 shows other agency's definition of VFM analysis.

Table 2.3-Definition of PPP VFM (FHWA, 2012; Morallos et al., 2009)

Organization	Definition
U.S. DOT	VFM is a process through which public agencies analyze the appropriate procurement approach that has the most potential benefit of public sector in their major infrastructure projects.
Canada Infrastructure Ontario	The value for money analysis refers to developing and comparing the costs of traditional project delivery and alternative financing and procurement expressed in monetary terms measured at the same time point.
Australia Infrastructure Australia	Value for money is paramount and achieving the best value for money outcome that should be the key consideration at all stages of a project. Value for money is a combination of the service outcome to be delivered by the private sector, together with the degree of risk transfer and financial implications for government.

As mentioned the definition of VFM assessment may differ between agencies, typically the analysis involves some financial comparison of the net present cost of PPP delivery method with conventional procurements shown as Figure 2.9. Morallos also mentioned in his research that the concept behind the VFM analysis is the calculation of the monetary of PPP benefits or savings (Morallos et al., 2009).

Therefore, if the estimated costs of the PPP procurement are less than those of the traditional public procurement, which will be named Public-Sector Comparator or PSC. In another words, the proposed PPP approach offers greater value to the sponsoring agency than the traditional approach. This analytical tool is often used to determine the project cost savings of a PPP approach paid for with availability payments or shadow tolls by the sponsoring agency, instead of through proceeds from direct user charges (AECOM, 2007).

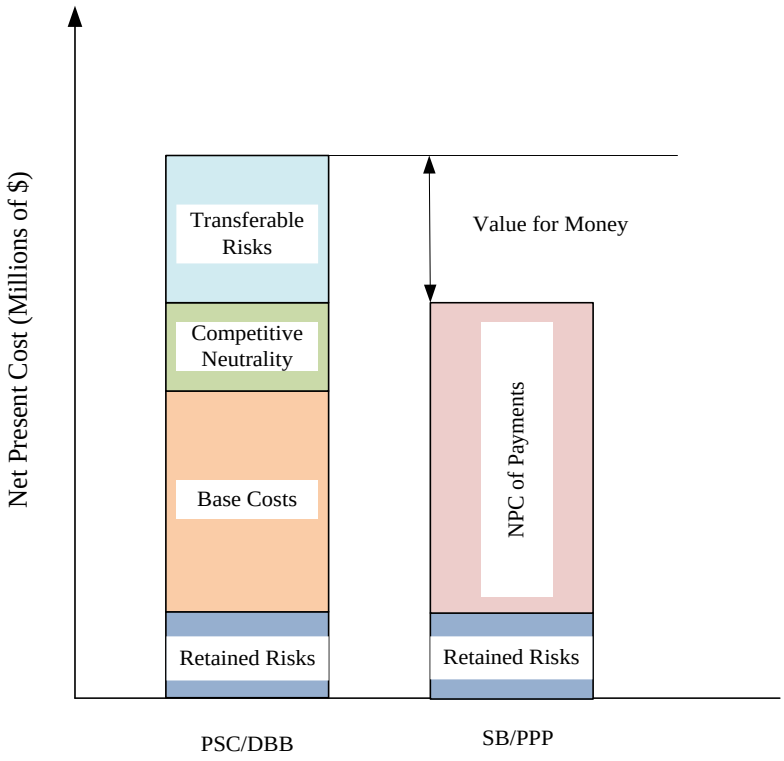

Figure 2.9-VFM Comparison of PSC and PPP Bid

However, not all agencies pursuing PPPs have established a specific set of guidelines or procedures for performing a VFM or similar type of analysis. The United Kingdom was one of the first to establish a set of procedure for calculating the VFM that can be achieved in pursuing projects as PPPs. Several agencies, including some in Australia, Canada, and throughout Europe, have published their own sets of guidelines that parallel the United Kingdom's VFM analysis. Moreover, some U.S. states like Virginia, Texas, Florida and California are pioneers in having PPP projects.

A list of guidelines and reports that are used for VFM analysis at different states and countries are collected in table 2.4.

Table 2.4-List of Guidelines by Different Agencies

Agency/State/Country	VFM Guideline
HM Treasury	Value for Money Assessment Guidance, 2006
World Bank	Value for Money Analysis-Practices and Challenges, 2013
FHWA	Value for Money State of the Practice Report, 2011
VDOT	PPTA Value for Money Guidance

2.4.2 Different types of VFM analysis

An initial feasibility assessment determining whether the project is economically viable and whether it should be pursued as a PPP, VDOT usually uses this kind of analysis for its project, the procurement phase or the bidding process, the construction phase, and the operation phase.

In defining VFM, it is also important to determine the factors that contribute to the VFM analysis of a project. In many cases, these factors may be called drivers of VFM. Arthur Andersen and Enterprise LSE (2000) surveyed various public agency officials and academic professionals on what factors they distinguish as the drive for VFM of PPP projects. According to the report value for money drivers in the Private Finance Initiative, those surveyed considered the following to be the most significant factors in affecting VFM analysis:

- Risk transfer
- Output based specification
- Long term nature of contracts
- Performance measurement and incentives
- Competition
- Private sector management skills

Based on when the VFM assessment will be conducted, there are two types of VFM analysis i.e. ex-ante and ex-post VFM analysis. As the names show ex-ante is the Latin for "from before" and it refers to the analysis before commercial close and before bids received. It is related to the public evaluation of PPP project whether it is beneficial or not. Typically, the ex-ante VFM assessment is conducted during the initial feasibility phase, when the economic viability of a project is reviewed before being open for bid. On the other hand, ex-post is Latin for "from after" and this VFM analysis considers project financial comparison after receiving the bids and commercial close. Therefore, VFM assessment may also reappear in the procurement phase or after that but typically only to ensure that the costs submitted by bidders fall below what it would cost in a traditional procurement strategy.

Table below shows some of the previous research on ex-ant VFM analysis.

Table 2.5-Previous Study on Ex-ante VFM Analysis

Research Title	Authors	Year
Evaluating the operation of PFI in roads and hospitals	P. Edwards et. al.	2004
Highway Robbery? Financial Analysis of Design, Build, Finance and Operate (DBFO) in UK Roads	J. Shaoul et. al.	2007
The Arlanda Airport Rail Link-Lessons Learned from a Swedish Construction Project	J. Nilsson et. al.	2008
How to Attain Value for Money Comparing PPP and Traditional Infrastructure Public Procurement	P. Burger et. al.	2011

Ex-post VFM will be reviewing whether a particular PPP project has achieved value for money in practice. In ex-ante value for money analysis the likely outcomes

of the project have been predicted and estimated before it is undertaken, to assist decision making on whether to undertake PPP option or not (N. Walzer, 1998).

This kind of analysis will give the public and private sectors better understanding regarding initial VFM analysis in order to use in future PPP decision making. As discussed further in subsequent sections, in practice few governments carry out ex-post VFM assessments of PPP projects which in turn creates challenges in data availability to inform ex-ante VFM analysis. Therefore, developing a solid framework for ex-post VFM analysis by using the current practice for ex-ante can be really critical and beneficial for both public and private sectors as a tool to oversee the efficiency of their first evaluation.

Ex-ante value for money is the difference between risk adjusted PSC and shadow bid SB while the ex-post VFM is the differences between PSC and PPP bids or Updated PPP Bid or APB at different stages. Figure 2.10 illustrates ex-ante and ex-post VFM at commercial close. In this case for example, bidder #1 attained higher VFM in comparison with SB and bidder #2.

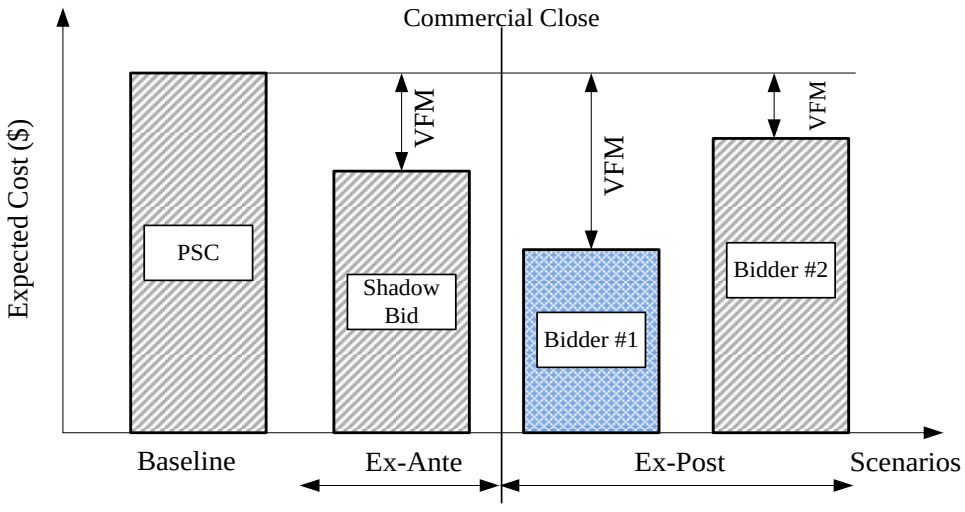

Figure 2.10–Ex-ante and Ex-post Value for Money Analysis Schematic

More details of ex-ante and ex-post VFM analysis will be discussed in the following sections and chapter 3 respectively.

2.4.3 VFM Analysis Framework

Figure 2.11 illustrates different components of VFM analysis. The VFM analysis typically involves a combination of qualitative and quantitative analysis (The World Bank, 2013).

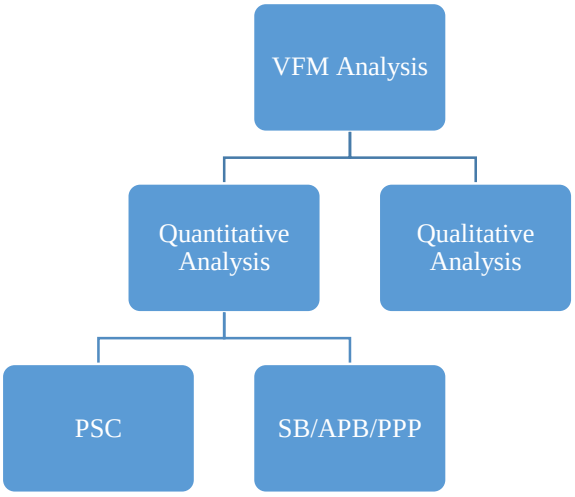

Figure 2.11-General Framework for VFM Analysis

The quantitative component includes all the factors that can be valued. It features a methodology that compares the PPP project costs with a similar project scenario often called the "public sector comparator" (PSC). The PSC is a hypothetical scenario used in a VFM assessment to determine what it would cost the procuring agency to pursue this same PPP project as a traditional procurement. The qualitative assessment of the VFM analysis takes into consideration the aspects of the project that cannot be quantified. The qualitative assessment also looks at factors such as the characteristic of the market and the competitiveness present within the bidding environment. This assessment portion also evaluates the resources and capabilities of the private and the

public sector as well as any other additional benefits and costs that were not assigned a value in the quantitative assessment. Each of the VFM analyses, i.e. ex-ante and ex-post frameworks, will be discussed in following sections and Chapter 3.

2.4.4 Ex-ante VFM analysis Framework

In ex-ante value for money analysis, the focus is on evaluating the project before commercial close. As mentioned previously, the basic structure of ex-ante value for money analysis contains two main parts: quantitative analysis and qualitative analysis. Quantitative section is formed by Public Sector Comparator (PSC) which is a benchmark for the costs of procuring the project through traditional delivery method such as DBB. On the other hand, the Shadow Bid (SB) includes the costs of the same project when the private-sector is responsible for delivering the project. Then, PSC and SB will be compared with each other (G. Dewulf, 2012).

2.4.4.1 Quantitative Analysis: Public Sector Comparator

One of the major components of the quantitative assessment of a VFM analysis is the PSC. As previously mentioned, the PSC is a hypothetical scenario that estimates the net present value (NPV) of the expected life cycle costs to the public agency if it were to pursue the PPP project through a traditional procurement (Morallos et al., 2009; Victorian Department of Treasury, 2001). Indeed, the Public Sector Comparator is the quantitative benchmark against which the value for money delivered by private bids is compared. In other words, the PSC is an estimate of the net present cost to the government if it were to deliver the project under a more traditional procurement method. The PSC contains forecast lifetime cash flows for a government delivered

reference project based on the infrastructure and service specifications provided to bidders, i.e. on a like-for-like basis to the PPP.

In summary, key attributes of a PSC include (Government of Western Australia Department of Treasury, 2013):

- A forecast based on the reference project, eflecting the cost to government of delivering the infrastructure and services to the same standards as being procured from the private sector under the most likely traditional procurement model if not a PPP;
- An expression in net present cost (NPC) terms;
- A life-cycle costing basis, i.e. the whole of life cost of providing the services and maintaining the infrastructure to standard prescribed for the PPP; and
- Risk-adjusted.

A PSC is not:

- An estimate of the cost of private sector delivery or potential savings associated with a PPP;
- Adjusted for innovation that the private sector may achieve; or

The PSC cash flows typically consists of four components:

- Raw PSC
- Retained Risk
- Transferable Risk
- Competitive Neutrality

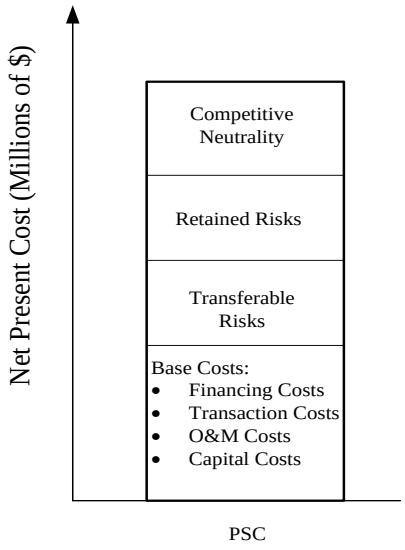

Figure 2.12-PSC Components

While the PSC is a useful tool for contributing to the ex-ante calculation, it has its inherent limitations. For instance, much caution is required in choosing the appropriate discount rate to calculate the NPV of the project were it to be carried out by the government (OECD, 2008).

Raw PSC

The raw PSC accounts for the base costs of delivering the project under the public procurement; these base costs are the capital and operating costs of producing the reference project. The reference project is virtually the same as the PPP minus the private sector involvement. For these two projects to be compared, the calculations should assume that the reference project will be subjected to the same level of standards and specifications that would be required in the PPP scenario.

The raw PSC calculates the costs associated with building, owning, operating, maintaining, and delivering the service during the same period specified in the PPP

proposal (Victorian Department of Treasury, 2001). It will include the cash flows of costs from the services but the cost of the risks in the project as there are two separate components of the PSC that determine the costs of transferable and retained risks will not be incorporated in raw PSC calculations (G. Dewulf, 2012)(Morallos et al., 2009). The simple formula (1) shows the relationship between raw PSC and its elements.

$$\text{Raw PSC} = \text{CAPEX} + \text{OPEX} \quad (1)$$

Capital costs should reflect the full resource costs of the project, including cost of public assets used in the project. Operating costs include whole life cost of operating and maintaining the asset to the same standard as required for private operator.

As mentioned, different type of costs are involved in PSC including Capex and Opex costs. These costs can also be divided into direct and indirect costs (Fig. 2.13)

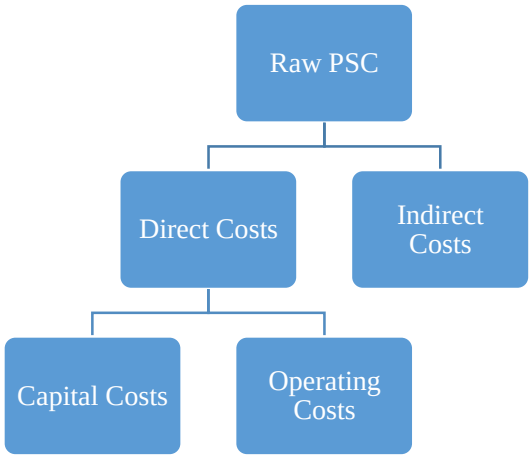

Figure 2.13-Raw PSC Components

Direct Capital Costs:

Direct capital costs include the cost of construction, raw materials, design allowance, planning, commissioning, and those transaction costs directly relevant to government delivery of the reference project. In ex-ante VFM analysis, these direct

costs should be based on the best available data. Raw PSC should exclude risk and contingencies because risk and contingency will be accounted under different groups.

Direct Operating & Maintaining Costs:

Direct operating & maintaining costs include the cost of services to be delivered by the private partner as a part of the project. The raw PSC should be checked against the service specification to ensure that all costs of government delivering services to the prescribed standard are included. This may mean that the cost of delivery in the raw PSC may be different from government's current cost of delivering similar services. These costs consist of raw materials, direct management costs, utilities, employee costs.

Indirect Costs:

Those costs which are not directly related to the project are indirect costs such as overhead.

Competitive neutrality

One of the key adjustments that is included in PSC is competitive neutrality. This adjustment removes the inherent competitive advantages or disadvantages that would be available to a government agency pursuing the PSC but inaccessible to the private sector completing the PPP (Burger & Hawkesworth, 2011; Morallos et al., 2009; Victorian Department of Treasury, 2001).

In other words, the competitive neutrality value allows the PSC and private sector bids to be compared on an equivalent basis. If competitive neutrality is not taken into account, the NPV of PSC may be artificially lower or higher than that for the private sector bid. Typically the value for competitive neutrality takes account of factors such as (VDOT, 2011 (Cruz, 2013) (Levy, 2011)):

- Differences in tax obligations;
- Differences in regulatory costs; and/or
- Tort liability limitations

Risk Matrix

Risk in a PPP project relates to the uncertain outcomes which can affect directly the project in terms of financial and services. The risks can be categorized based on the phase that happened and based on their types. A Risk matrix usually has been used to define different risks in the project.

Table 2.6-Risk Matrix in a Typical PPP project

Risk Phase	Risk Category	Risk Nature
General	Political	Change in Law
		Political Opposition to Project
	Economic	Interest rates
		Inflation
Construction Phase	Site	Site Acquisition
		Ground Condition
		Permits
		Environmental Permits and Risks
		Archaeology and Fossils
		Access, Right of Way (ROW) & Easements
		Connections to the Site
		Protesters
		Disposal of Surplus Land
	Construction	Construction Subcontractor
		Price Adjustments
		Change by Public Authority
		Revenue during Construction
	Completion	Design
		Delay by Construction Subcontractor
		Performance
Operation Phase	Operation	Revenue Payment
		Availability and Service
		Maintenance
		Operation
		Network

	Termination	Force Majeure
		Termination by Public Authority
		Project Company Default

Risks are categorized based on the phase of the project into the five groups including political risks, construction risks, site related risks, completion risks, O&M risks, termination risks and financial risks (A. Akintoye, 2009).

Table 2.6 illustrates a typical lists of risks that might be occurred in a PPP project (Yescombe, 2007). In another study conducted by Department of Finance and Administration (DFA, 2004), PPP risks are categorized into four groups; including:

- **Construction risk**, which is related to design problems, building cost overruns, and project delays;
- **Financial risk**, which is related to variability in interest rates, exchange rates, and other factors affecting financing costs;
- **Performance risk**, which is related to the availability of an asset, and the continuity and quality of service provision;
- **Demand risk**, which is related to the ongoing need for services;

Risk Allocation

One of the key differences between a PPP and traditional procurement is how risk is allocated. PPPs seek to transfer risk from the government to the private sector. While an inflow of private capital and a change in management responsibility alone can be beneficial, significant risk transfer is necessary to derive the full benefit from such changes. The impact of risk transfer on financing costs, and the pricing of risk to ensure

efficient risk transfer, then have to be addressed (DFA, 2004). It is believed that risk transfer can improve risk management and makes PPPs more cost-efficient that traditional public procurement.

In fact, the principle is that risks should be transferred to those who can control them at lowest cost. Therefore, the public sector should retain those risks that the private sector cannot control cost-effectively or when the cost of taking those risks by private sector will be so high it becomes inefficient. One of the common mistakes made by the public sector is the transfer of as much of the risk to the private sector as possible

Risk transfer is at the heart of structuring VFM analysis either ex-ante or ex-post VFM analysis. There are only a limited number of ways in which risks can be handled. Some of the risks can be retained by public-sector retained risks. The Second group belongs to those risks that transfer to the private sector, i.e. transferable risks. It is quite difficult to ensure or even define an optimal risk allocation scenario. Figure 2.14 shows that FHWA in its VFM guideline gives an example of PPP risk allocation between public and private parties.

Table 2.14-Risk Allocation in a PPP Project (FHWA, 2011)

Risk	Public	Private	Shared
Change in Scope	X		
NEPA Approvals	X		
Permits		X	
Right of Way			X
Utilities			X
Design		X	
Ground Conditions		X	
Hazmat			X
Construction		X	
QA/QC		X	
Security			X
Final Acceptance		X	

O&M		X	
Financing		X	
Force Majeure			X

Risk Pricing

Estimating risk costs is an essential part of the VFM analysis in PPP procurement process. Public and private's point view in risk estimations are different regarding estimating the cost of the risks allocated in PPP project; therefore, the amount of risk costs that the public-sector considers takes in PSC and SB are not the same as the private sector or SPV considerations and calculations in their PPP proposal bid.

The general formula (2) to quantify the risk is as shown below:

$$\text{Risk Value} = \text{Probability of Occurrence} \times \text{Risk Cost} \quad (2)$$

Risk costs will capture all possible costs that are not considered in direct and indirect costs which are discussed in previous sections. After all types of costs were calculated, the public-sector and private-sector are required to develop a cash flow model for each of them. Once risks have been quantified and allocated to the best party, their values needs to be incorporated into the VFM analysis in order to compare procurement models on a risk-adjusted basis.

2.4.4.2 Quantitative Analysis: Shadow Bid

A Shadow Bid is defined as the estimated cost to the public sector if the same project will be delivered by the private sector as a PPP (FHWA, 2012). In other words, Shadow Bid or SB is the financial model of the expected PPP delivery option. This model is not the same financial model that a bidder will prepare and submit with its proposal; in fact, it is

prepared initially by the Authority and its advisers for use in the feasibility analysis and used to compare private delivery option with the traditional public delivery i.e. DBB (European Investment Bank, 2015). SB consists of retained risks and net present costs of service payment which public sector will pay to private sector per year or half year.

It is important to stress that SB is just an estimation of the project if it will be procured in form of PPP delivery model. On the other hand, a PPP bid proposal is the actual estimation from private sector which is considered as the ex-post VFM. Chapter 3 will elaborate the ex-post VFM analysis framework.

2.4.4.3 Qualitative Analysis

In making an overall VFM assessment, it is also important to consider other factors that cannot be stated in monetary terms and therefore a qualitative VFM assessment is also required. Although the quantitative assessment, i.e. developing PSC and SB or PPP Bid, establishes a substantial portion of the VFM analysis, it is not the only section of VFM analysis to evaluate the PPP option; indeed, the scope of measurement of the PSC has been focused on financial measures. The second part of VFM analysis which completes the quantitative analysis discussion is the qualitative assessment. This analysis should also be considered in determining whether pursuing a project through a PPP or not (Victorian Department of Treasury, 2001). The qualitative VFM assessment needs to take account of factors that cannot be expressed in monetary terms, such as any predicted differences in service quality between the delivery options. Unlike the quantitative assessment, the qualitative assessment is often less prescriptive; it will often vary by what the procuring agency believes important to consider depending on the project and other conditions (VDOT, 2011).

Partnerships Victoria (2001) suggests pursuing the qualitative assessment after the completion of the quantitative assessment and after the bids have been submitted. According to Partnerships Victoria, the consideration of qualitative factors can make or break the attractiveness of the PPP procurement route especially when the lowest private bid is very close to the PSC; therefore, qualitative assessment should be revisited at every stage of the project (FHWA, 2012).

In considering the impact of the qualitative factors, Partnerships Victoria suggests identifying all material factors that have not been incorporated in the PSC and then considering the impact of these qualitative factors on the private bids.

In general the qualitative assessment will seek to identify factors which will influence the project in terms of:

- Viability–the ability to form a comprehensive contract;
- Performance–the opportunity to encourage risk sharing and innovation; and
- Achievability–the capability of the public and the private sector to deliver the project.

Some examples of qualitative risks according to Partnerships Victoria and VDOT include material costs that cannot be quantified, the reputation and competency of the private bidder, wider benefits or costs that a PPP could bring, the accuracy and comprehensiveness of the information used and assumptions made in the PSC.

Overall Assessment:

After developing the quantitative and qualitative analyses for VFM the results of the quantitative and qualitative assessments should be added together for each of PSC and SB or PPP bids in a standard framework to provide a final VFM assessment. An

example of this overall assessment at commercial close has been chosen from FHWA PPP guidebook to shows the final output.

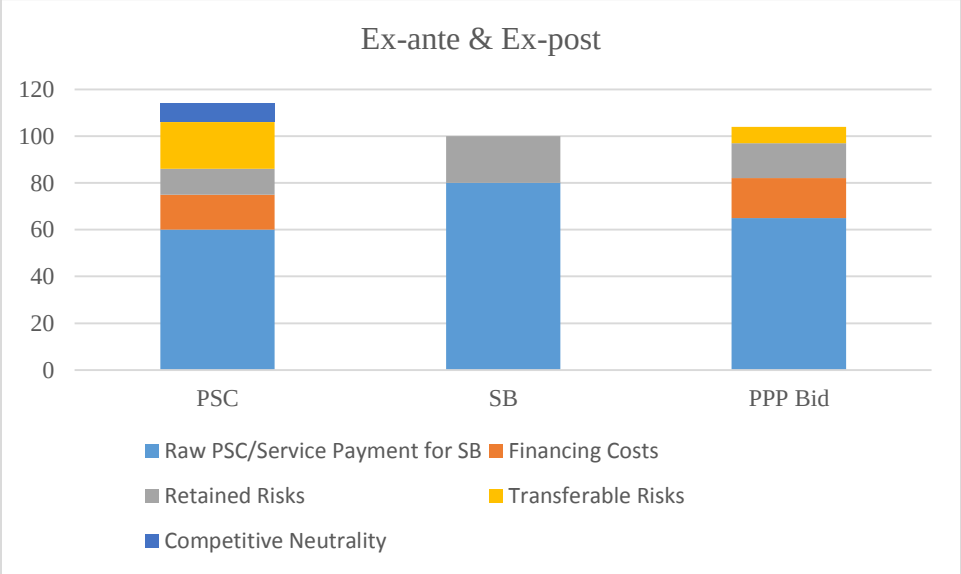

Figure 2.14-Ex-ante & Ex-post VFM analysis example

Example-Figure 2.14 illustrates an example of VFM analysis considering SB and PPP Bid which are ex-ante and ex-post VFM analysis respectively. In this example, the assumptions of three scenarios i.e. PSC, SB and PPP bid are presented in table 2.15.

Table 2.15-Exapmle project's PSC, SB and PPP bid assumptions

	PSC	SB	PPP Bid
Raw PSC/Service Payment for SB	60	80	65
Financing Costs	15	0	17
Retained Risks	11	20	15
Transferable Risks	20	0	7
Competitive Neutrality	8	0	0
Total	114	100	104

2.4.5 Advantages and Disadvantages of Ex-ante VFM

When developing PPP and VFM frameworks, it is important to consider the advantages and disadvantages VFM brings to the process of taking projects from

planning through to commercial close (FHWA, 2011). Some strengths and weaknesses of VFM that should be considered are shown in Table 2.16.

Table 2.16-Advanatages and disadvantages of current VFM analysis

Advantages	Disadvantages
Provide the public sector sponsor a better understanding of the costs and risks of a project.	Ensuring all aspects of the project are properly evaluated is a challenge.
Enhance public support for PPP.	The analysis is not immune to the appearance or actual influence of politics.

2.4.6 Ex-post VFM

As mentioned earlier, ex-ante VFM analysis analyzes the project before the public-sector receives the bids to define whether PPP can be an option for the project or not and how much value for money the project can bring for public. On the other side, ex-post VFM analysis should be conducted by the owners and/or sponsors to monitor whether the initial VFM is still valid ~~or not~~. Ex-post VFM analyses are those VFM conducted after bid received by private sector. Once final bids are received from the private sector, the whole of life cost of these bids can be compared to the PSC to determine whether the bids provide value for money to the taxpayer (Government of Western Australia Department of Treasury, 2013).

With regard to these concerns, several studies mention that the PSC which is the core element in the ex-ante VFM creates an incomplete basis for VFM analysis to cover whole lifecycle of the project. This is mainly because the PSC is measured based on the expectations and the estimation using previous projects data. Therefore, the PSC is based on estimates of future costs and it can be useful at the point of initial evaluation

of the project i.e. before bid proposal. The ex-ante VFM, in another words, is a tool that helps government and public decision makers to decide whether to procure the project in PPP or not and it does not consider actuals costs and financial parameters at the beginning of the evaluation which can be changed through the project life.

Therefore, it is necessary and critical for both public and private sectors to develop a way or framework to evaluate the VFM analysis during the project stages or after bid received. In order to measure actual VFM it is necessary to make a comparison of the concession's whole life costs against a fair comparator.

Ex-ante VFM is a hypothetical analysis based on many assumptions; therefore, the costs estimations and risks allocation will be different from what assumed and evaluated at first steps.

Consequently, the net present cost of acceptance of bid stage should be adjusted to take account of relevant quantifiable costs and risks that are not included in the PSC or even in the bid proposal. Such costs and risks could include: any higher government-funded transaction costs; any higher contract management costs; and any additional unmitigated sponsor risk compared to traditional procurement (Victorian Department of Treasury, 2001). This requires that data be recorded and reported on a whole-of-life project. Recording data on a whole-of-life project basis will be applied for an ex post assessment of both PPP projects (Burger & Hawkesworth, 2011).

An adequate evaluation framework should be formed by both ex-ante and ex-post VFM analysis. More discussion about the potential framework of ex-post VFM analysis will be provided in the next chapter.

Chapter 3: Methodology

3.1 Overview

In this chapter, I will first introduce various types of ex-post VFM based on the main milestones of the project during the lifecycle, including commercial close, financial close, substantial completion, and final acceptance. Then, I will define a general framework for ex-post VFM analysis. This general framework will be developed based on current VFM analysis and follows the same project evaluation methodology used in ex-ante VFM analysis that compares net present cost (NPC) cash flows for projects developed by the public sector (PSC) with NPC cash flows for projects procured by the private sector in which the public sector will pay back the private investment based on the availability of the facility to the public.

The purpose of developing a general ex-post VFM assessment framework is to evaluate the performance of PPP delivery method during the project life cycle, to investigate the different elements of VFM analysis at different stages of the project in order to highlight the critical elements that should be considered in PPP evaluation during the project life cycle and to provide better information in the process of decision making for potential PPP delivery methods in future projects by tracking the VFM at different stages of the project.

After introducing the general framework for ex-post VFM analysis, each section of ex-post VFM analysis will be discussed in detail for cases with considering unforeseen factors in ex-ante VFM analysis. Differences between ex-ante and ex-post process will be investigated section by section. In Chapter four, the Presidio Parkway project will be used as a case study to assess the ex-post VFM framework at different milestones.

3.2 Assumptions

Some assumptions have to be made before discussing an appropriate framework for ex-post VFM analysis:

- The framework has been developed for the routine Design-Build-Finance-Operate-Maintenance PPP model which can be modified for other PPP formats.
- The ex-post VFM framework has been developed for those PPP projects that have availability payment structure.
- The framework has been developed for scenarios with and without project scope changes.
- The ex-post VFM analysis refers to the analyses that occur after receiving bid proposals from the private sector at the points of commercial close
- The quantitative analysis of VFM will be investigated and qualitative analysis will not cover in this research.
- Those risks which were taken during the project will be considered as zero in the ex-post calculation.

3.3 Overview of Ex-post VFM Framework

Some experts define ex-post VFM as an evaluation method of PPP projects after financial close or after substantial completion. In this study, the ex-post VFM analysis refers to the analyses that occur after receiving bid proposals from the private sector at the points of commercial close.

Ex-post VFM analyses for five different milestones in the project lifecycle will be introduced in the next section. At each of these milestones, some of the project data

will be available in the form of the actual numbers to conduct the ex-post VFM analyses. For example, at commercial close, private sector entities submit their bids. Therefore, the public sector has the actual bid numbers in ex-post VFM analysis instead of estimated shadow bid, as is the case in ex-ante VFM analysis. In other words, ex-post VFM analysis is a type of re-evaluation or re-estimation of an initial evaluation or estimation VFM analysis. Figure 3.1 illustrates two VFM analysis ex-ante and ex-post in a simple view. For example, in this figure the amount of actual VFM at commercial close is less than what was calculated in ex-ante VFM analysis.

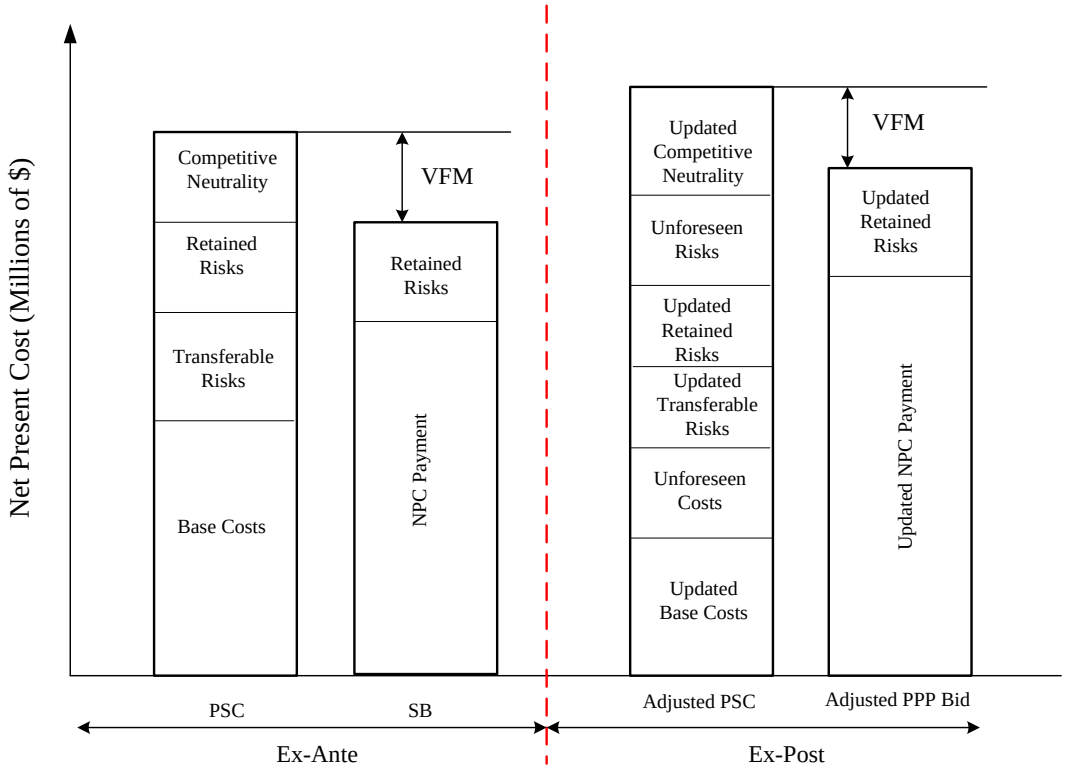

Figure 3.1- Ex-ante vs. Ex-post VFM analysis at commercial close

In order to develop the ex-post VFM framework, different sections of the ex-ante VFM framework will be updated or adjusted based on the actual data. For example, project costs will be updated through the project lifecycle, and therefore it is necessary

to replace the initial estimations with the actual project costs for such things as construction. Similar to ex-ante VFM analysis, ex-post VFM consists of two major sections: quantitative and qualitative VFM assessment (see Figure 3.2). Although a comprehensive ex-post VFM analysis should take into consideration changes in both quantitative and qualitative analysis, this study focuses only on quanitative analysis.

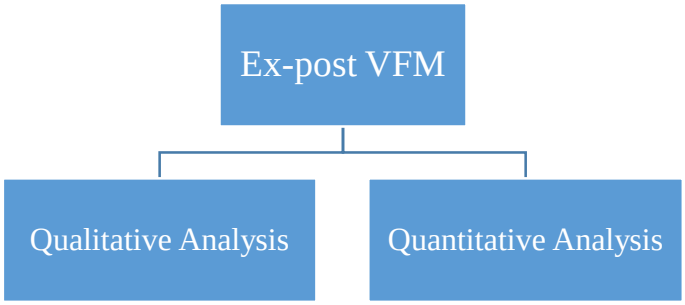

Figure 3.2-General Ex-post VFM Analysis Framework

Several data categories have to be considered in developing the ex-post VFM framework, including time, cost, risk, unforeseen factors, and financial parameters. Each of these groups of data will be elaborated in the following sections (figure 3.3).

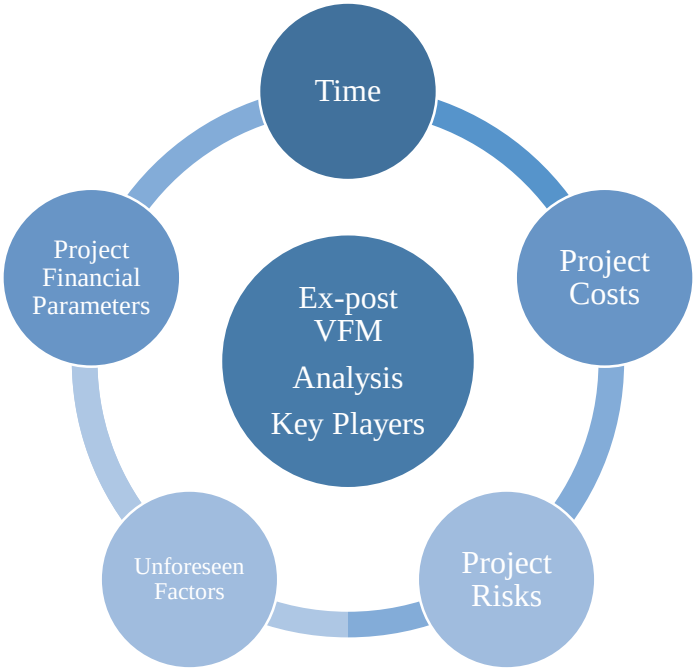

Figure 3.3-Five key elements in developing ex-post VFM analysis framework

3.4 Project Lifecycle (Time)

The first element in developing the comprehensive ex-post VFM framework is the factor of time. The number of phases in the lifecycle of a PPP project can vary depending on the type of PPP agreement. For example, in the design-build-finance procurement model, three phases should be considered and the private sector is not responsible for O&M activities; therefore, in conducting ex-post VFM analysis for this type of project, O&M costs and other concerns cannot be updated. In this study, the assumption is that the framework will be developed based on the DBFOM PPP model which can cover the whole project life cycle. In conducting value for money analysis, the first step is to consider the impact of time because the money invested in the project has different values over the course of the project. In other words, one dollar today has less value next year, depending on the discount rates.

There are two reasons that time should be considered in developing VFM analysis, especially in the ex-post VFM framework. First, it is necessary to define different ex-post VFM based on the different milestones. Second, time affects calculations of the NPC or NPV in VFM analysis.

Other factors such as costs, risks, and financial parameters could also change with time. For example, after substantial completion, actual construction costs are available to repeat the VFM analysis.

Different milestones as figure 3.4 shows will be defined including commercial close, financial close, substantial completion, and final acceptance and different the ex-ante and the ex-post value for money analysis can be developed based on these milestones.

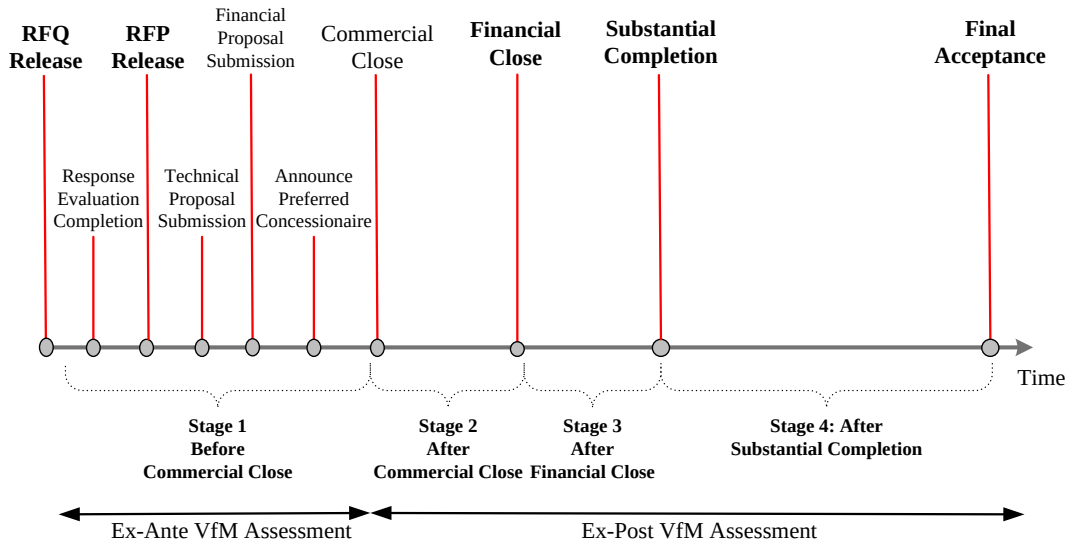

Figure 3.4-Typical Project Lifecycle Milestones

In the first step of developing ex-post VFM framework, the boundary between ex-ante and ex-post VFM should be defined. In this study, commercial close is the borderline between ex-ante and ex-post VFM analysis. Therefore, all VFM analysis before commercial close will be considered as the ex-ante and all analyses after commercial close are considered as the ex-post VFM analyses. Based on this definition, five different types of ex-post value for money analysis can be introduced (figure 3.5):

- 1st Ex-post VFM: At commercial close
- 2nd Ex-post VFM: At financial close
- 3rd Ex-post VFM: At substantial completion
- 4th Ex-post VFM: During O&M Phase
- 5th Ex-post VFM: At final acceptance

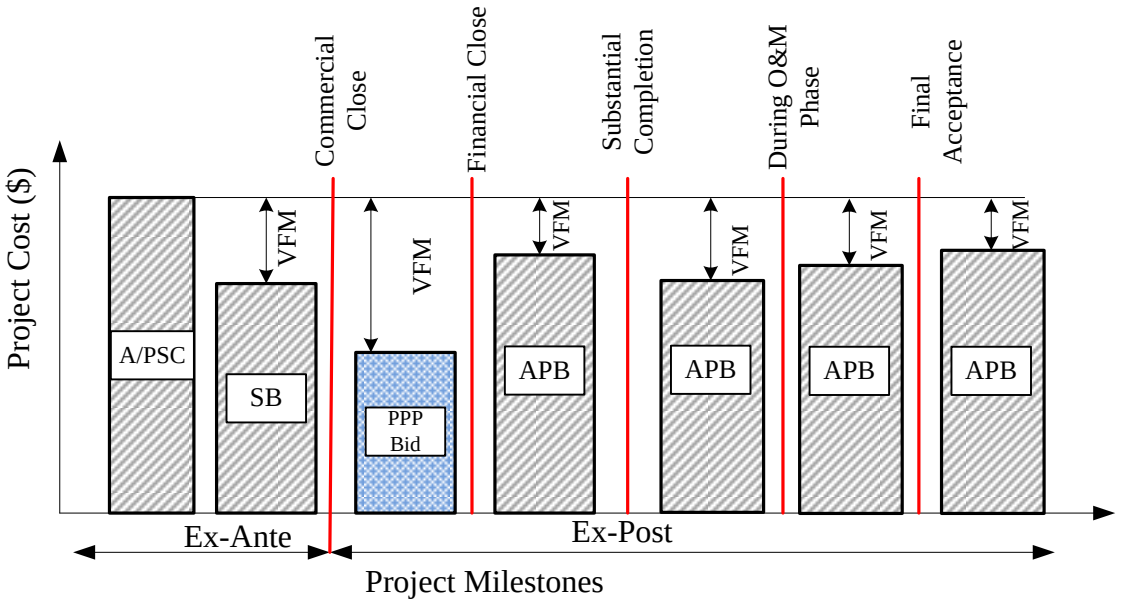

Figure 3.5-Different VFM at different milestones[1]

The amount of VFM will be changed during project lifecycle as actual data will be available to conduct VFM analysis. As mentioned earlier, time will affect the calculation of net present cost or value (NPC/NPV) in determining the VFM of the project. The NPC/NPV formula shows the role of time in the calculation (Ross, 2010).

$$NPV = \sum_{t=1}^{T} \frac{Cash\ Flow_t}{(1+i)^t} - Initial\ Investment$$

Where:

t = Cash flow period

i = Interest rate assumption

The concept of discounted cash flow (DCF) is at the heart of VFM analysis (figure 3.6). DCF is the method of valuing a project by using the concept of time value of money, which reflects the fact that present money is more valuable than the same

[1] APB: Adjusted PPP Bid

amount of money received in the future. Time value of money computation is based on present value and discounting techniques (Boussabaine, 2014).

Figure 3.6-Discounted Cash Flow (DCF) analysis Concept

There are different types of cash flows for each project: 1) Costs; and 2) Revenue. In PPP projects, private sector entities borrow money from banks, equity investors and lenders to begin the design and construction. Then, SPV will be compensated by public-sector after substantial completion. Some of the PPP projects have tolls, so the toll revenue cash flow will be added to the calculations. In VFM analysis, all cash flows should be estimated and discounted to calculate the present values or costs at each of the five milestones to figure out the amount of VFM at each stage.

3.5 Unforeseen Factors

In order to develop a comprehensive framework for ex-post VFM analysis, those unforeseen factors such as unforeseen costs and risks in initial estimation will be considered.

For example, scope change, "Change in scope" easily ranks among the top issues that keep project managers awake. At the project's launch, the scope, schedule and budget are determined. Then, somewhere during the project, someone changes the

scope (Heerkens, 2014). Therefore, the scope change is one of the issues that will be considered in developing the ex-post VFM analysis. The effect of these unforeseen factors will be investigated in each of the original PSC and PPP Bid and Adjusted PPP Bid at each milestone.

Adjusted Quantitative Analysis:

As figure 3.7 shows, the adjusted quantitative analysis section has two main parts:

- Adjusted Public Sector Comparator (APSC)
- Adjusted PPP Bid (APB)

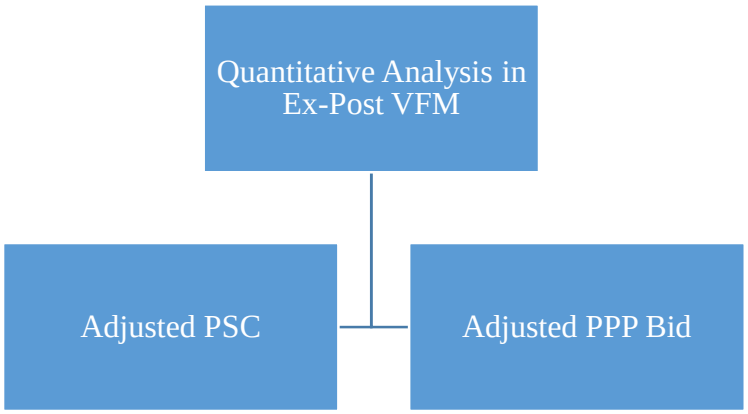

Figure 3.7-Quantitative Analysis in Ex-post VFM Framework

Adjusted PSC is an updated version of the original PSC from initial VFM analysis considering the unforeseen factors. And APB is an updated version of shadow bid from ex-ante VFM assessment. Each of these two sections will be disscussed in more details.

Developing Adjuste Public Sector Comparator (APSC)

In Chapter 2, PSC was described as a whole-life and risk-adjusted cost estimate of the project that is delivered by the public sector. During the development of a PSC, several assumptions are made, including that the public sector can complete the project

with the same quality and standards anticipated in a delivery by the private sector; and these assumptions will be used in the ex-post VFM analysis(FHWA, 2011).

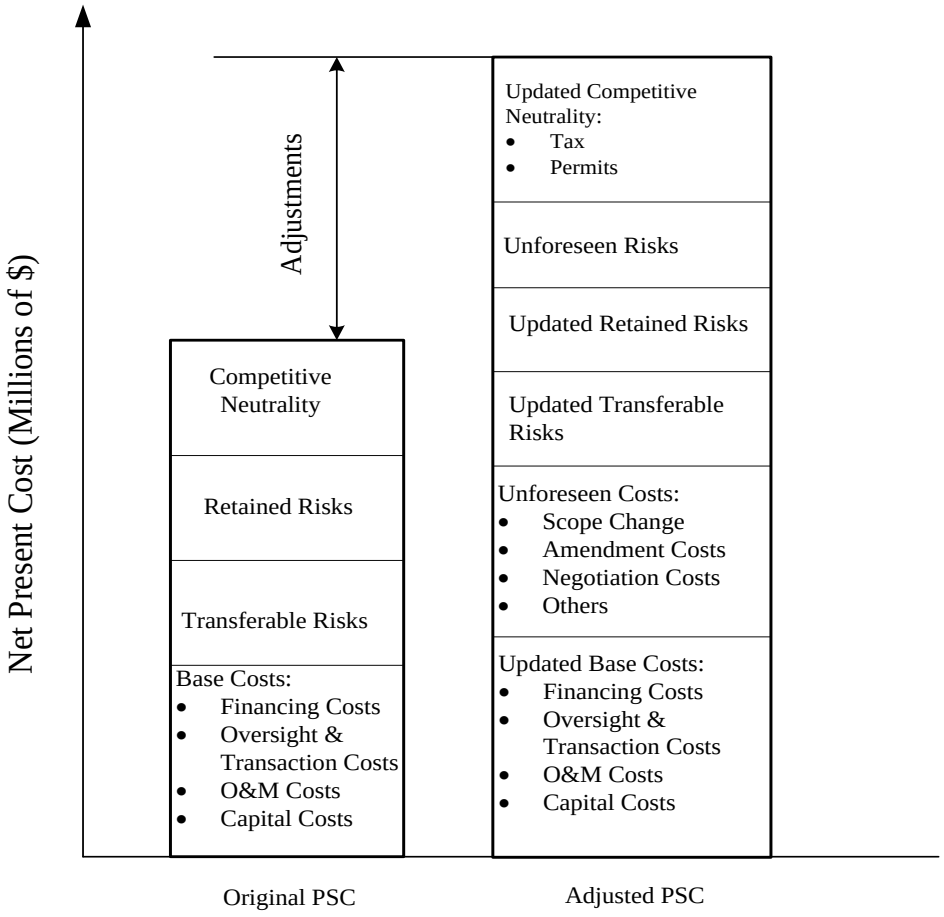

Figure 3.8-The Original PSC vs Adjusted PSC Structure

In developing the ex-post VFM framework, one of the essential assumptions is that the PSC developed in ex-ante VFM will not be the same as that developed in ex-ante VFM because of unforeseen factors and elements, and it has to be updated based on the these factors and then be used as the baseline in ex-post VFM to compare with different Adjusted PPP bids. Figure 3.8 depicts both original PSC and adjusted PSC to understand the possible differences between PSC of ex-ante and ex-post analysis.

Indeed, the APSC has the same sections and elements incluidng base costs, retained risks, transferable risks, and competative neutrality (figure 3.8) but all required parts have to be adjusted or updated based on the final project scope. By using the adjusted PSC, we can see clearly how much difference exists between ex-ante and ex-post analysis and how much the ex-ante VFM analysis has changed during the project.

Consequently, APSC should be investigated at different milestones to see which of its items need to be updated and adjusted.

Developing Adjusted PPP Bid (APB)

The shadow bid was developed as part of the quantitative assessment of the ex-ante VFM analysis, which was conducted before commercial close. The shadow bid is typically developed using cost estimates made early in the project lifecycle and does not cover changes and adjustments that occur during the project. In other words, project cost estimates may increase or decrease due to project delays or private efficiency. Therefore, there is a need to review the initial estimate and develop an updated version of the PPP bid evaluation that the private sector submited at the time of the bid proposal (commercial close). Therefore, the VFM anlysis should be continually adjusted and refined throughout the project as a part of the ex-post VFM analysis. This adjustment will be conducted in two forms: firstly, all estimation should be up to date based on the actual data such as costs and risks, and seconldy, those unforeseen items in initial evaluation should be added to private sector calculation to cover all aspects of the project. Figure 3.9 shows different sections of SB, PPP Bid, and Adjusted PPP Bid.

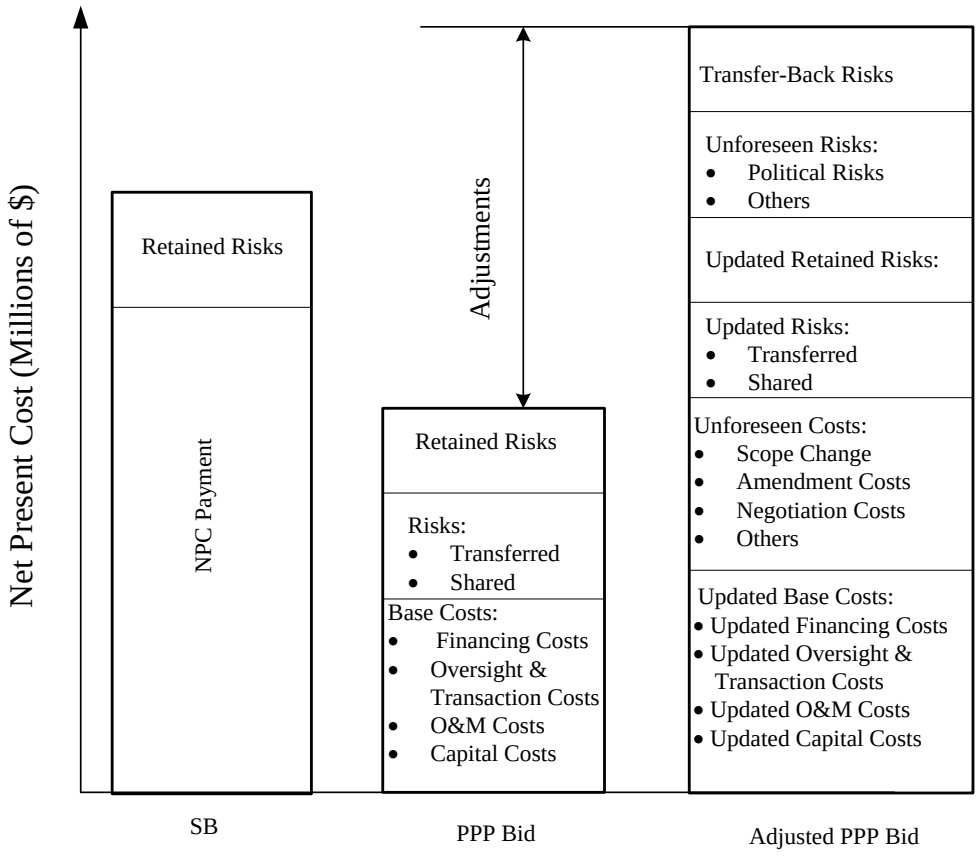

Figure 3.9-SB vs PPP bid and Adjusted PPP Bid Structure

APB is comprised of different elements such as updated or adjusted project base costs, unforeseen costs, updated private risks, updated retained risks, unforeseen risks and transfer back risks, those risks that were transferred to private initialy but they transferred back to the public in reality. APB is based on the NPC calculation; then APB is compared with adjusted PSC to assess whether or not the project still brings the value for money for the public sector. Figure 3.9 shows the main componenets of adjusted PPP bid. At each milestone, APB's componenets will be changed and they should be updated to show the actual situation of VFM on that stage. For example, most

of the time, financing costs change at financial close after long negotiations between SPV and banks. These modifications should be reflected in ex-post VFM.

In the Presidio Parkway project, the TIFIA loan interest rate of 4.15% was used in ex-ante VFM (i.e. before commercial close) but changed into 2.7% at financial close, which made a big difference in VFM calculations. These factors like interest rate that will change during the project should be considered in the ex-post VFM framework.

3.6 Project Base Costs

Both APSC and APB has the project cost element. Different types of costs are involved in VFM analysis both ex-ante and ex-post analysis. These costs will be changed or updated or replace with the actual one during the project life time from commercial close to final acceptance because of scope change and actual costs. At the beginning of the project, all costs are estimation based on the costs of similar previous projects for both the public and the private entities. The base cost for PSC will be adjusted based on new information available for the project such as scope change and these costs are still estimations. On the other side, the base costs will be adjusted and updated with new information available for the private sector and actual data of those items that occurred.

As mentioned in chapter 2, project base cost is one of the main elements in the VFM analysis and will be appeared in form of raw PSC or base cost of ex-ante and base cost of APB of the ex-post VFM analysis. Base costs of APB themselves consist of different type of costs including capital costs, O&M costs, financing costs, and transaction costs (figure 3.10).

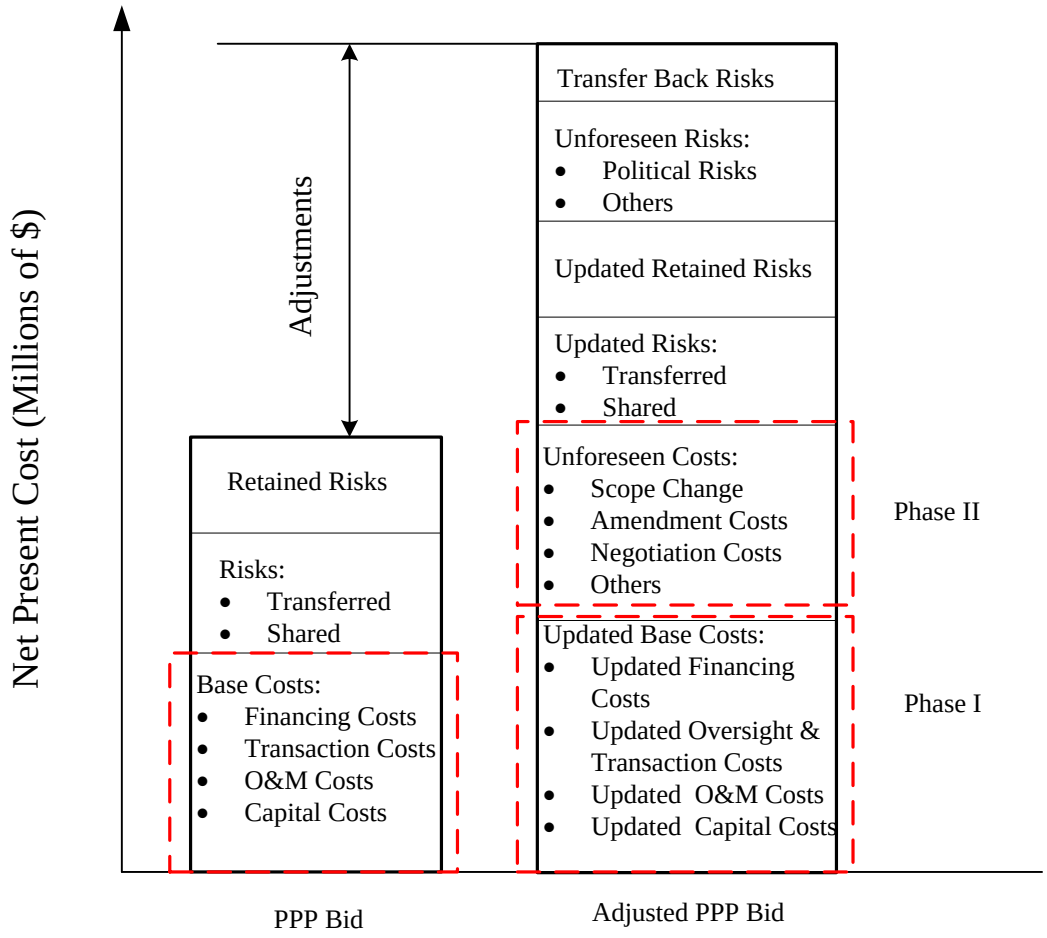

Figure 3.10-Adjusted PPP Bid Based on Scope Change

Adjusted PPP Bid Base Cost

As figure 3.10 shows the process of adjusting the project costs will be done in two phases: phase one is adjusting and up to dating the each of the elements of base costs that previously estimated and replace with the actual data, and the second phase is adding those unforeseen costs which might create by scope change and other factors during the project and should be considered in developing the ex-post VFM analysis.

The APB base cost accounts for the base costs of delivering the project under the private procurement; these base costs are the capital, operating costs and transaction

costs of project. In order to have a fair comparison between adjusted PSC (from ex-ante VFM) and Adjusted PPP Bid, the calculations should assume that the private sector will deliver the project at the same level of standard that public-sector required for the project. In other words, the base costs of Adjusted PPP Bid calculates the costs associated with building, owning, operating, maintaining, and delivering the service (figure 3.11).

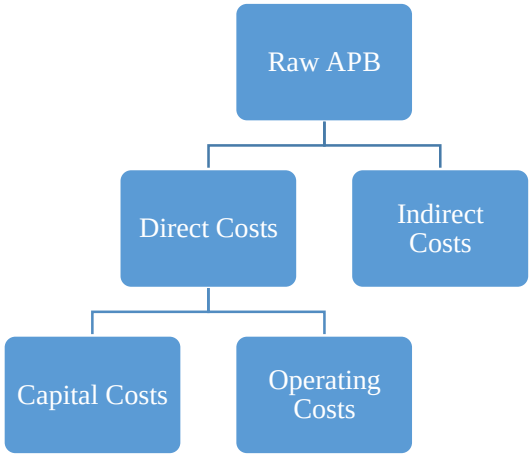

Figure 3.11-Raw APB Components

In most of the PPP Projects, the cost section is generally categorized into six main categories:

- Capital Costs
    - Construction Costs,
    - Design Costs,
- O&M Costs
    - Annual Operating Costs,
    - Annual Routine Maintenance Costs,
    - Periodic Maintenance Costs,

- Transaction Costs,
    - Contract Management Costs
        - Dispute resolution
        - External Consultants
        - Feasibility Studies
    - Initiation and Procurement Costs
- Right of Way (ROW) Costs,
- Financing Costs,
- Special Purpose Vehicle (SPV) Costs

At each project milestone, these costs have to be adjusted based on the most up-to-date, or actual, costs in order to re-assess the VFM analysis to get ex-post VFM.

Table 3.1-Project Costs Key Performance Indicators

Performance Metric	Definition/Formula
Total Cost Growth (%)	[Total Actual Costs-Total Engineer's Estimate Costs]/Total Engineer's Estimate Costs
Contract Award Cost Growth (%)	[Award Cost-Total Engineer's Estimate Costs]/Total Engineer's Estimate Costs
Project Cost Outcome (%)	Actual Final Cost/Original Cost Estimate

After adjusting the costs at each stage, a number of key performance indicators (KPIs) can be used to track the cost change as a part of the post evaluation of PPP projects by having the actual numbers. In fact, these KPIs illustrate how much the costs at different sections have been changed and can also define the differences between ex-ante and ex-post VFM elements in terms of different costs. These KPIs include costs

growth, project costs outcome and contract award costs growth. The comprehensive list of these KPIs are provided in table 3.1.

3.6.1 Project base Costs at different Stages

In the process of developing the framework of ex-post VFM analysis, different categories of the costs should be re-evaluated or updated during the project lifecycle using actual or most updated costs. In this sub-section, each cost category will be reviewed at different milestones. Table 3.2 illustrates the version of calculations of the costs at different stages of the project, which are the estimated, updated, and actual version of the costs.

Table 3.2- Cost Categories in different Stages of the Project

Cost Category	Before Commercial Close	@ Commercial Close	@ Financial Close	@ Substantial Completion	During O&M Phase	@ Final Acceptance
Construction Costs	E[2]	E	E	U[3]	A[4]	A
Operating Costs	E	E	E	E	U	A
Routine & Periodic Maintenance Costs	E	E	E	E	U	A
Transaction Costs	E	E	E	U	A	A
Financing Costs	E	E	A	A	A	A
ROW Costs	E	E	E	A	A	A
SPV Costs	E	U	U	U	U	A

[2] Estimation
[3] Updated
[4] Actual

Stage 1-Before Commercial Close-Ex-ante VFM

Before reaching the commercial close, public-sector uses the previous project records to estimate the total costs of the project to prepare the shadow bid which is the ex-ante VFM analysis. Therefore, all the costs are estimates and are not actual (Table 3.2).

Stage 2-At Commercial Close-1st Ex-post VFM

On the other hand, at commercial close, private-sector also uses its previous database to prepare the bid documents to bid the project. All costs are the estimations and are not actual numbers in first ex-post VFM.

Stage 3-At Financial Close-2nd Ex-post VFM

At financial close, only the SPV cost will be updated and all other cost categories will remain constant.

Stage 4-At Substantial Completion-3rd Ex-post VFM

At this milestone, SPV cost, transaction costs, and the capital costs i.e. design and construction costs will be updated in the ex-post VFM analysis. Moreover, ROW costs and financing costs are the actual. In contrast, O&M costs are still are constant.

Stage 5-During O&M Phase-4th Ex-post VFM

In this period of time, O&M costs will be updated during time for example, after 5, 10, 20 years of beginning of the O&M stage depends on the availability of the data. The O&M costs are critical elements play an important role in conducting this version of ex-post VFM. On the other hand, the actual costs of design, construction costs, ROW, financing, and transaction costs will be applied in this ex-post VFM. Furthermore, the SPV costs will be updating in this stage again.

Stage 6-At Final Acceptance-5th Ex-post VFM

At final acceptance *when* the private officially will deliver the project to the public-sector after the concession period, all the costs will be in actual form.

3.7 Project Risks

Another key element of Adjusted PPP Bid is the project risks which include transferable and shared risk from the public sector point of view and how the private sector is going to take project risks through the project lifecycle and how they will be adjusted. In order to adjust the project risks previous risks, unforeseen risks and those risks which transferred back to the public should be considered (see figure 3.12).

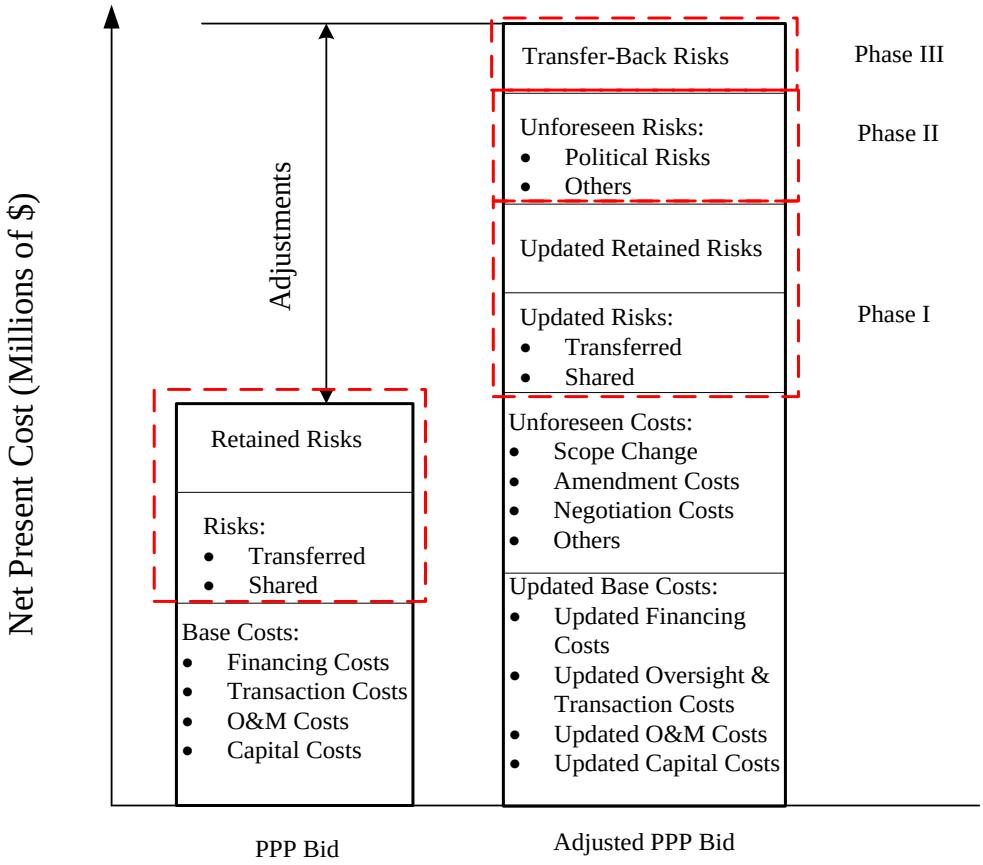

Figure 3.12-PPP Bid and Adjusted PPP Bid Risks

Risk management is the heart of the concession arrangement and VFM analysis, but there is a major lack of historical data to develop risk cost estimation which can be used through the project life cycle. Consequently, the risk probability and risk estimations are not well founded. Previous studies show that in most of the concessions the probability of a risk were remained the same, which is clearly not the case because the risk patterns will change when the facility transfers realization to the operational stage (G. Dewulf, 2012).

Choobineh et al believe that the risk is the consequence of taking a time value decision in the presence of uncertainty, while uncertainty is the manifestation of unknown consequences of change in time value parameters. So uncertainty in time value is the gap between the information currently available and the data required to make the decision (Choobineh, 1992).

Before addressing the method which can be used to adjust the project risks in ex-post VFM analysis, it should be mentioned the cost of the risks in the project has two separate components in the APB: costs of transferable, and retained risks that will not be incorporated in raw APB calculations.

As mentioned in chapter 2, risk analysis in VFM analysis consists of three main parts: 1) Risk matrix or register, 2) Risk allocations, 3) Risk pricing. These three sections will also be applied in developing ex-post VFM framework.

In this thesis, the risk matrix and risk allocation will be discussed in different milestones of the project and a solution to calculate and adjust the risk cost at different stages will be suggested.

Risk Matrix

Risk in a PPP *project* relates to the uncertain outcomes which can affect directly the project in terms of financial and services. The risks can be categorized based on their types. Risk matrix usually has been used to define different risks in the project. Risks are categorized based on the phase of the project into the five groups including political risks, construction risks, site related risks, completion risks, O&M risks, termination risks and financial risks (A. Akintoye, 2009; G. Dewulf, 2012).

Table 3.3-Risk Matrix in a Typical PPP project

	Risk Nature	I	II	III	IV	V
Political	Change in Law	X	X	X	X	X
	Political Opposition to Project	X				
Economic	Interest rates	X	X			
	Inflation	X	X	X	X	X
Site	Site Acquisition	X	X			
	Ground Condition	X	X	X		
	Permits	X	X	X		
	Environmental Permits and Risks	X	X	X	X	X
	Archaeology and Fossils	X	X	X		
	Access, Right of Way (ROW) & Easements	X	X			
	Connections to the Site	X	X			
	Protesters	X	X	X		
Construction	Construction Subcontractor	X	X	X		
	Change by Public Authority	X	X	X	X	
	Revenue during Construction	X	X	X		
Completion	Design	X	X	X		
	Delay by Construction Subcontractor			X		
Operation	Revenue Payment				X	X
	Availability and Service				X	X
	Maintenance				X	X
	Operation				X	X
	Network				X	X
Termination	Force Majeure	X	X	X	X	X
	Termination by Public Authority	X	X	X	X	

Table 3.3 illustrates a typical list of risks and their availability in each of the milestone. So the first step is to re-build the risk matrix for ex-post VFM analysis and figure out what kind of risks are present at each stage of ex-post VFM. For example, the risk of changing in law is kind of a risk for PPP project that should be considered in VFM analysis during the project and it exists in all stages.

Risk Allocation

The second issue related to project risks is how to allocate risks to the best parties, whether public or private. It is believed that risk transfer can improve risk management and makes PPPs more cost-efficient than traditional public procurement. In fact, the principle is that risks should be transferred to those who can control them at lowest cost. Therefore, public-sector should retain those risks that private sector cannot control cost-effectively or the cost of taking those risks by private will be so high that it is no longer efficient.

Table 3.4-Risk Allocation in a PPP Project before Commercial Close (FHWA, 2011)

Risk	Public	Private	Shared
Change in Scope	X		
NEPA Approvals	X		
Permits		X	
Right of Way			X
Utilities			X
Design		X	
Ground Conditions		X	
Hazmat			X
Construction		X	
QA/QC		X	
Security			X
Final Acceptance		X	
O&M		X	
Financing		X	
Force Majeure			X

Risk transfer is at the heart of structuring VFM analysis for both ex-ante and ex-post VFM analysis. Some of the risks can be retained by public-sector while others will transfer to the private sector. It is quite difficult to ensure or even define an optimal risk allocation scenario for the whole project timeline. Table 3.4 illustrates an example of PPP risk allocation between public and private parties before commercial close.

In ex-ante VFM analysis, there is an initial risks allocation which should be updated or adjusted in ex-post VFM analysis during the project. For example, force major, which will be shared between two parties may transfer to the public after financial close; this is really dependent on the type of the project and opinion of risk consultants. Indeed, the initial risk allocation plays a role as baseline and should be reviewed by experts to get updates. Literature shows that there are minor revisions for risk allocation in ex-post VFM analysis.

Risk Pricing

The last section of the risk analysis addresses how the costs of allocated risks will be determined. Estimating risk costs is an essential part of the VFM analysis in PPP procurement process. Public and private have different points of view with regard to estimating the cost of the risks allocated in PPP project based on their database gained from previous PPP projects; therefore, the amount of risk costs that public and private sector considers in PSC and SB is not the same as what the private sector or SPV studies in APB.

As discussed earlier, the general formula to quantify the risk is shown below:

$$\text{Risk Value} = \text{Probability of Occurrence} \times \text{Risk Cost (Impact)}$$

So, the risk value simultaneously depends on the probability of occurrence and the cost or impact of that risk. Risk costs will capture all possible costs that are not considered in direct and indirect costs which are discussed in previous sections. Once risks have been quantified and allocated to the best party, their values needs to be incorporated into the ex-post VFM analysis in order to have fair comparison between original PSC and risk –adjusted APB. Therefore both parts i.e., the probability and the impact need to be adjusted at each stage.

The challenge for experts in developing ex-post VFM analysis is coming up with the probability of the risk at different milestones. For example, the probability of occurrence of ground conditions are different at commercial close and substantial completion. This means that before beginning of the project the probability of having issues with ground conditions based on the geo-tech lab results and data that available to the public and private sectors can be 20%. But after substantial completion the probably will be changed it may decrease or increase and even can be zero at final acceptance.

So, there is a need to conduct a comprehensive investigation through all risks mentioned in the risk matrix at different milestones. At each stage of the project some of the risks may be taken, some still exist, and some new risks might be added to the initial risk register. After substantial completion, construction risk has been already taken and will not exist anymore. Therefore, these risks should be taken out from risk matrix and assessment to reflect the actual situation of the project risks on that specific milestone.

Therefore, the value for each of the risk categories should be updated or adjusted to make the ex-post VFM analysis. This computations are really dependent on the availability of data from concessionaire to provide enough information to make the re-evaluation of the risk assessment possible for public-sector.

Adjusted Risk Value= Adjusted Probability of Occurrence × Adjusted Risk Cost

Adjusted risk costs consist of those elements involved in risk calculation which have been changed during the project. It should mention again that each project has its own specific risk matrix; therefore, there is no way to elaborate details in general way. Adjusted risk cost can be gained directly from the actual costs of the project.

Moreover, the adjusted probability of occurrence can be calculated by repeating the risk workshop experts who participated in initial risk workshop for the project. Bayesian theory can be applied in calculating the adjusted probability of occurrence at different milestones. The original formula for Bayesian Theorem is:

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

Where:

- P(A|B) is the posterior probability
- P(B|A) is the likelihood
- P(A) is the prior probability

The Bayesian concepts will be applied to adjust the initial probability of occurrence at each stage. Therefore P(A|B) means the probability of happening risk A by knowing the probability of happening B.

For example, if the probability of ground condition risk at commercial close was calculated in amount of B, the probability of ground condition risk at substantial completion can be calculated by considering the initial probability (i.e., B) using Bayesian formula.

3.8 Project Financial Parameters

The last significant element in developing the ex-post VFM framework is the project financial parameters. Indeed, these parameters define the financial structure of the project and elaborate the percentage of equity, debt and loan contributions in the project. Financial parameters contain different indicators like interest rate of senior bond and TIFIA, ADSCR[5], return on equity, and discount rate. The definition and formula of discount rate will be explained in depth in appendix A.

As mentioned earlier, choosing an appropriate discount rate is one of the most important decisions in time value of money. Because the discount rate will affect the acceptance or rejection of investment options under consideration. The choice of the discount rate is really critical in the comparison between original PSC and APB of ex-post VFM analysis. Most of the time PSC and SB have the same discount rate but APB which is the adjusted version of PPP bid can have different discount rate. The result of VFM analysis in both ex-ante and ex-post is very sensitive to small changes in the discount rate. A discount rate is selected to reflect the different costs and revenues which occur at different stages of the project lifecycle (Boussabaine, 2014).

[5] Annual Debt Service Coverage Ratio

Financial close is the key milestone in project life cycle. In fact, the financial parameters before financial close all are based on the current conditions of the market and are estimations. After financial close, however, they are actual numbers which will remain constant during the project lifecycle.

Chapter 4: Case Study Results and Discussion-Presidio Parkway

4.1 Introduction

In this chapter, a brief background about Presidio Parkway project will be demonstrated first. In addition, influential assumptions including time, costs, risks, unforeseen factors, and financial parameters which are significant in developing VFM analysis will be considered. Then, the results of each VFM analysis will be presented in terms of present value (PV) of PSC, SB/APB and availability payment (AP). In order to investigate the effect of discount rates on the VFM, the analysis was conducted for different discount rates including 5.5%, 7.5%, 8.5%, and 9.2%.

8.5% is the discount rate that was applied in developing VFM analysis of ARUP/PB business case for Presidio Parkway project. A complementary discussion about the methods of choosing the appropriate discount rate will be provided in appendix A. Finally, a comprehensive comparison of VFMs and APs for different stages of the project will be discussed. Presidio Parkway has been used as a case study to evaluate ex-post VFM frameworks in PPP projects. Furthermore, it has been used to assess current ex-ante VFM analysis in order to show how reliable it is and how VFM will be changed throughout the project lifecycle; different milestones of project are shown in figure 4.1.

Figure 4.1-Different project milestones

The VFM analysis will be presented at different stages:

- Ex-ante VFM-Arup/PB Inputs/Original-Commercial close
- Ex-ante VFM-Arup/PB inputs/UMD Model-Commercial close
- Ex-post VFM (I)-GLC Inputs/Original-Commercial close (Bid Proposal)
- Ex-post VFM (I)-GLC Inputs/UMD Model-Commercial close
- Ex-post VFM (II)-GLC Inputs/UMD Model-Financial close
- Ex-post VFM (III)-GLC Inputs/UMD Model-During construction
- Ex-post VFM (IV)-GLC Inputs/UMD Model-Substantial completion
- Ex-post VFM (V)-GLC Inputs/UMD Model-Final acceptance

P3 VALUE analytical tools, which were developed by FHWA, includes risk assessment tool, Public-Sector Comparator tool, Shadow Bid tool, and Financial Assessment tool, are being used to develop VFM analyses at different stages of the project. More details about P3 VALUE tools are provided in the appendix B.

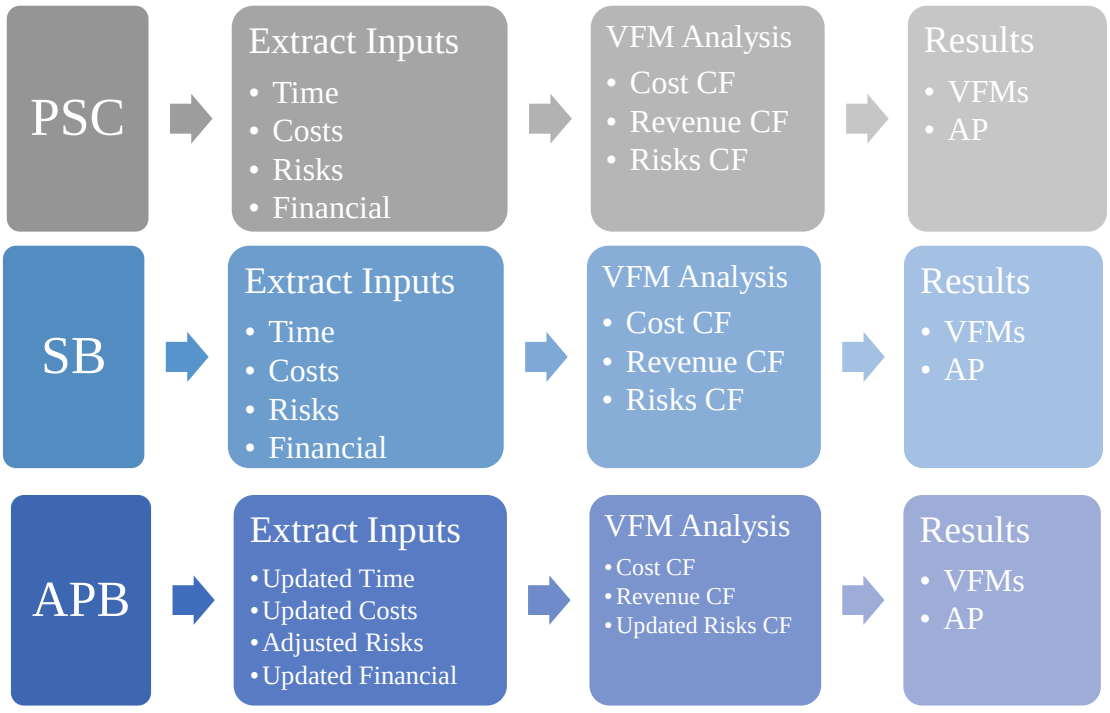

Figure 4.2-Overview of different process in VFM analysis

Each of the above VFM analyses has specific assumptions and also different results. Assumptions comprise time, project costs, project risks, project unforeseen elements and financing data. The results section show the results of the PSC, SB and APB at different discount rates. Moreover, the effect of different discount rates on VFM analysis will be investigated. Figure 4.2 describes the whole process at three different elements i.e. PSC, SB, and APB, which were used in developing ex-ante and ex-post VFM analyses.

4.2 Presidio Parkway Project Background

The Presidio Parkway is the replacement for the historic south access road to the iconic Golden Gate Bridge, known as Doyle Drive or Route 101, which at the start of construction in 2009 was structurally and seismically deficient. The roadway was originally built in 1936, but by the 2000s Doyle Drive had reached the end of its useful life. In April of 2012, traffic was shifted onto a seismically safe temporary bypass to carry traffic until the replacement of Doyle Drive is complete (Caltrans, 2015).

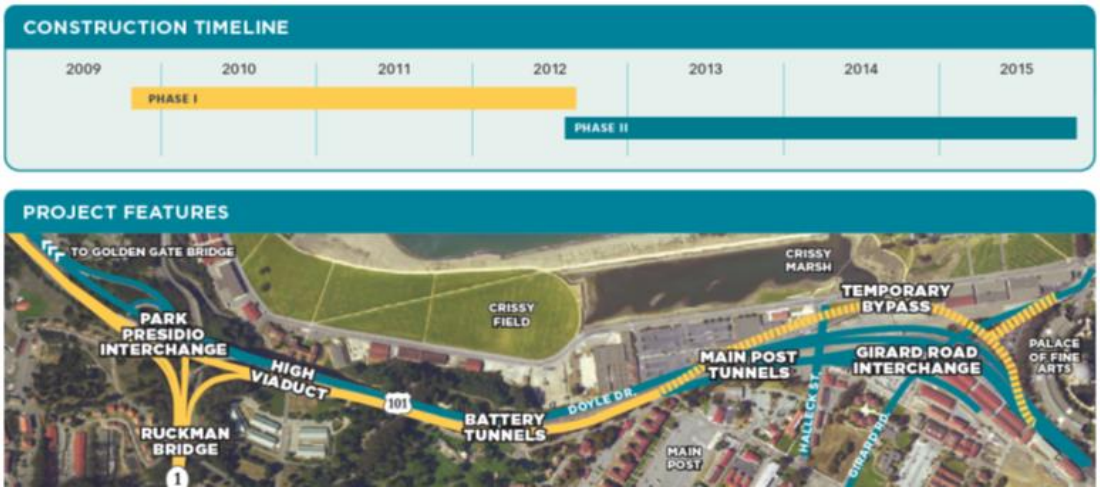

Figure 4.3-Presido Parkway Timeline (Caltrans, 2015)

The Presidio Parkway is being designed and built in two phases. Phase I was delivered through the traditional design-bid-build (DBB) method, while phase II is being delivered through a public-private partnership (PPP) in form of Design-Build-Finance-Operate-Maintain (DBFOM).

Table 4.1-Presidio Parkway Capital Costs (Caltrans, 2015)

	Phase I ($,million)	Phase II ($,million)
Environmental	27.8	-
Development and Design	50.1	-
Right of Way	83.8	-
Transaction, Construction Management and Oversight	59.1	37.4
Construction	274.4	-
Construction Completion Milestone Payment	-	185.4
TIFIA Tranche A Loan Repayment	-	91
TIFIA Tranche B Loan Repayment	-	-
Reserve	1.1	46.5
Availability Payments	-	-
Total	**496.3**	**360.3**

The new roadway provides tremendous seismic and traffic safety improvements, particularly in the event of an earthquake. Presidio parkway has a sustainable design that meets high environmental standards. The costs of phase I is $496.3 million and phase II is an estimated $360.3 million. Table 4.1 summarizes project capital costs.

As mentioned in literature review, PPP project has a long contractual agreement between the public and private sector. Each of these two sectors has different parties and stakeholders to develop the project. In Presidio Parkway project, Golden Link Concessionaire (GLC) plays the role of special purpose vehicle (SPV), Meridiam and HOCHTIEF are two equity investors, HNTB, Flatiron and Kiewit formed design/build joint venture, Transfield is O&M developer, and Caltrans and SFCTA are sponsors of the project (Figure 4.4).

At different milestones VFM analyses have been conducted; figure 4.5 illustrates these different stages for Presidio Parkway project.

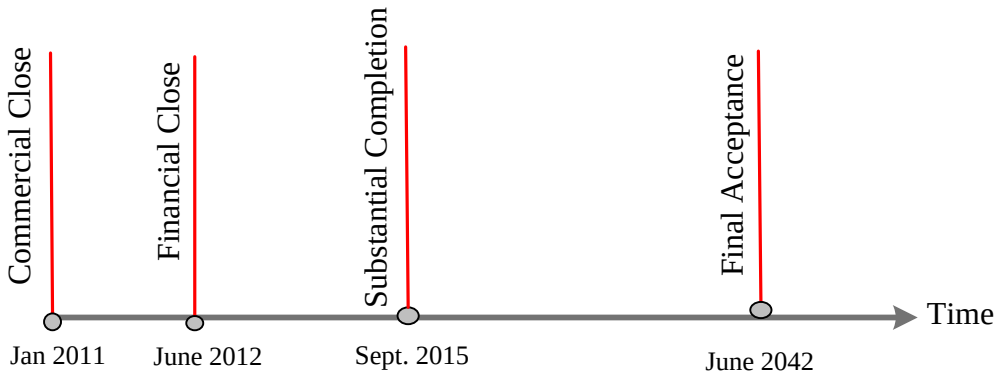

Figure 4.4-Presidio Parkway Project Key Milestones

Ex-ante VFM Analysis Assumptions and Results

Commercial close is used as the border of ex-ante and ex-post in VFM analysis. Therefore, the analysis before commercial close is named "ex-ante VFM" and after that is called "ex-post VFM" analysis. In this section, two groups of results of ex-ant value for money analysis will be discussed. The first category was conducted by ARUP/PB in 2010; and the second group has been developed by UMD financial model using the ARUP/PB's assumptions (year 2010) as inputs before commercial close to evaluate whether the PPP project has brought value for money for the Public entities.

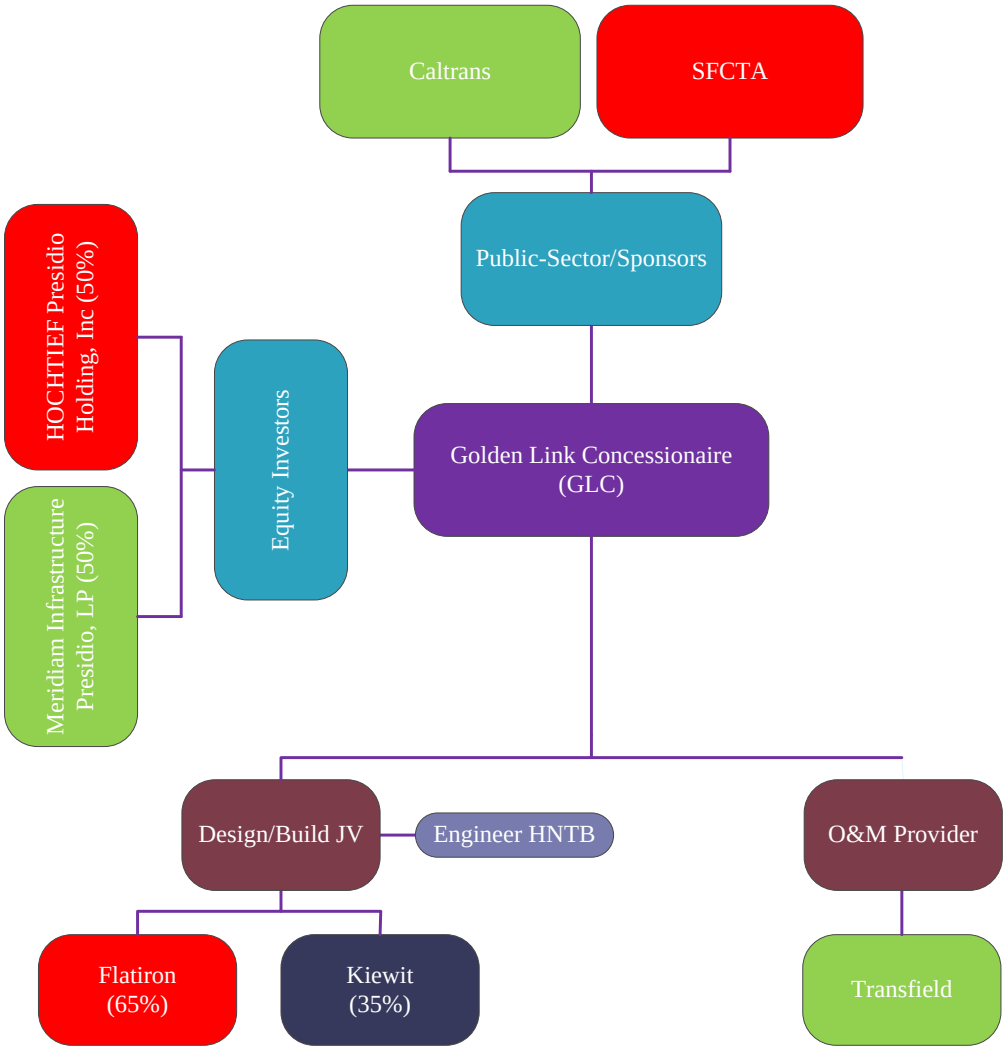

Figure 4.5-Presidio Parkway Stakeholders

The ARUP/PB initial assumptions has been used in UMD financial model in order to: 1) recreate ARUP/PB VFM analysis; 2) evaluate the UMD financial model results in comparison with ARUP/PB.; 3) build a reference PSC for the following VFM analyses.

4.2.1.1 Ex ante VFM-ARUP/PB-Commercial Close

Assumptions:

Data were collected from ARUP/PB business case report (2010) to develop Public Sector Comparator and Shadow Bid in the ex-ante VFM analysis. Tables 4.2, 4.3, 4.4 and 4.5 show the assumptions including time, costs, risks, and financing for both PSC and SB. At this stage, which is before commercial close, all the data are estimates based on project specifics and similar previous PPP projects in the State of California and other states. The same timing assumptions are being used in both PSC and SB (table 4.2), but data for cost, risk and financing assumptions are different, which will be discussed in more detail.

Timing Assumptions:

Base date is the date to which all costs and revenues are being discounted and NPV or NPC will be presented. ARUP/PB used 2009 as the base date of their analysis and discounted all costs and revenues cash flows to the 2009 dollar. Timing assumptions are presented in table 4.2. Although the actual concession period is 33 years ARUP/PB considered 60 years as the concession period. This is one of the reasons for the differences between the ARUP/PB results and the UMD results, even though the underlying assumptions are almost the same.

Table 4.2-ARUP/PB Timing Assumptions at Commercial Close

Base Date	**2009**	**Construction Period (Yrs.)**	**3**
Concession Period (Yrs.)	60	Operation Start	2013
Construction Start	2010	Operation End	2042
Construction End	2012	Operation Period (Yrs.)	30

Cost Assumptions:

In VFM analysis, different project cost cash flows are being considered, including design, construction, tax, financing, operation, maintenance and rehabilitation (figure 4.6).

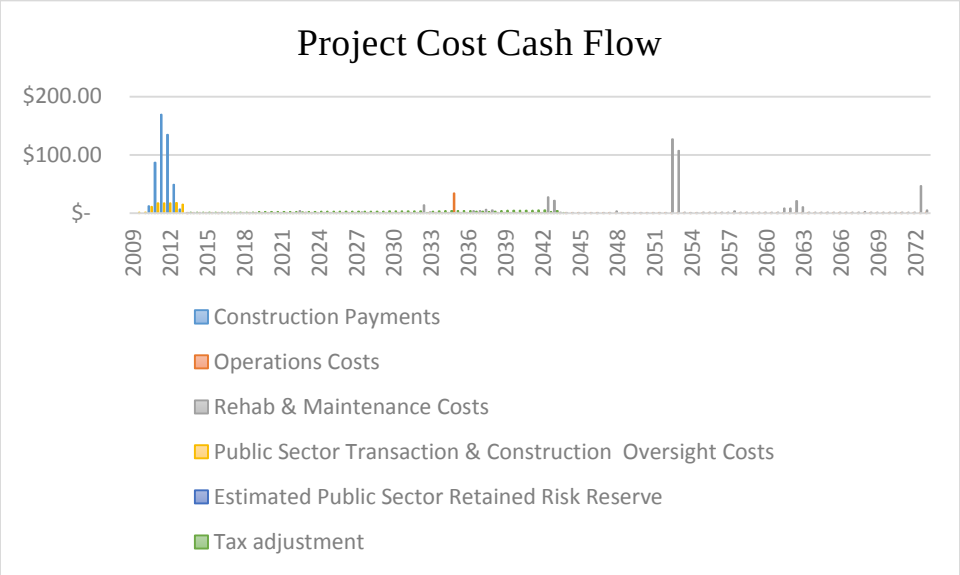

Figure 4.6-Presidio Parkway Cost Cash Flow

Table 4.3 illustrates the project costs under DBB and PPP delivery methods at commercial close stage.

Table 4.3-ARUP/PB Cost Assumptions at Commercial Close

Cost Items ($, million)	PSC/DBB	SB/PPP
Construction Costs	416	394
Oversight, Transaction & Financing Costs	90	16
O&M Costs during Construction	10.3	8.9
Annual Routine Maintenance Cost	0.486	0.685
Annual Operating Cost	0.377	0.833
Periodic Maintenance Cost	2.57	1.45

Risk Assumptions:

The availability of risk data is limited in this project, as private firms are not willing to share their data in this category. Therefore, the comprehensive analysis for risk data

is not currently possible. Although Arup/PB used P80 in their analysis UMD model just have used P70 in its calculations to approximate the risks calculation (Table 4.4). This inconsistency can affect the results of the recreated version of VFM analysis.

Table 4.4-ARUP/PB- Risk Assumptions at Commercial Close

	Cost ($2009, million)		Schedule (%)	
Risk Allocation	**PSC/DBB**	**SB/PPP**	**PSC/DBB**	**SB/PPP**
Design-Build Phase-Public (Retained)	100	52	100	-
Design-Build Phase-Private (Transferable)	-	48	-	-
Risk Value	**P80**			
Design Build Cost Impact	125	91		
Design Build Schedule Impact	1	-		

Risks data presented by ARUP/PB shows that there is a need in this section for public to have a better data availability.

Financing Assumptions:

There is no financial structure in the PSC because all the costs are paid for by public. But SB or Adjusted PPP Bid (APB) has financial structure; therefore, financial input data are need to develop the financial model.

The construction phase of Presidio Parkway has been financed by three parts: a commercial senior loan, a TIFIA loan and an equity contribution from the private finance partner. The financial data that ARUP/PB used in its VFM analysis are illustrated in table 4.5. Chapter 3 and Appendix A elaborate each of these factors in more depth.

Table 4.5-ARUP/PB Financial Assumptions at Commercial Close

Financial Parameters			
Discount Rate	8.5%	Equity Return	11.5
Interest Rate	4.15%	ADSCR	1.2
Issuance Fee	3%	Project Subsidy ($)	N/A
% of Project Financed	89.5	Maturity (Year)	N/A
CPI	2.2%		

VFM Analysis Results:

ARUP/PB VFM analysis results are showing that the PPP procurement method can save $147 million for the public sector over the life of the project. In this analysis, the amount of money that the public-sector should pay to the private sector as availability payment (AP), based on the availability of the road to the public, is $35.4 million.

Table 4.6-Ex-ante VFM analysis Results-Net Present Value (2009$, million)

Discount rate	PSC/DBB	SB/PPP	VFM	AP
5.5%	730	676	54	35.4
7.5%	660	538	122	35.4
8.5%	635	488	147	35.4
9.2%	619	469	150	35.4

Results show that low discount rates decrease the amount of VFM; therefore, there is a range of discount rates that gives the optimum VFM. In this project, Arup/PB chose 8.5% as the best choice for discount rate. Results show that all APs are the same and AP is independent from the discount rate (See figure 4.7).By increasing the discount rate VFM will increase. Therefore, the public sector has to choose the appropriate discount rate to cover all circumstances of the project.

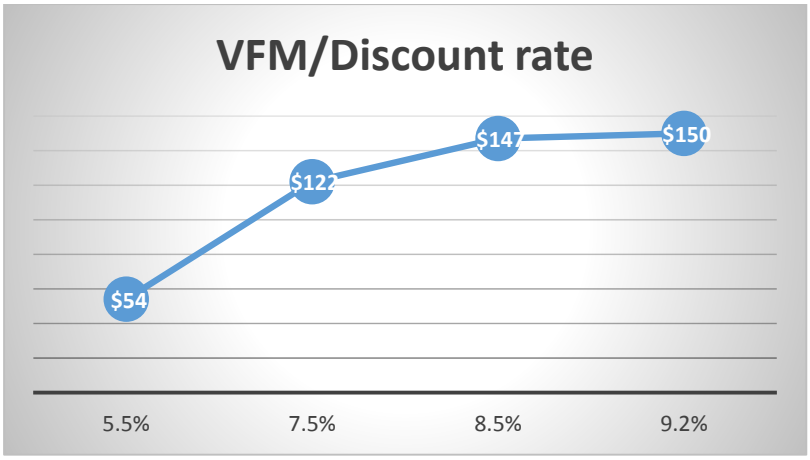

Figure 4.7-The effect of discount rate on VFM

Figure 4.8 illustrates that at commercial close PPP delivery can save $147 million for public-sector.

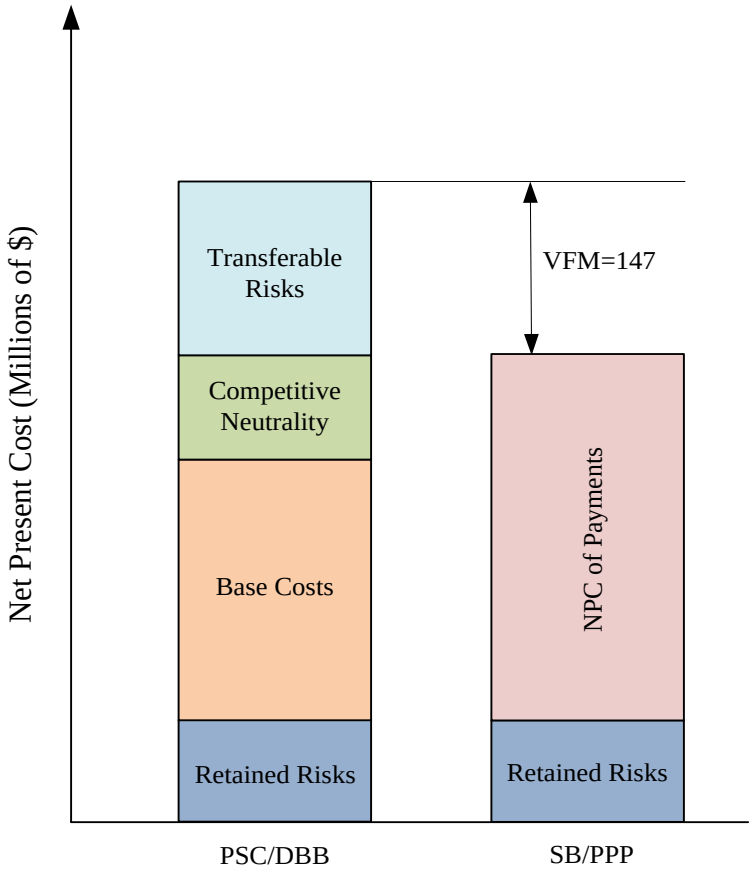

Figure 4.8-ARUP/PB VFM Analysis at Commercial Close (8.5%)

4.2.1.2 Ex-ante VFM-UMD Model-Commercial Close

The second ex-ante VFM analysis will be developed using P3 VALUE tools. The assumptions, which were used by ARUP/PB in the previous section, are mostly the same and will be applied here. The results also will be presented for different discount rates including 5.5%, 7.5%, 8.5%, and 9.2%. Indeed, this ex-ante VFM is a recreated version of the ARUP/PB ex-ante VFM analysis to calibrate the UMD financial model

and to use the results of the PSC of this VFM as a baseline to compare with the APB of ex-post VFM at different stages.

Assumptions:

The assumptions which have been used in UMD model for ex-ante VFM are approximately the same. But there are some differences including:

- UMD considered 33 years as a concession period
- Treatment of $150 million milestone payment w/r/t its tax impact
- P70 was considered in comparison with P80 used in ARUP/PB report

These differences and other limitations in the model made the results different between ARUP/PB and UMD, which will be explained in next sections.

Timing Assumptions:

As mentioned before, one of the differences between UMD and ARUP/PB is related to the concession period and construction start date. In the UMD model, the concession period is 33, whereas ARUP/PB used 60 years. In addition, UMD assumed that construction started at the beginning of the year 2010 while ARUP/PB used the second half of the year of 2010, creating small differences in the final calculations.

Table 4.7-UMD Timing Assumptions at Commercial Close

Timing Assumptions			
Base Date	2009	Construction Period (Yrs.)	3
Concession Period (Yrs.)	33	Operation Start	2013
Construction Start	2010	Operation End	2042
Construction End	2012	Operation Period (Yrs.)	30

Cost Assumptions:

The cost assumptions are largely the same as those used in the previous section. However, they consist of different cost categories, construction costs, transaction costs, and O&M costs during after construction (Table 4.8).

Table 4.8-UMD Cost Assumptions at Commercial Close

Cost Items ($)	PSC/DBB	SB/PPP
Construction Costs	416	394
Transaction Costs	90	16
O&M Costs during Construction	10.254	8.9
Annual Routine Maintenance Cost	0.377	0.685
Annual Operating Cost	0.468	0.833
Periodic Maintenance Cost	2.573	1.45

Risk Assumptions:

The risk assumptions are the same as those used in section 4.1.2.1, the only difference being that the UMD model applies P70 in its calculations (Table 4.4). This inconsistency can affect the results of the recreated version of VFM analysis.

Table 4.9-UMD-Risk Assumptions at Commercial Close

	Cost ($2009, million)		Schedule (%)	
Risk Allocation	**PSC/DBB**	**SB/PPP**	**PSC/DBB**	**SB/PPP**
Design-Build Phase-Public (Retained)	100	52	100	-
Design-Build Phase-Private (Transferable)	-	48	-	-
Risk Value (P70)	**PSC/DBB**	**SB/PPP**		
Design Build Cost Impact	125	91		
Design Build Schedule Impact	1	-		

Financing Assumptions:

There is no financial structure in the PSC because all of the costs are paid for by public. Yet SB has financial structure, or, in other words, the private sector takes advantage of debt and loans to finance the project in PPP. Several data are required to develop the financial model, including interest rates and percentages of contribution of

debt and equity. At commercial close, it was assumed that the Presidio Parkway construction was financed by three parts: a commercial senior loan, a TIFIA loan, and an equity contribution from the private finance partner.

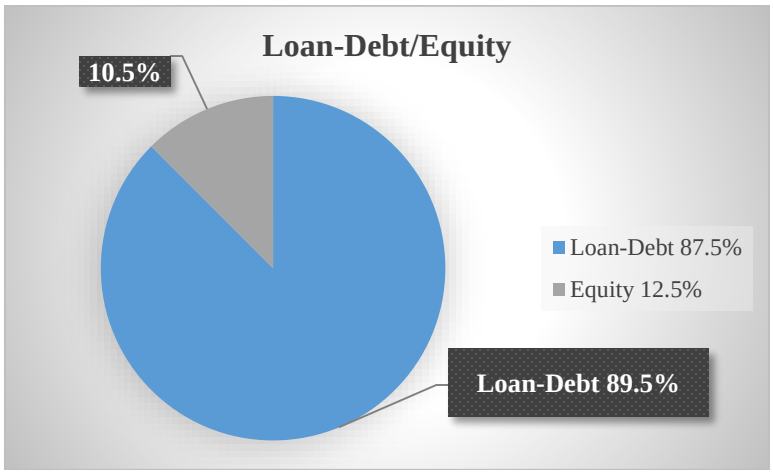

Figure 4.9-GLC Financial Structure

The financial data that ARUP/PB used in VFM analysis are illustrated in table 4.10. More details regarding the discount rates topic can be found in appendix A.

Table 4.10-Financial Assumptions at Commercial Close

Financial Assumptions			
Discount Rate	8.5%	Equity Return	11.5
Interest Rate	4.15%	ADSCR	1.2
Issuance Fee	3%	Project Subsidy ($)	127.5
% of Project Financed	89.5%	Maturity (Year)	27
CPI	2.2%		

Results:

UMD VFM analysis results show that the PPP procurement method can save $137.1 million for the public sector considering the whole project life. In this analysis, the amount of money that the public sector should pay to the private sector, based on the availability of the road to the public, is $35 million.

Table 4.11-Ex-ante VFM analysis Results-Net Present Value (2009$, million)

Discount rate	PSC/DBB	SB/PPP	VFM	AP
5.5%	716.8	709.4	7.4	35
7.5%	657.4	553.9	103.5	35
8.5%	632.4	495.3	137.1	35
9.2%	616.5	459.9	156.6	35

Results show that low discount rates decrease the amount of VFM; therefore, there is a range of discount rates that gives the optimum VFM. In this project, Arup/PB chose 8.5% for the discount rate. Results show that all APs are the same and independent from the amount of the discount rate (See figure. 4.10).

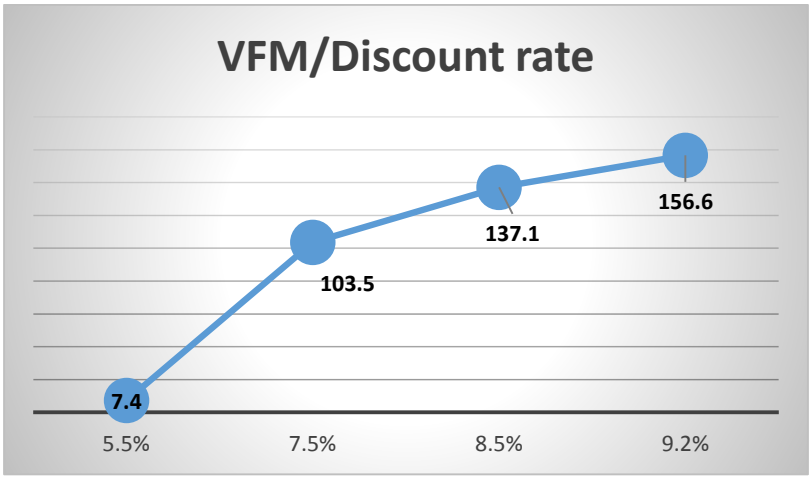

Figure 4.10- The effect of discount rates on VFM

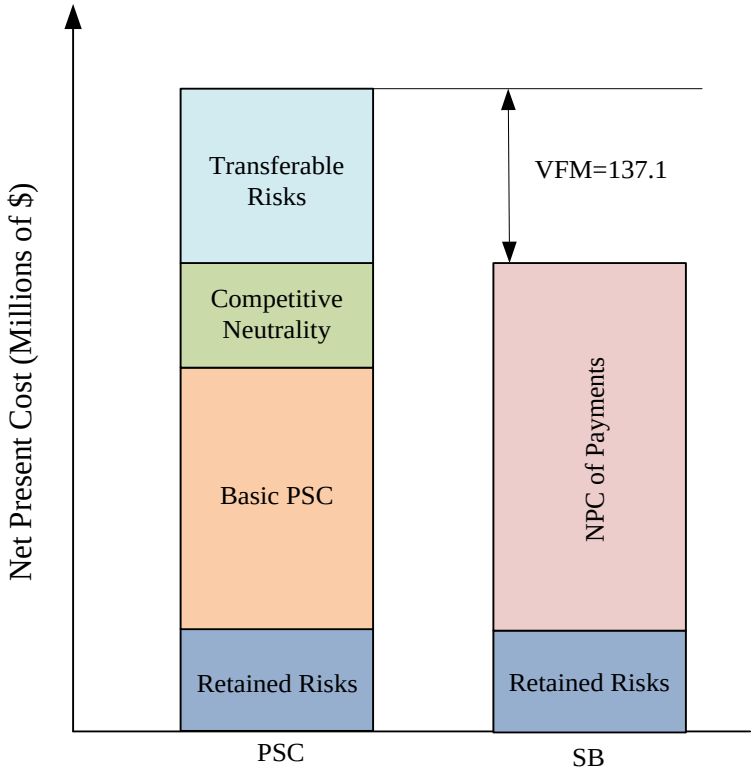

Figure 4.11-UMD VFM Analysis at Commercial Close (8.5%)

Comparison between ARUP/PB and UMD results-Commercial close

Table 4.12 summarizes and compares two ex-ante VFM analyses conducted by ARUP/PB and UMD. The recreated VFM by UMD model shows similar results even though some of the assumptions and inputs differ from the original model.

Table 4.12- ARUP/PB vs. UMD results-Commercial Close (8.5%)

Model	ARUP/PB	UMD
PSC ($M)	635	632.4
SB ($M)	488	495.3
VFM ($M)	147	137.1
AP ($M-2013)	35.4	35

4.2.2 Ex-post VFM Analysis Assumptions and Results

The ex-post VFM analysis will be developed at five different key milestones of the project: commercial close, financial close, during the construction, substantial completion, and after final acceptance using P3 VALUE tools. These ex-post analyses will be conducted based on the availability of data provided by the concessionaire for each of these milestones. At each milestone, some of the data can be replaced with the actual, other data will still be estimates, and other sets of data will be updated considering the progress of the project on that specific milestone. The assumptions and data at each milestone will be presented, after which the VFM analysis will be conducted and the results investigated for several discount rates, including 5.5%, 7.5%, 8.5%, and 9.2%.

4.2.2.1 Ex-post VFM-Commercial Close

At commercial close, 3 different bidders provided their bids for Presidio Parkway. At the end, Golden Link Concessionaire (GLC) won the bid and was selected as the concessionaire. As mentioned before, the shadow bid is not the actual bid, but it is hypothetical format of the bid and it is just the estimation of the project by the public sector to determine whether the project can be delivered by the private sector.

GLC provided various type of data including construction, operation & maintenance costs, and financial data that was used to prepare the bid proposal. But the risk data and its VFM analysis was not provided at this time to the public. To develop the ex-post VFM analysis, the PSC which was used in ex-ante VFM analysis will be adjusted and then employed.

Assumptions:

Data were collected from the GLC bid proposal (2010) to develop the PPP bid. Similar to ex-ante VFM, various assumptions including timing, costs, risks, and financing will be used in the analysis, as presented in the following tables.

Timing Assumptions:

In GLC's bid proposal, year 2010 was selected as the base year to discount all lifecycle costs and cash flows. Different timing assumptions, such as concession period, are presented in table 4.14.

Table 4.13-Timing Assumptions at Commercial Close

Timing Assumptions			
Base Date	2010	Construction Period (Yrs.)	3
Concession Period (Yrs.)	30	Operation Start	2013
Construction Start	2010	Operation End	2042
Construction End	2012	Operation Period (Yrs.)	30

Cost Assumptions:

Like ex-ante VFM, cost assumptions contain design, construction, financing, operation and maintenance at the commercial close stage (Table 4.15).

Table 4.14-Cost Assumptions at Commercial Close

Cost Items ($)	**PSC**	**PPP**
Construction Costs	416	248.6
Oversights, Transaction & Financing Costs	90	96.1
O&M Costs during Construction	10.254	8.343
Annual Routine Maintenance Cost	0.377	0.574
Annual Operating Cost	0.468	1.9
Periodic Maintenance Cost	2.573	1.715

Risk Assumptions:

One of the limitations of this thesis is GLC's risk data because such data did not provide by private sector to the public. In order to complete ex-post VFM analysis, the previous risk data that was used in ex-ante will be applied on ex-post analysis.

Table 4.15-UMD-Risk Assumptions at Commercial Close

	Cost ($2009, million)		Schedule (%)	
Risk Allocation	**PSC/DBB**	**SB/PPP**	**PSC/DBB**	**SB/PPP**
Design-Build Phase-Public (Retained)	100	52	100	-
Design-Build Phase-Private (Transferable)	-	48	-	-
Risk Value (P70)	**PSC/DBB**	**SB/PPP**		
Design Build Cost Impact	125	91		
Design Build Schedule Impact	1	-		

Financing Assumptions:

There is no financial structure in the PSC like ex-ante VFM analysis because all the costs are paid for by the public. On the other hand, PPP bid has financial structure and the private sector takes advantage of using debt and loan to finance the project in PPP.

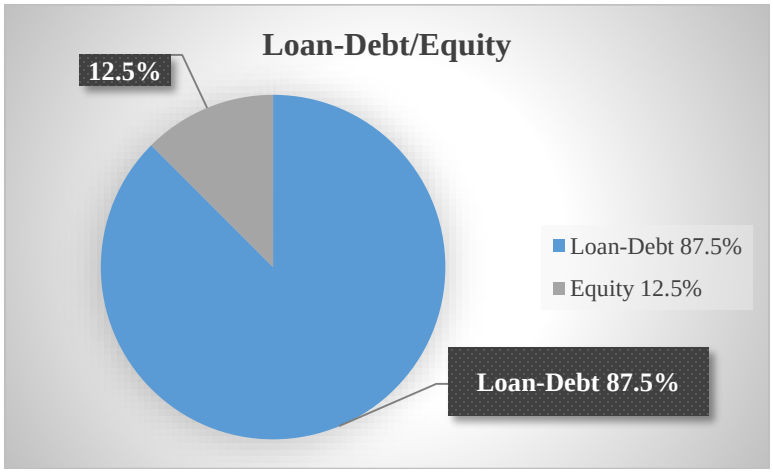

Figure 4.12-GLC Financial Structure

Several data are required to develop the financial model, such as loan interest rates, and percentage of contribution of debt and equity (Figure4.12). At commercial close,

it was assumed that Presidio Parkway construction was financed by two debt issues-a commercial senior loan and a TIFIA loan plus an equity contribution from the private finance partner. The GLC's financial data used in the VFM analysis are illustrated in table 4.16.

Table 4.16-Financial Assumptions at Commercial Close

Financial Assumptions			
Discount Rate	8.5%	Equity Return	11.5
Interest Rate	4.5%	ADSCR	1.25
Issuance Fee	3%	Project Subsidy ($)	127.5
% of Project Financed	87.5%	Maturity (Year)	27
CPI	2.2%		

Results:

Ex-post VFM analysis results are showing that PPP procurement method can save $210.9 million for public sector considering whole project life. In this analysis, the amount of money that public-sector should pay back to private because of the availability of the road to the public is $21.9 million which is almost 13 million dollars below the AP calculating by ARUP/PB. Different project costs and financial structure which was used by GLC can make this big difference between APs.

Table 4.17-Ex-post VFM Results-Commercial Close (NPV-2009$, million)

Discount rate	**PSC**	**APB**	**VFM**	**AP**
5.5%	716.8	580.5	136.3	21.9
7.5%	657.4	544.8	112.6	21.9
8.5%	632.4	421.5	210.9	21.9
9.2%	616.5	394.9	221.6	21.9

The analysis was repeated for different discount rate to investigate the effect of different discount rate on VFM and AP (Table 4.17). Results show that low discount rate decreases the amount of VFM; therefore, there is a range of discount rate that gives the optimum VFM. In this project, Arup/PB chose 8.5% for discount rate. Results show

that all APs are the same and independent from the amount of discount rate (See figure. 4.13).

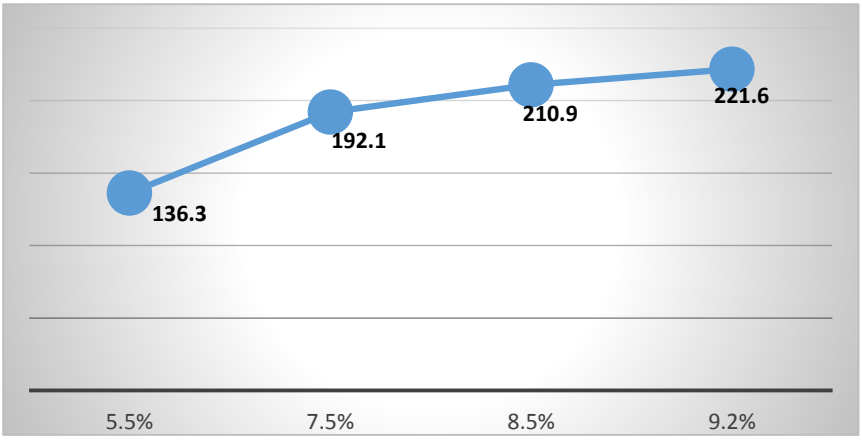

Figure 4.13-VFM at different Discount rates

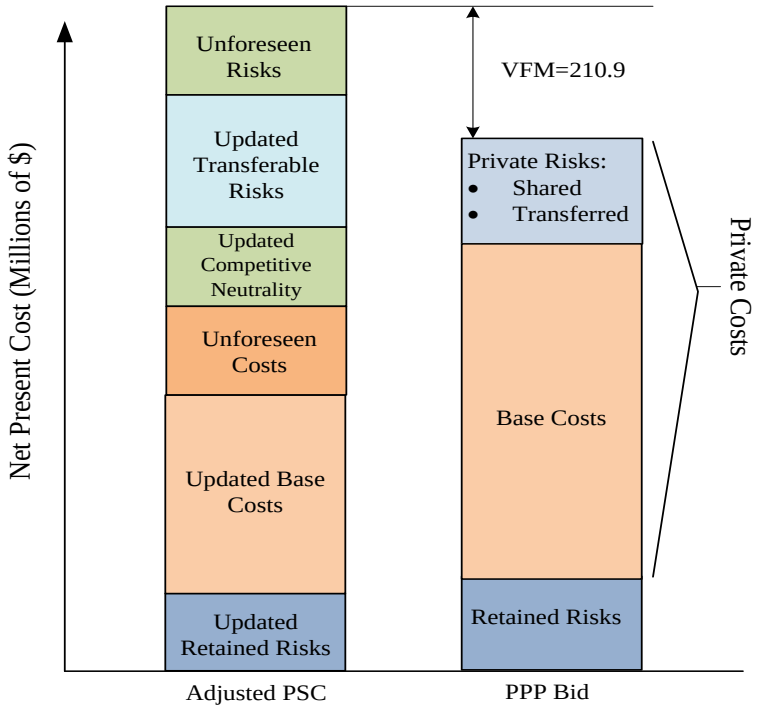

Figure 4.14-Ex-post VFM Analysis at Commercial Close (8.5%)

Compare Original Bid with UMD model results at Commercial Close

GLC's bid shows that they bided the project at $28.5 million as the availability payment. On the other side, the results from UMD's analysis illustrates the $21.9 million for AP. This variance makes sense when one considers the profit that the private sector keeps for itself.

4.2.2.2 Ex-post VFM-Financial Close

The second ex-post VFM analysis conducted the analysis after financial close. After commercial close, public and private sectors negotiate with each other to reach to the final financial factors. Selected bidder also negotiates with banks and equity investors regarding interest rates, maturity period, and other financial parameters. Therefore, ex-post VFM analysis should be conducted at financial close to consider these changes after commercial close. After financial close, these factors will not change. At this point, all data are the same as the previous stage and the only data that will be changed are financial parameters. These financial parameters are the actual ones used in the project.

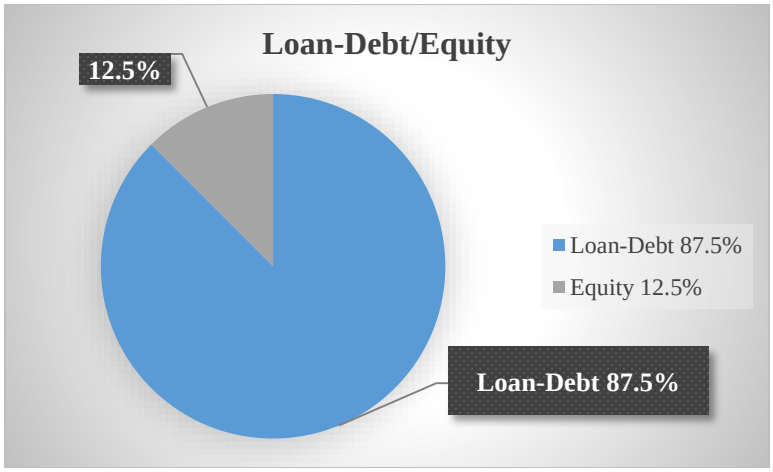

Figure 4.15-GLC Financial Structure

Financing Assumptions:

As mentioned earlier, there is no financial structure for PSC. But Update PPP Bid (APB) has financial structure (See figure 4.15). Some of the data have been changed during the time between the two milestones (i.e., commercial close and financial close). At commercial close, TIFIA loan was assumed to be one trench long term loan but at financial close TIFIA loan consists of two trenches: Trench A and Trench B with different amount, interest rates and tenor. The GLC's financial data used in VFM analysis at this milestone are illustrated in table 4.18.

Table 4.18-Financial Assumptions at Commercial Close ($ million)

Financial Parameters	Commercial Close	Financial Close
Discount Rate	8.5%	8.5%
Issuance Fee	3%	3%
% of Project Financed	87.5%	87.5%
CPI	2.2%	2.2
Equity Return	11.5%	14.5%
Milestone Payment	150	185
Project Subsidy ($)	127.5	147.3
TIFIA Loan Amount	150	Trench A: 89.8
		Trench B: 60.2
TIFIA Loan Interest rate	4.5	Trench A: 0.46%
		Trench B: 2.71%
TIFIA Loan Tenor	27	Trench A: 3.5 Years
		Trench B: 28 Years
ADSCR	1.25	1.25

Results:

After updating the financial assumption at financial close stage, Ex-post VFM analysis results are showing that PPP procurement method can save $233.7 million for public sector. In this analysis, the amount of money that public-sector should pay back to private because of the availability of the road to the public in form of availability payment term is $20.1 million which is almost 1.8 million dollars below the AP

calculating at commercial close or bid time. Changes in financial factors made this variance between two Aps at financial close and commercial close.

Table 4.19-Ex-post VFM analysis Results-Net Present Value (2009$, million)

Discount rate	A/PSC	APB	VFM	AP
5.5%	716.8	549.8	167	20.1
7.5%	657.4	440.5	216.9	20.1
8.5%	632.4	398.7	233.7	20.1
9.2%	616.5	373.3	243.2	20.1

The analysis was repeated for different discount rates to see the effect of different discount rates on VFM and AP (Table 4.19).

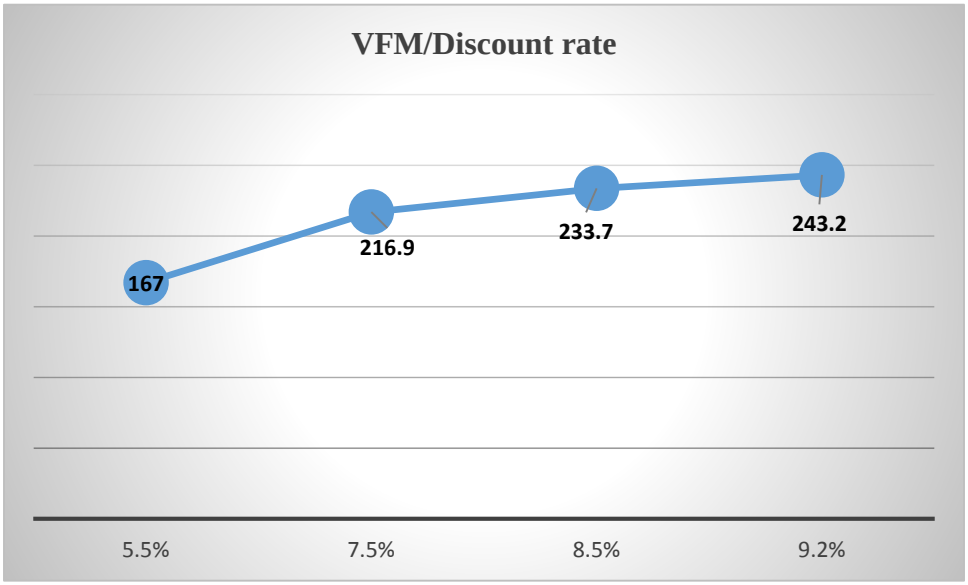

Figure 4.16-VFM at different Discount rates

Results show that low discount rate decreases the amount of VFM; therefore, there is a range of discount rate that gives the optimum VFM. In this project, Arup/PB chose 8.5% for discount rate. Results show that all APs are the same and independent from the amount of discount rate (See figure 4.16 & 4.17).

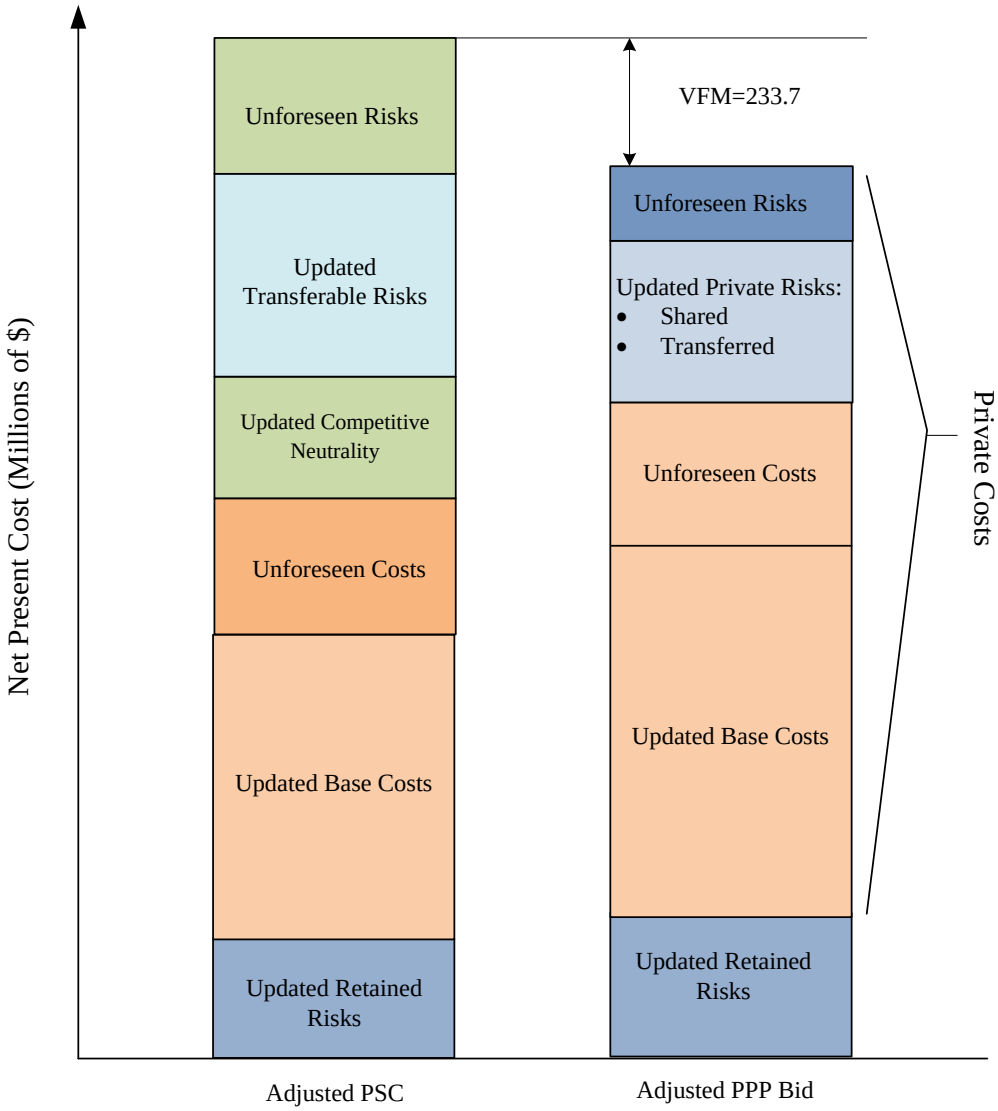

Figure 4.17-Ex-post VFM Analysis at Financial Close (8.5%)

4.2.2.3 Ex-post VFM during Construction-2015

The third ex-post VFM analysis belongs to construction period. During the construction period several assumptions like time and costs could be updated and changed because of delays and cost overruns and financing assumptions are the same as assumption at financial close. Risk assumptions also are the same as commercial

close because of lack of information regarding the risks. To develop the ex-post VFM analysis, the PSC is the same that was used in ex-ante VFM analysis.

Timing Assumptions:

In GLC's bid proposal, year 2010 was selected as the base year to discount all lifecycle costs but the updated base date is 2011. Moreover, length of construction changed to 4 years from 3 years. Different timing assumptions like concession period is presented in table 4.14.

Table 4.20-Timing Assumptions during Construction

Timing Assumptions			
Base Date	2011	Construction Period (Yrs.)	4
Concession Period (Yrs.)	30	Operation Start	2016
Construction Start	2012	Operation End	2045
Construction End	2015	Operation Period (Yrs.)	30

Cost Assumptions:

Like ex-ante VFM, cost assumptions contain design, construction, financing, operation and maintenance at commercial close stage (Table 4.15).

Table 4.21-Cost Assumptions at Commercial Close

Cost Items ($)	**PSC**	**PPP**	**APB**
Construction Costs	416	248.6	261.5
Transaction Costs	90	96.1	87.325
O&M Costs during Construction	10.254	8.343	8.152
Annual Routine Maintenance Cost	0.377	0.574	0.574
Annual Operating Cost	0.468	1.9	1.9
Periodic Maintenance Cost	2.573	1.715	1.715

Results:

Ex-post VFM analysis results are showing that PPP procurement method can save $246.1 million for public sector considering whole project life. In this analysis, the amount of money that public-sector should pay back to private because of the

availability of the road to the public is $21.9 million which is almost 13 million dollars below the AP calculating by ARUP/PB. Different project costs and financial structure which was used by GLC can make this big difference between APs.

Table 4.22-Ex-post VFM analysis Results-Net Present Value (2009$, million)

Discount rate	PSC	APB	VFM	AP
5.5%	716.8	550.6	166.2	20.1
7.5%	657.4	431.4	226	20.1
8.5%	632.4	386.3	246.1	20.1
9.2%	616.5	359	257.5	20.1

The analysis was repeated for different discount rate to investigate the effect of different discount rate on VFM and AP (Table 4.22).

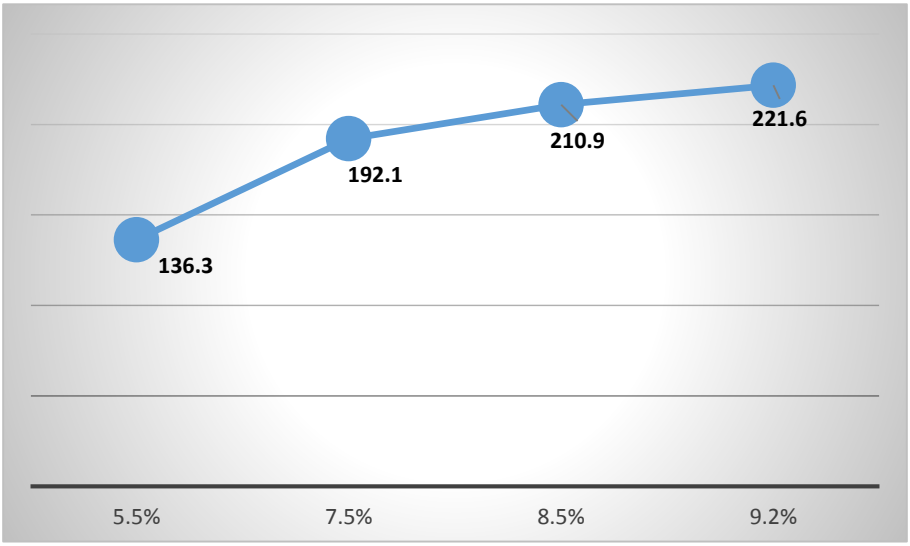

Figure 4.18-VFM at different Discount rates

Results show that low discount rate decreases the amount of VFM; therefore, there is a range of discount rate that gives the optimum VFM. In this project, Arup/PB chose 8.5% for discount rate. Results show that all APs are the same and independent from the amount of discount rate (See figure 4.18).

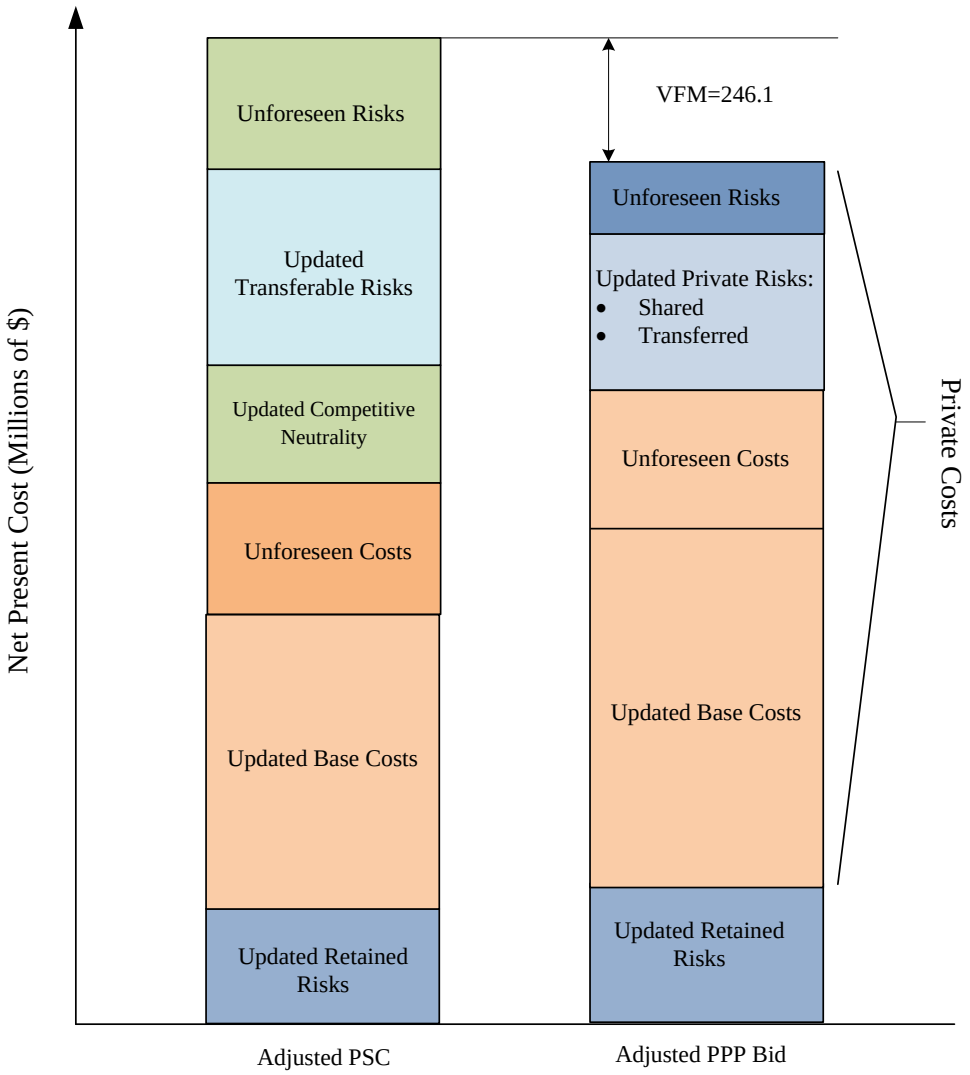

Figure 4.19-Ex-post VFM Results during construction (8.5%)

The required data to develop ex-post VFM analyses for substantial completion and final acceptance will not be available at the time of writing this thesis.

Summary: Comparing Ex-ante and Ex-post VFM and KPIs Results

After reviewing all ex-ante and ex-post value for money analyses, table 4.23 summarizes the all results of the analyses.

Table 4.23-Summary of ex-ante and ex-post VFM Analyses

		Ex-Ante		Ex-Post		
		ARUP	UMD	PPP Bid	Adjusted PPP Bid-GLC	
		Before Commercial Close		Commercial Close	Financial Close	During Construction
	Actual Date	February, 10		January, 11	June, 12	December, 14
5.5%	PSC ($ M)	730	716.8	716.8	716.8	716.8
	SB ($M)	676	709.3	580.5	549.8	550.6
	VFM ($ M)	54	7.5	136.3	167	166.2
7.5%	PSC ($ M)	660	657.4	657.4	657.4	657.4
	SB ($M)	538	553.9	465.3	440.5	431.4
	VFM ($ M)	122	103.5	192.1	216.9	226
8.5%	PSC ($ M)	635	632.4	632.4	632.4	632.4
	SB ($M)	488	495.3	421.5	398.7	386.3
	VFM ($ M)	147	137.1	210.9	233.7	246.1
	AP ($M-2013)	35.4[6]	35[7]	21.9[8]	20.1[9]	20.1[10]
9.2%	PSC ($ M)	619	616.5	616.5	616.5	616.5
	SB ($M)	469	459.9	394.9	373.3	359
	VFM ($ M)	150	156.6	221.6	243.2	257.5

Moreover, figure 4.20 illustrates the VFM results and shows VFM has increase during the project after updating and adjusting the required data to develop VFM analysis.

[6] Page H 1 Arup – 17.7*2=35.4
[7] AP_1=17.4+17.6=35
[8] AP_2=(12.8 +13)/1.085^2=21.9 (2013$)
[9] AP_3=(11.8+11.9)/1.085^2=20.13
[10] AP_4=(12.8+12.9)/1.085^3=20.12

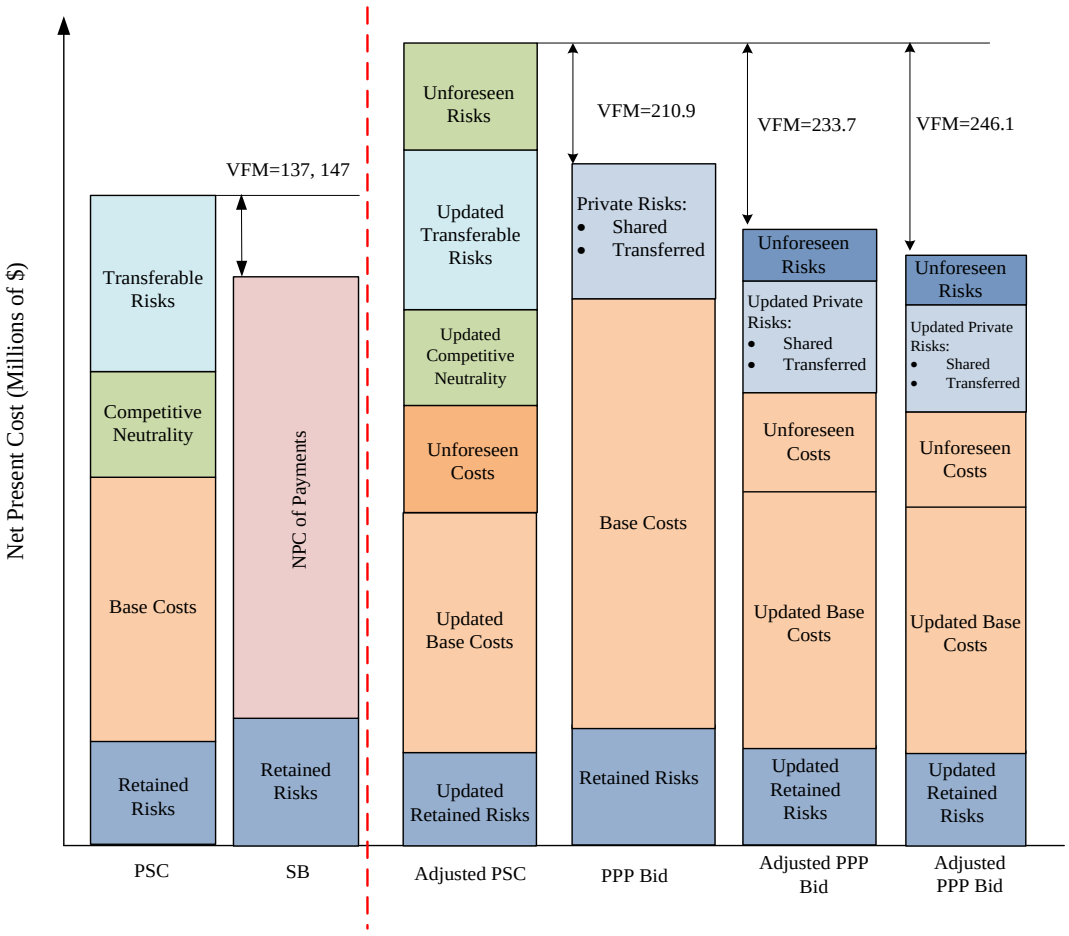

Figure 4.20-Ex-ante and Ex-post VFM analyses

Availability payment at different stages also has been shown in figure 4.21. It illustrates that ARUP/PB at first estimated $35.4 million which UMD approximate $35 million which is really close. Then, UMD calculated AP at commercial close $21.9 million which is below $28.5 million that GLC proposed in its bid. And finally after the financial parameters got fix, UMD approximated $20.1 million as the AP although this number for GLC and Caltrans is $22.1.

UMD calculations and results similar trend to the actual and the differences can make because of some variations in the assumptions and the method of calculations.

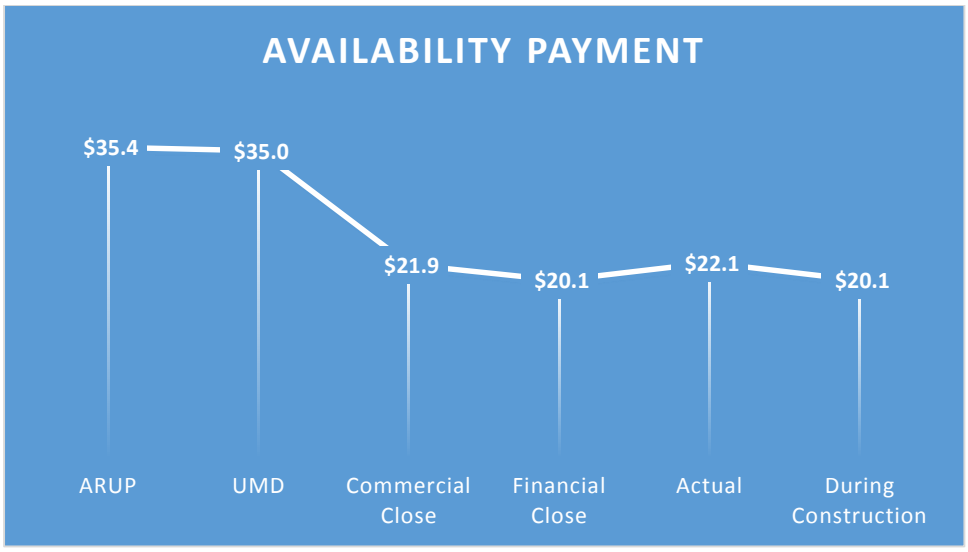

Figure 4.21-Availability Payment (AP) at different Milestones

The effects of different discount rate on VFM analyses at different stages have been studied; and the results show that by increasing the discount rate the VFM will increase (See figure 4.22).

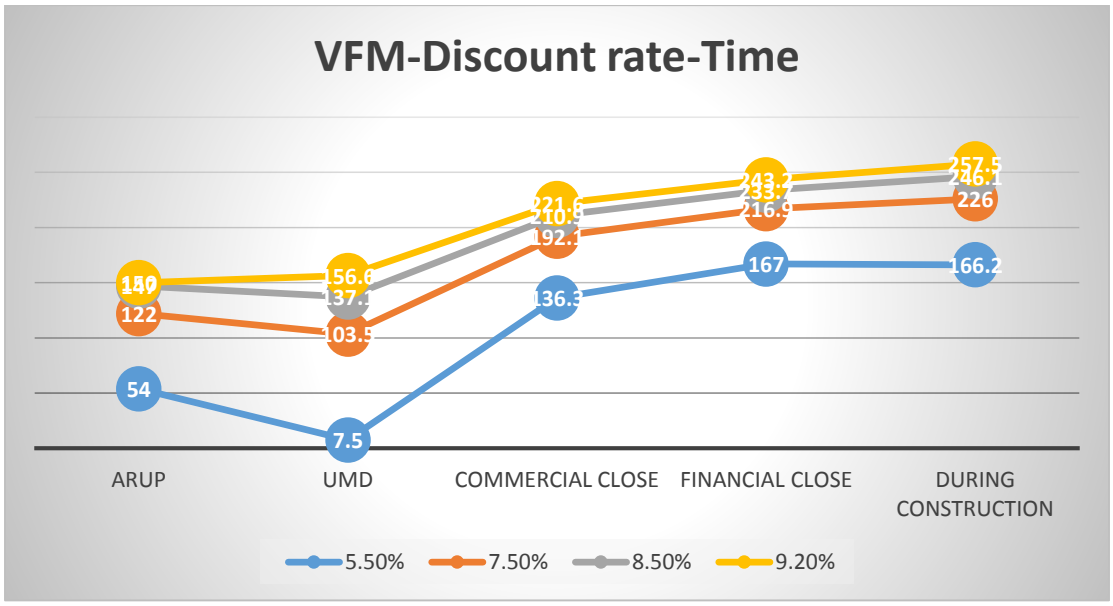

Figure 4.22-The Effects of Different Discount rates on VFM Results

Chapter 5: Conclusions and Recommendations

In conclusion, it should be mentioned that developing a solid framework for ex-post VFM analysis by using the current practice for ex-ante can be really beneficial for both public and private sectors as a tool to oversee the efficiency of their first evaluation. And public and private sector should put this analysis as a part of PPP project analysis.

5.1 Contribution of Research

Chapter 2 of the study were devoted to an in-depth review of Public Private Partnerships and value for money analysis literature with a specific focus upon assessing ex-ante VFM analysis in PPPs. Apart from framing the research's focus, providing readers with an overview of, and background to public private partnership concepts and value for money analysis, the literature review chapters functioned to direct the research towards an in-depth exploration of comparatively unexplored issues within value for money analysis specifically ex-post VFM framework in PPPs. This brings us directly to the question of the research's contribution to the field. The research has made three contributions to the field of PPPs, each of which shall now be briefly highlighted.

The first contribution lies in the discovery of the need for ex-post VFM analysis framework to track VFM at different milestones in a PPP infrastructure projects. The literature review, experts interviews show the need for such a framework and analysis in order to enhance the financial feasibility of PPPs both for private and public entities.

The second contribution of this research lies in the development of general framework for the ex-post value for money analysis. This framework can be used as a benchmark to develop the VFM analysis after commercial close in PPP projects.

The third contribution is the comparison between developed ex-post VFM framework with ex-ante VFM analysis. The last contribution of this study is the suggestion of using the Bayesian Network or expert's opinion in order to adjust the risks probability in ex-post VFM analysis.

5.2 Implications of the Study

This study can be applied in all PPP projects which may be at different stages of their project lifecycle. For example, ex-post VFM can be applied for those PPP project are in construction, those are in O&M phase, and also should be used in PPPs which are done. Ex-post VFM analysis shows how much those PPP project can attain value for money both for public and private sector.

5.3 Limitations of the Study and Future Work

Even it was mentioned in chapter one about the importance of conducting this research in PPP worlds, it is necessary to conclude with a concern to the study's limitations. Such a concern, will apart from framing the study in the sense that it outlines the basis upon which it should be judged, support the previously stated recommendations for future research. It is very possible that the present study be judged on the basis of that which it has not covered. Accordingly, one need acknowledge that the study has not suggested a formula to estimate risks after they were taken, but it has used Bayesian Theory to develop a concept as a suggestion to evaluate these kind of risks. The main reason lies in the fact that PPP programs in the US are not well

established yet, and therefore collecting accurate data especially about different type of risks at different stages of PPPs in the US is really difficult or it should say it is almost impossible. Lack of enough data makes it almost impossible to apply suggested Bayesian formula to estimate new risks probability. Therefore, because of the mentioned limitations the only available choice was to use initial estimation in ex-post VFM analysis too.

Appendices

Appendix A: Discount rates (ARUP/PB, 2010)

The existing approaches to the discount rate applied for VFM analysis in countries considered relatively more experienced in the P3 field are considered below:

- **Social Time Preference Rate**–the value society places on consumption of goods and services now, for example as applied in the U.K.
- **Project Specific Rate (pre-tax time-weighted WACC)**–as proposed by Partnerships BC, Canada
- **Differentiated Discount Rates (Public sector comparator rate vs. P3 rate)**–the current Risk-free Rate (to reflect the time value of money) with a premium added to account for the systematic risk, as applied in Australia

The Social Time Preference Rate

The 2003 U.K. "Green Book," the U.K. HM Treasury's guidance for appraisal and evaluation of government projects applicable to P3-PSC comparisons, uses a "social time preference" (STP) rate, deriving from classic concepts in welfare economics fleshed out in the 1950s and 1960s. The STP rate reflects the value society places on consumption of goods and services now, compared with consumption in the future.

The Green Book STP rate is the sum of few components:

- An inter-temporal preference rate
- A "catastrophe risk" rate

- A third component that takes into account the idea (roughly) that as per capita income increases, people will care less about additional income, and this increases their preference for money today relative to money in the future.
- The inflation rate

In 2003 the STP real discount rate (i.e., before inflation) was revised and estimated to be 3.5 percent, which was reduced from 6 percent. This is referred to as the "recommended" discount rate, which applies to all types of projects at multiple decision points during the project phase, including for feasibility studies that evaluate the economic benefits and costs of undertaking a project investment (Investment decision). This rate is also used for the procurement decision analysis that determines the appropriate procurement process (traditional vs. P3).

In the United States the closest equivalent to the STP rate is established by the Federal government's Office of Management Budget under Circular A-94 "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs," published in 1992. The real discount rate applicable to evaluate the government's investment decision for projects with social benefits is 7 percent. This rate has not been changed since that time. Prior to 1992, the real discount rate was 10 percent.

In both STP rate cases noted above (U.K. and U.S.), the nominal discount rate that is required to discount nominal cash flows (i.e., cash flows that include the effect of inflation) is taken to be equal to the sum of the real discount rate (U.S. 7.0%) as adjusted for the assumed annual rate of inflation (U.S. 2.2%). This would result in an estimate for the United States of 9.2%.

Project Pre-Tax Time-Weighted WACC

British Columbia's agency Partnerships BC, the most experienced province in Canada in the P3 field, has a standard methodology to perform P3 evaluations. These are presented in the draft document entitled "Methodology for Quantitative Procurement Options Analysis," released in August 2009, as part of its guidance documents. The document proposes a methodology to perform VFM analysis and also provides guidelines for estimating the discount rate.

Partnership BC's approach on the discount rate for VFM analysis differs substantially from the one in the U.K. because it results in the application of different discount rates to different decision points in the project phase. The first decision point, the investment decision, is when the government determines whether if should fund the construction of an infrastructure asset. The second decision point, the procurement decision, is when the government determines whether to assume the risk of holding and operating an infrastructure asset rather than having those functions taken on by the private sector. The investment decision is evaluated using a social discount rate reflecting the opportunity cost of capital from society's viewpoint. Typically, the cost/benefit decision of whether the government should fund an infrastructure project includes the assessment of social costs (environmental and social public costs) and benefits (heath, convenience, etc.) that are not necessarily reflected in the price individuals would pay to use infrastructure.

The procurement decision is an asset portfolio management decision: whether the infrastructure asset under consideration should be included in a government's asset portfolio or owned by a private partner. According to Partnership BC's approach, the

risk profile and considerations of the project are similar whether the project is delivered by the public sector or the private sector, although the cash flows may be different because of the differences in the ways the risks are managed by each. Since in the type of P3 approach considered for this Project the revenues received by the P3 concessionaire are the same as the payments made by the Project Sponsors (i.e., the P3 concessionaire has no other revenues other than the payments received from the public sector), the revenue return to the government from the P3 investment is very similar, if not exactly the same as, the revenue return to the P3 concessionaire. Based on Partnership BC's rationale, as a result of the above the government should discount costs and revenues using essentially the same cost of capital of the P3 concessionaire. Partnership BC's methodology to establish the discount rate is based on investment portfolio theory. This approach involves basing the discount rate on the cost of capital for a particular project, expressed as the weighted average cost of capital (WACC) of the various project funding sources such as debt and equity. In order to correctly apply the WACC as the discount rate for a project, consideration needs to be given to the manner in which the capital structure and consequently, the WACC, changes over the life of the project. To accurately model the project over the term of the partnership, the pre-tax time weighted WACC is used. The pre-tax, time-weighted WACC for the base case DBFOM option is 8.50%.

Differentiated Discount Rates

The Council of Australia Governments endorsed the National Public Private Partnership Policy and Guidelines on 29 November 2008, which apply to all Australian, State and Territory Government agencies. Australia's methodology agrees with

Partnership BC's approach that different discount rates may be appropriate to different decision points: investment fund decision versus procurement decision. While in the former the social discount rate is appropriate, in the latter case a project specific rate should be estimated.

However, the discount rate methodology for procurement analysis differs in that 1) it distinguishes between PSC and P3 discount rates, the PSC is discounted using the risk free rate, while the P3 option is discounted using the project specific rate, and 2) the framework to estimating the project specific discount rate is based on Capital Asset Pricing Model (CAPM) and not on WACC. The Discount Rate determined by CAPM includes the current Risk-free Rate (to reflect the time value of money) and adds a premium for the systematic risk40 of the project being analyzed. The difference compared to Partnership BC's approach is in that the Risk-free Rate is applied to the cash flows of the PSC, while the discount rate determined by CAPM, which is the Risk-free Rate plus the premium for systematic risk, is applied to the private sector cash flows in the P3 approach. As risks are being transferred from the government to the private sector, the project's inherent rate derived from the CAPM analysis increases.

The Capital Asset Pricing Model (CAPM) says $Ra = R_f + \beta_a (R_m - R_f)$

- R_a is the required return on assets whose risk class is designated by the Beta or Systematic Risk (the Project Rate).
- R_f is the Risk-free Rate and is taken to be the yield to maturity of a 10-year Commonwealth Bond.

- β_a is the Asset Beta, which reflects the degree that asset returns (returns of a particular project) are expected to vary with returns of the market (a well-Diversified Portfolio of assets or projects).
- (R_m-R_f) is the return over the Risk-free Rate (the market risk premium or equity risk premium) that investors would need or expect in order to invest in an asset. The market risk premium in real terms is taken to be 6 percent.

According to the Australian National Public Private Partnership Policy and Guidelines, the PSC cash flows should always be discounted using the risk free rate, while the discount rate for discounting the P3 cash flows should be the risk free rate plus a proportion (which can be from 0% to 100%) of the project risk premium, reflecting the proportion of the systematic risk that is transferred.

Annex 3 of the National Public Private Partnership Policy and Guidelines provides indicative Betas and project risk premiums for different infrastructure sectors, for example, as figure A1 below shows, the rate of return or discount rate for a transportation project procurement decision would typically be around 8 percent.

Figure A1-Indicative Project Rate of Return for Different Infrastructure Sectors

Risk Band	Project Sectors	Asset Beta	Real Risk Premium	Project Rate of Return
Very Low	Accommodation and related services	0.3	1.8	6.8
Low	Water, transport, and energy	0.5	3.0	8.0
Medium	Telecommunications, media, and technology	0.9	5.4	10.4

Note: the risk free rate was 4.95% as January 2009 based on Treasury Corporation of Victoria. The project rate of return equals the risk free rate + risk premium.
Source: National Public Private Partnership Guidelines-Volume 5 Discount Rate Methodology Guidelines.

Appendix B: P3 VALUE Analytical Tools (source: fhwa.dot.gov)

Structure of P3-VALUE Under a public-private partnership (P3) for a highway project, a private partner may participate in some combination of design, construction, financing, operations and maintenance, including collection of toll revenues. Value for Money (VFM) analysis is a process used to compare the financial impacts of a P3 project against those for the traditional public delivery alternative. The methodology for carrying out a VFM analysis that is incorporated in P3-VALUE involves:

- Creating a Public Sector Comparator which estimates the risk-adjusted whole-life cost of carrying out the project through a traditional approach;
- Estimating the risk-adjusted whole-life cost of the P3 alternative (either as proposed by a private bidder, or a hypothetical "shadow bid" at the pre-procurement stage); and
- Completing an "apples-to-apples" comparison of the present values of costs under the two approaches.

As depicted in Figure B.1, P3-VALUE is comprised of four interactive, integrated spreadsheet-based analytical tools that allow users to explore different components of Value for Money Analysis (VFM) including:

Risk Assessment Tool – This tool allows users to document project risks and risk management strategies and to estimate the costs of risks under different procurement structures.

Public Sector Comparator (PSC) Tool – This tool allows users to calculate the risk-adjusted costs for a project that is designed, financed, constructed, maintained and operated under a traditional public sector delivery model.

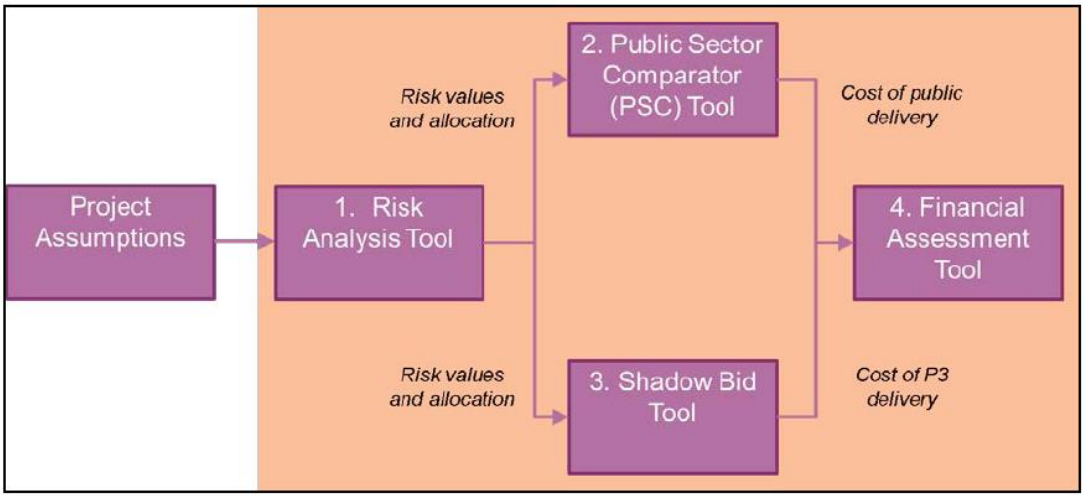

Figure B.1-P3 VALUE Overview (Source: fhwa.dor.gov)

Shadow Bid Tool – This tool allows users to calculate the costs of payments to a private partner for delivering a project as a P3 concession.

Financial Assessment Tool – This tool allows users to compare the PSC and Shadow Bid costs for procuring a project and to assess the financial subsidies required using different procurement methods.

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