A Study on Value for Money to Evaluate Public-Private Partnership Projects in Road Sector in Vietnam

By

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TABLE OF CONTENTS

ACKNOWLEDGEMENT ii
TABLE OF CONTENTS iii
LIST OF TABLES viii
LIST OF FIGURES x
LIST OF ABBREVIATIONS xiii
ABSTRACT xiv
Chapter 1: Introduction 1
1.1. Research background 1
1.2. Research issues 4
1.3. Research questions 9
1.4. Research objectives 10
1.5. Methodological framework 10
1.6. Significance of the research 12
1.7. Organization of the research 13
Chapter 2: Literature review 19
2.1. Introduction 19
2.2. Concept of Public private partnership 20
2.2.1. Definitions of Public private partnership 20
2.2.2. Types of the PPP 24
2.2.3. Comparison of PPP and traditional government procurement models 26
2.2.4. The use of PPP in road sector development 29
2.3. Concept of Value for Money 33
2.3.1. Definitions of Value for Money 34
2.3.2. Quantitative Value for Money assessment 36

2.3.3. Qualitative Value for Money assessment 46
2.3.4. Comparison of Value for Money assessment in many countries 53
2.4. Previous studies on Value for Money assessment 65
2.5. Conclusion 68
Chapter 3: Research methodology 69
3.1. Introduction 69
3.2. Methodology for the quantitative VFM assessment 69
3.2.1. Modified method of quantitative VFM assessment 69
3.2.2. Choosing the discount rate methodology 74
3.2.3. Risk quantification 75
3.2.4. Sensitivity analysis 77
3.2.5. Monte Carlo Simulation 78
3.2.6. Bootstrap method 83
3.2.7. Checking the fitness of the hypothetical distribution 85
3.3. Methodology for the qualitative VFM assessment 86
3.3.1. Determining the evaluation criteria and the questionnaire instrumentation 86
3.3.2 Data analysis 87
3.4. Data collection 99
3.4.1. Data collection for the quantitative VFM assessment 99
3.4.2. Data collection for the qualitative VFM assessment 100
Chapter 4: PPP projects in road sector in Vietnam 103
4.1. Introduction 103
4.2. Socio-economic overview of Vietnam 103
4.3. Road system in Vietnam 110
4.3.1. Overview of road system in Vietnam 110
4.3.2. Road infrastructure investments in Vietnam 113
4.4. Implementation of PPP road projects in Vietnam 118
4.4.1. Legal framework and regulations on PPP 118
4.4.2. The PPP process 120
4.4.3. Forms of PPP road projects 123

4.5. Conclusions 128

Chapter 5: Case study of the Phu My project 130

5.1. Introduction 130

5.3. Value for Money assessment 133

5.3.1. Basic assumptions for the VFM assessment 133

5.3.2. Quantification of risks 136

5.3.3. Determination of the PSC and the SBP 138

5.3.4. Value for Money analysis 142

5.4. Conclusion 152

Chapter 6: Case study of the Trung Luong – My Thuan Expressway project 154

6.1. Introduction 154

6.2. Summary of the project 155

6.3. Value for Money assessment 157

6.3.1. Basic assumptions for the VFM assessment 157

6.3.2. Determination of the PSC and the SBP 160

6.3.3. Value for Money analysis 164

6.4. Conclusion 179

Chapter 7: Case study of the My Loi bridge project 181

7.1. Introduction 181

7.2. Summary of the project 181

7.3. Value for Money assessment 184

7.3.1. Basic assumptions for the VFM assessment 184

7.3.2. Determination of the PSC and the SBP 187

7.3.3. Value for Money analysis 191

7.4. Conclusion 201

Chapter 8: Value for Money analysis of general PPP projects 203

8.1. Introduction 203

8.2. Quantitative analysis of general PPP projects 203

8.3. Qualitative analysis of general PPP projects 208

8.3.1. Determination of the evaluation criteria 208

8.3.2. Characteristics of the respondents 213

8.3.3. Data analysis 215

8.4. Conclusion 242

Chapter 9: Implications and conclusions 243

9.1. Introduction 243

9.2. Overview of the research findings 243

9.2.1. Major findings of quantitative VFM assessment 243

9.2.2. Major findings of qualitative VFM assessment 246

9.3. Research implications 247

9.4. Contributions of the research 248

9.5. Limitation of the research and recommendation for future research 250

BIBLIOGRAPHY 253

APPENDICES 270

Appendix 1: Characteristics of Palisade's @RISK software version 7.5 270

Appendix 2: Cumulative probability of VFM 271

Appendix 3: Actual inflation rate in Vietnam during the period 1994-2015........ 273

Appendix 4: Toll based on the Circular 90/2004/TT-BTC dated 07 September 2004 of the Ministry of Finance 273

Appendix 5: Forecasted and actual traffic demand of BOT road projects in Vietnam since 2003 273

Appendix 6: Forecasted and actual construction cost in road projects of Vietnam since 2003 274

Appendix 7: Forecasted number of vehicle of Phu My project 275

Appendix 8: Forecasted number of vehicles of Trung Luong-My Thuan project 276

Appendix 9: Forecasted number of vehicles of My Loi project 279

Appendix 10: Summary of background of respondents 280

Appendix 11: Statistic Results of final structural equation model 280

Appendix 12: Research questionnaire 285

Appendix 13: Estimation of model parameters 289

LIST OF TABLES

Table 2.1: Types of PPP 25
Table 2.2: Differences between PPP procurement and traditional procurement models 27
Table 2.3: Types of costs and revenue used for raw PSC calculation....................43
Table 2.4: Evaluation Criteria for the viability of PPP 52
Table 2.5: VFM assessment best practices 59
Table 3.1: Previous researches using MCS in VFM analysis 79
Table 3.2: Thresholds values in Cronbach's alpha assessment 88
Table 3.3: Threshold of the fitness indices 96
Table 3.4: Test of reliability and validity 97
Table 4.1: Comparison of Ease of Doing Business in Vietnam and other countries 107
Table 4.2: Length of road system in Vietnam 110
Table 4.3: Comparison of Vietnamese road quality and neighboring countries .. 111
Table 4.4: Transport projects with private participation, 2011-2015 116
Table 4.5: Estimated investment capital in road sector from 2012 to 2020.........116
Table 4.6: Changes in legal framework on PPP in Vietnam 119
Table 4.7: Forms of PPP projects constructed before 2010 124
Table 4.8: List of national projects in road sector that need foreign investment 127
Table 5.1: Calculation of the SBP, at 13.64 % nominal discount rate 140
Table 5.2: Net present value of the PSC, at 15.1% nominal discount rate 141
Table 5.3: Comparison of the costs of the project under PPP and traditional model 142
Table 5.4: Changes in the VFM due to movement of input variables 144
Table 5.5: Probability distribution of input Variables 146
Table 6.1: Cost distribution ratios for maintenance costs 158
Table 6. 2: Net present value of SBP, at a 14.23% nominal discount rate...........162
Table 6.3: Net present value under the PSC, at a 12.76 % nominal discount rate 163
Table 6.4: Comparison of the costs of the project under PPP and traditional method

....164
Table 6.5: Sensitivity analysis of cost components on VFM 167
Table 6.6: Probability distribution of the input variables 168
Table 7.1: Cost distribution ratios for the maintenance costs 185
Table 7.2: Net present value of the SBP, at a 16.26% nominal discount rate 188
Table 7.3: PSC Calculation of the My Loi project, at a 12.56 % nominal discount rate 190
Table 7.4: Comparison of the costs of the project under a PPP and the traditional delivery 191
Table 7.5: Sensitivity of the VFM to input variables...194
Table 7.6: Probability distribution of input variables 195
Table 8. 1: Bootstrap confidence interval 207
Table 8.2: Evaluation criteria for the viability of PPP 209
Table 8.3: Reliability statistics of the Cronbach's alpha 218
Table 8.4: Result of the KMO and Bartlett's Test of Sphericity 220
Table 8.5: Total variance...221
Table 8.6: Rotated component matrix 222
Table 8.7: Fit indices for the alternative structural equation model 228
Table 8.8: Alternative structural equation models 228
Table 8.9: Covariance between the latent factors in the alternative models........228
Table 8.10: Construct validity of final SEM model 231
Table 8.11: Correlation between the latent factors in final model 233
Table 8.12: Comparison of the chi-square between unconstrained and constrained 236
Table 8.13: Comparison of the chi-square between unconstrained and constrained 236
Table 8.14: Fit indices for the unconstrained structural equation model 237
Table 8.15: Comparison of public and private views 238
Table 8.16: Comparison of the chi-square between unconstrained and constrained 239
Table 8.17: Comparison of the chi-square between unconstrained and constrained model 240
Table 8.18: Comparison of the views of less experienced and more experienced groups..241

LIST OF FIGURES

Figure 1.1: Flowchart of research methodology 12
Figure 2.1: Investment in PPP road transport projects from 1990 to 2015............29
Figure 2.2: Investment in PPP road transport projects, by regions, between1990 and 2015 31
Figure 2.3: Number and capital investments in road PPP projects, by regions (1990-2015) 32
Figure 2.4: Comparison of PSC and PPP bids 37
Figure 2.5: Comparison of PSC and preferred bid for an availability payment concession in Australia 38
Figure 2.6: Overview of quantitative VFM assessment...41
Figure 2.7: Stages of Raw PSC computation..42
Figure 3.1: Process of the modification of the VFM methodology 73
Figure 3.2: Flow research for simulation model..81
Figure 3.3: Schematic diagram of the bootstrap process 85
Figure 3.4: A Hypothesized model of assessing factors impact on the viability of PPP 91
Figure 4.1: Developments in the macroeconomic indicators of Vietnam (2005-2015) 106
Figure 4.2: National budgets of Vietnam in the period of 2005-2015 108
Figure 4.3: Most problematic factors for Doing Business in Viet Nam 109
Figure 4.4: Road density in some countries 112
Figure 4.5: Volume of road passenger transport between 2001 and 2013 113
Figure 4.6: Capital investment in transport infrastructure, 2001-2010................114
Figure 4.7: Sources of investments in transport projects, 2001-2010 115
Figure 4.8: Financing model for transport projects, 2011-2015 115
Figure 4.9: Procedure of PPP road project implementation 121
Figure 4.10: BOT, BT projects under construction and operation (2011-2016)..126
Figure 5.1: Stakeholders involved in the Phu My Bridge BOT project...............132
Figure 5.2: Picture of the Phu My Bridge 133
Figure 5.3: Probability density distribution for the construction cost overrun ratio 136
Figure 5.4: Probability density distribution for the traffic volume uncertainty...137

Figure 5.5: Comparison of the cash flow of the project under PPP and traditional delivery 143
Figure 5.6: Sensitivity of the VFM to input variables 144
Figure 5.7: Time series of inflation rate between 1994 and 2034........................147
Figure 5.8: Distribution for the project's Value for money 148
Figure 5.9: Cumulative probability of VFM...148
Figure 5.10: Summary graph of VFM...149
Figure 5.11: Sensitivity tornado graph for the VFM 150
Figure 5.12: Scatter graph of VFM versus construction cost overrun risk..........151
Figure 5.13: Scatter graph of VFM versus traffic volume risk..........................152
Figure 6.1 : Stakeholders involved in the Trung Luong-My Thuan Expressway project 156
Figure 6.2: Location of the project site..157
Figure 6.3: Comparison of the cash flow of the project done via PPP scheme with 165
Figure 6.4: Simple sensitivity analysis of the impact of the cost components on VFM..166
Figure 6.5: Time series of inflation between 1994 and 2047..............................169
Figure 6.6: Distribution for the project's VFM...170
Figure 6.7: Cumulative probability of VFM...171
Figure 6.8: Distibutions of VFM with alternative PSC toll level 172
Figure 6.9: Summary trend of VFM 173
Figure 6.10: Sensitivity tornado graph for the project's value-for-money...........174
Figure 6.11: Scatter graph of VFM versus construction cost overrun risk 175
Figure 6.12: Scatter graph of VFM versus traffic volume risk............................176
Figure 6.13: Comparison of the cash flow of the quantitative VFM with and without subsidy 177
Figure 6.14: Distribution for the project's value for money without government subsidy 178
Figure 6.15: Cumulative probability of the VFM without government subsidy government 179
Figure 7.1: Stakeholders involved in the My Loi Bridge 184
Figure 7.2: Cash flow of the project under PPP and conventional models.........192
Figure 7.3: Sensitivity analysis of input variables to VFM 193
Figure 7.4: Time series of inflation between 1994 and 2047..............................196

Figure 7.5: Distribution for the project's value for money 197
Figure 7.6: Cumulative probability of positive VFM 197
Figure 7.7: Summary trend of VFM between 2014 and 2045 198
Figure 7.8: Sensitivity tornado graph for the project's value for money 199
Figure 7.9: Scatter graph of the VFM and the risk of construction cost overrun 200
Figure 7.10: Scatter graph of VFM versus traffic demand risk 201
Figure 8. 1: Graphical application of Bootstrap for the value of PSC 204
Figure 8. 2: Graphical application of Bootstrap for value of the SBP 205
Figure 8. 3: Histogram of 1,000 bootstrap replications of VFM 206
Figure 8.4: The Structural equation model. 206
Figure 8.5: Synthesis of the evaluation factors . ……………………………….214
Figure 8. 6: Screen test for factor analysis...220
Figure 8. 7: Standardized path estimates for initial structural equation model ..227
Figure 8. 8: Standardized path estimates for final structural equation model 230
Figure 8. 9: Correlation between factors and viability of PPP 234

LIST OF ABBREVIATIONS

ADB: Asian Development Bank

BOT: Build – Operate – Transfer

BT: Build – Transfer

BTL: Build – Transfer - Lease

CAPEX: Capital Expenditure

IMF: International Monetary Fund

MCS: Monte Carlo Simulation

OPEX: Operation Expenditure

PPP: Public-Private Partnership

PSC: Public Sector Comparator

SBP: Shadow Bid Price

SEM: Structural Equation Modeling

VFM: Value for Money

WACC: Weighted Average Cost of Capital

WB: World Bank

ABSTRACT

As in the cases of other developing countries, the Vietnamese government has decided to adopt Public-Private Partnership (PPP) as one of the methods for procuring infrastructure services since 1993. To date, 62 road projects have been undertaken under PPP model in Vietnam with the total investment of VND186,600 billion (equivalent to USD 9.3 billion). However, as pointed out by Deloitte (2015), PPP does not necessarily present the best selection of procurement. In fact, some PPP road projects in Vietnam have turned out to be failure or have failed to achieve expected results. Among them, Phu My Bridge, and Trung Luong-My Thuan Expressway, had been decided to be brought back to the public sector. The research question of this thesis is whether this government decision to return these projects back to the public sector was correct or not.

The purpose of the research is to retroactively examine which method of procurement should have been applied for each of these three projects between PPP and the conventional procurement method. A specific methodology having been used for this examination is the value for money (VFM) assessment. In applying the VFM methodology, this research has used a modified version of the VFM method, which was designed for the application of the BOT type PPP projects, the type of the PPP used in Vietnam in road sector.

A methodological contribution of this thesis is the use of Monte Carlo Simulation which has enabled to conduct the sensitivity analysis in a much more comprehensive manner, taking into account of all possible combinations of risks associated with the development of these projects. Furthermore, this VFM methodology has been expanded in scope to include the assessment of the qualitative aspects of the projects with use of Structural Equation Model to identify key elements which would affect the viability of PPP projects. Additional contribution of this research is the use of Bootstrap method so as to assess the general applicability of the PPP model for the road sector in general for Vietnam. The results of VFM assessment with use of Monte Carlo Simulation have proved that the PPP model could be a better option to only one project, namely Trung Luong-My Thuan Expressway project. In contrast, PPP scheme is not preferred to traditional government procurement method in regard to implementing the Phu My and My Loi projects. Additionally, Bootstrap analysis has indicated that there is a 55 percent confidence level that PPP model could be more suitable than public finance to conduct road projects in general in Vietnam. The Structural Equation Model has found that, in order to enhance the viability of PPP projects in Vietnam, public policy makers should focus on financial performance and economic environment.

This research has attempted to provide a detailed and practical application of VFM assessment, using the real-world projects for road sector in Vietnam. Therefore, it is expected to become a useful reference not only for the government of Vietnam but also for the governments of other ASEAN countries. However, it should be noted that this study has focused mainly on the VFM assessment of PPP projects in the road sector (mostly Expressways and Bridges) without a consideration of railways, airports and water transport projects. Should VFM assessment of PPP projects in these sectors be conducted, we will have a better opportunity to compare the PPP suitability of projects across all four of them.

Key words: value for money, public private partnership, Vietnam

Chapter 1: Introduction

1.1. Research background

For two decades, public-private partnership (PPP) has been considered as a promising alternative to the traditional approaches used for procuring road-sector projects in many countries. This trend is evidenced by the use of the PPP approach in the implementation of 958 road infrastructure projects that are worth about USD274,025 billion between 1990 and 2015 (World Bank, 2017). It is reasonable to argue that such a trend helps explain some distinct advantages of a PPP, as pointed out in many studies (Yong, 2012; Cruz& Marques, 2012).

One of the main objectives of the PPP involves facilitating the transfer of the development of infrastructure services to the private sector in a manner that achieves greater efficiency, and better financial performance (Alfen et al., 2009). Besides, PPP involves transfer of risk from public sector to private sector (International Monetary Fund, 2006). Hence, most studies have argued that the benefits that policymakers could derive from PPP model include cost-savings, risk allocation, improvements in the quality of public service, and the utilization of private sector skills and expertise.

In spite of its increased use, there seems to be no consensus or generally accepted definition of a PPP. Nevertheless, some definitions have been proposed. As an example, the Asian Development Bank (2008) defines it as “a range of possible relationships among public and private entities in the context of infrastructure and other services” (Asian Development Bank, 2008, p. 1).

Along with the development of PPP projects, several evaluation tools that are applicable to the implementation of PPP projects have been developed. These include various models of Cost-Benefit Analysis (CBA), Computable General Equilibrium (CGE) and the Value for Money assessment. As Contreras (2014) notes, CBA and CGE address the issues that arise when determining whether the PPP approach would lead to an effective use of public funds. Furthermore, Contreras (2014) contends that CBA and CGE are incapable of facilitating the determination of the alternative methods for implementing a particular project. On the other hand, unlike the CBA and CGE, VFM assessment looks at the optimal method for procuring a particular service. Sarmanto and Miranda (2010) argue that the VFM is one of the most effective tools available for the evaluation of the value of a project under PPP model in comparison with the conventional delivery routes, because it provides a simple methodology for cost estimation, and a project’s risk and benefits’ assessments. As Morallos et al. (2009) argue that the inclusion of a VFM analysis in determining the suitability and feasibility of the PPP approach (in comparison with the conventional methods of public procurement) is gradually becoming a common practice among many public-sector agencies in the world. Generally, there is a general consensus that the VFM assessment is significantly better, when compared to other methods for appraising the viability of procuring a project under PPP.

As the World Bank (2013) notes, the VFM can be defined as "the optimum combination of whole-life costs and quality (or fitness for purpose) of the good or service to meet the user's requirements" (World Bank 2013, p. 9). Additionally, Contreras (2014) argues that the VFM not only quantifies the costs, but also checks for the quality and suitability of a project to facilitate the identification of the service's overall value and benefits. According to Infrastructure Australia (2013), VFM is "a quantitative and qualitative assessment of the costs and benefits of public versus private provision of services" (Infrastructure Australia 2013, p.vi).

Based on the definitions in existing the studies (such as Kelly et al., 2004; Sarmanto & Miranda, 2010), it is possible to identify two kinds of VFM approaches – the quantitative and the qualitative assessment. The former involves comparing the whole costs of a project between the case of PPP procurement and that of the traditional procurement (World Bank, 2013; Infrastructure Ontario, 2007; Morallos & Amekudzi, 2008). This assessment allows public policymakers to determine which procurement method, whether PPP delivery or the traditional method, can better bring costs down in relation to the implementation of a given project. Under the latter (i.e. the qualitative assessment) some qualitative evaluation criteria are used to determine the fitness of a procurement method (World Bank, 2013; Contreras, 2014; Korea Development Institute, 2010; Morallos & Amekudzi, 2008). In particular, a qualitative VFM is designed to assess the impact of a set of factors on the viability of a PPP (Government of India, 2010).

In general, the use of the VFM analysis has been recognized as an efficient method for the evaluation of PPPs by a number of countries. Some of the countries that have used the VFM for PPP evaluation include UK, US, Australia, Korea, and Canada (University Transportation Center for Alabama, 2010; Gil, 2013; Cruz & Marques, 2012; National Council for Public-Private Partnerships, 2012).

1.2. Research issues

The major infrastructure problems that Vietnam is facing in the road system include those associated with an overwhelming volume of demand and deteriorated road conditions. According to the General Statistic Office of Vietnam (2016), the volume of road transport passengers in 2001 totaled more than 500 million. This figure has increased significantly over the past decade, with a peak of approximately three billion passengers in 2013. At the same time, according to the Global Competitiveness Report (2016), the quality of roads in Vietnam is ranked 93th out of 140 countries in the world. A main problem in this regard is that the rapid increase of demand has surpassed the existing capacity of road networks in Vietnam. Thus, developing and investing in the road sector has been recognized as one of top priorities of the Vietnamese government.

According to the World Bank (2013), on average, Vietnam will need an annual investment of about USD 25 billion to develop the public-transport infrastructure during the period of 2013-2020. But, the amount of the State budget and international Official Development Assistance, together with the amount of money to be mobilized through the issuance of national bonds can only meet a half of this requirement. It is therefore hoped that PPP could help fill the gap between the need and the availability of capital for road sector.

Being aware of the importance of PPP in road-sector development, the government of Vietnam has undertaken a significant number of PPP projects since the first announcement of its interest in private-sector participation in infrastructure in 1993. Since then, more than 62 projects have been implemented through the PPP scheme in Vietnam. However, recently, 6 of these PPP projects (or about 10% of the PPP projects) have been reverted to the public sector, despite the fact that the concession terms are still active. While this number of projects may not appear particularly large, one can argue that the Vietnamese government needs to evaluate more carefully the suitability of PPP in advanced model, particularly with regard to the potential issues which would bring detrimental impacts on the success of the projects.

A central consideration of the Vietnamese government is how to encourage private participation. This concern needs to be accompanied by a critical evaluation of the viability of investment by the private sector. In the absence of a critical assessment on whether PPP model is more appropriate than traditional project procurement, the government's goal of attracting more PPP may fail. Therefore, it is argued in this thesis that use of a value-for-money analysis to evaluate the "economic, efficiency and effectiveness" of PPP projects is necessary as a step for the development of road sector projects.

There are two different viewpoints which have emerged from recent studies on PPP projects. Some have argued that the use PPP model is essential for the development of road projects in Vietnam (Tu, 2015). The others have argued that the Vietnamese government tends to have an overly optimistic viewpoint of use of the PPP model over the traditional procurement methods (Minh, 2016). The use of VFM analysis could help address the competing views on the suitability of PPP projects in Vietnam.

It should be noted that 23 years have passed since the enactment of the BOT law that aims at attracting private-sector investments in roads infrastructure development. However, an evaluation of the viability of the BOT/PPP model over traditional form of public procurement is yet to be carried out in Vietnam. This arguably might have resulted from the lack of knowledge on how to implement a VFM analysis. Hence, despite the Vietnam government's claim that PPP delivery helps in reducing costs, and the increasing efficiency of public-sector procurement (particularly in the road sector), they have yet to produce an evidence that shows the superiority of the PPP approach in Vietnam. Some international studies, such as Marollas et al. (2009), Sarmento (2010), Gil (2013) and Park (2014), have also attempted to enhance the value for money and financial aspect of PPP projects by reviewing international value for money assessment practices. However, this strategy has not been adopted and implemented systematically in Vietnam, which puts Vietnamese PPP projects at great risks such as resources' wastage, inefficiency, or budget overrun.

Furthermore, compared to other countries in the same region, Vietnam currently attracts less private participation in the transport sector. According to the World Bank (2013), one of the factors that have undermined Vietnam's ability to attract private participation in this sector is the fact that majority projects do not provide sufficient information before the initiation of the bidding process. As a result, private investors do not often have enough information on the risks associated with the projects, tariffs, the projected financial performance, and the types of support that the government would provide. In turn, this makes it difficult for the government to determine if using PPP is actually better than the public finance approach. Ideally, a test of VFM analysis is carried out before deciding on whether to go with PPP approach or not. Arguably, if the VFM analysis is implemented, the government of Vietnam stands to avoid the risks of opting for a wrong procurement model.

Since Vietnamese government is planning to implement PPP projects worth

USD 61 billion[1] between 2011 and 2020 in Vietnam. Hence, PPP projects are expected to increase in the future. Despite the possibility of such substantial investments, many practitioners in this field have questioned the viability of using PPP in the Vietnamese road sector. Therefore, a study on how to evaluate the viability of PPP in Vietnam is desirable. For these reasons, this research is intending to carry out VFM assessment, in order to identify those factors that affect the overall viability of road PPP projects' in Vietnam.

1.3. Research questions

The research is trying to answer the following key questions:

- Is the Vietnamese government's decision to revert each of two projects (namely, the Phu My Bridge and the Trung Luong-My Thuan Expressway) back to the public sector, correct? In addition, is the decision-making to opt for PPP approach, instead of the on-going conventional delivery to finance My Loi Bridge, correct? The reason for taking up these questions is that this issue was heavily debated at the time of the government decision to change the procurement method to implement these projects.

[1] Vietnamese Ministry of Transport. 2016. Mobilize capital of VND 186660 billion to invest PPP projects. http://www.tapchigiaothong.vn/bo-gtvt-huy-dong-186660-ty-dong-dau-tu-du-an-ppp-trong-5-nam-d26977.html

- What key factors that affect the viability of PPP projects in road sector in Vietnam?

1.4. Research objectives

The main objective of the research is to systematically examine which procurement between PPP model and traditional government investment has been better in the implementation of three projects (i.e. the My Loi Bridge, the Trung Luong-My Thuan Expressway and the Phu My Bridge). In order to clarify these specific issues, they should have carried out an analysis based on an objective method, which is VFM assessment.

Additionally, this research aims to get a general indicator on the suitability of the PPP model for the road sector in general for Vietnam with use of a Bootstrap method. This exercise would be supplemented by the qualitative assessment of VFM with use of Structural Equation Modeling (SEM). This method would enable to find key elements that influence the viability of road PPP projects in Vietnam.

1.5. Methodological framework

The methodological framework of this thesis is illustrated in Figure 1.2. This thesis uses the VFM model to examine the decision to use the PPP approach to implement three road infrastructure projects in Vietnam. Accordingly, the VFM assessment carried out in this study involves both quantitative and qualitative analysis. In addition, the study uses a sensitivity analysis to simulate a project's VFM due to the effect of the change-of-cost components. There are two kinds of sensitivity analyses implemented in this research - simple sensitivity analysis and advanced sensitivity analysis. A simple sensitivity analysis is used to compute the effects of different values of PSC cost components on the VFM outcome. Meanwhile, an advanced sensitivity analysis is able to indicate the range of VFM for a project, based on a variety of risk combination for various cost factors. Monte Carlo Simulation is used for this purpose, which would enable to estimate the likelihood of a positive VFM for a particular project.

Additionally, the study uses a Bootstrap method to quantify the confidence interval of a positive VFM for general projects. Regarding the qualitative VFM assessment, this thesis uses a Structural Equation Modeling to measure the effects of the factors that affect the viability of road PPP projects in Vietnam.

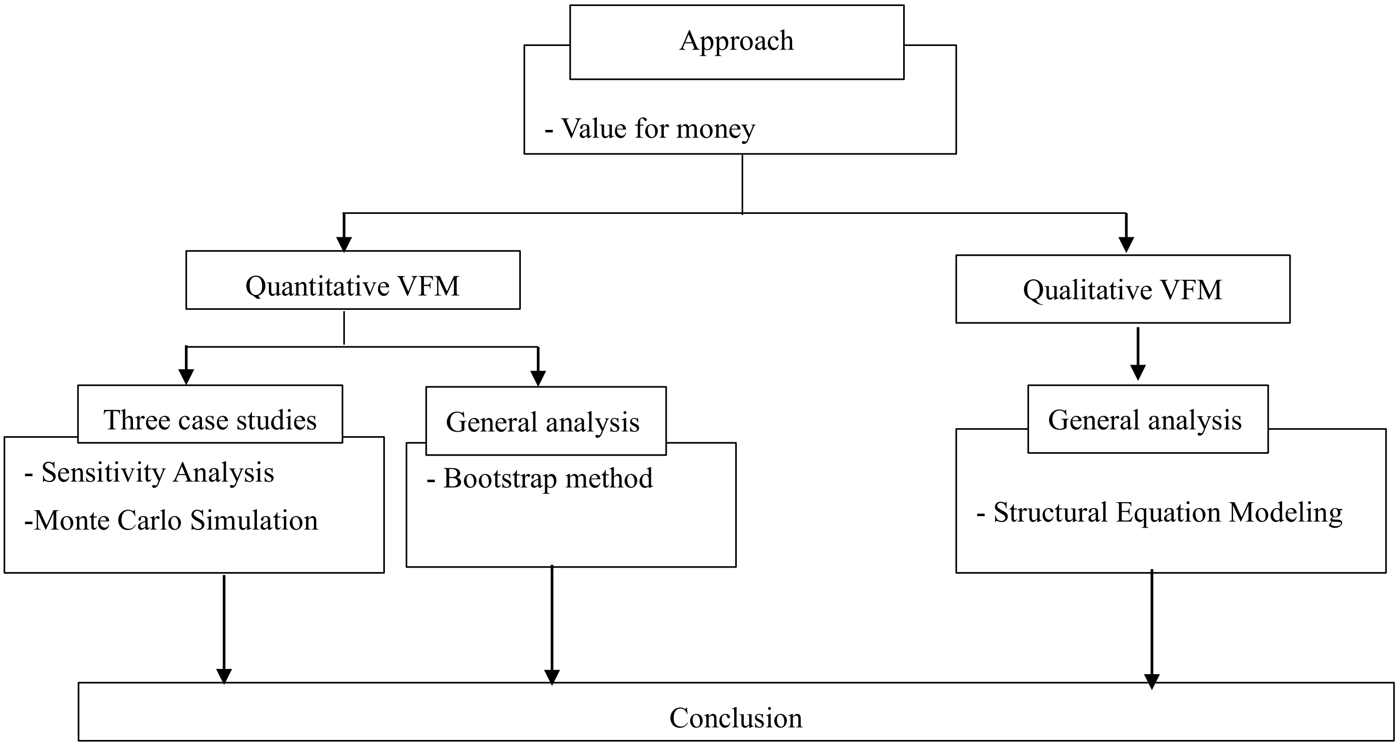


Figure 1.1: Flowchart of research methodology

1.6. Significance of the research

This research examines the suitability of PPP model to carry out public projects in road sector through application of VFM assessment. This thesis is expected to facilitate decision-making process for the government of Vietnam in the selection of appropriate methods of procurement for road transport infrastructure. The study will also help provide some insights that would be useful for the implementation of the government's strategic Socio-Economic development plans to improve the performance of PPP in the development of road networks in the country.

This thesis will also demonstrate how VFM assessment methodology is applied in a real-world decision-making problem that involves the selection of appropriate procurement methods for road projects. Therefore, it is hoped that the thesis can serve as a useful reference only for the government of Vietnam but also for the governments of other ASEAN countries. Finally, the research is expected to provide a basis for the development of a methodology that can quantify the effects of the qualitative factors that affect the viability of PPP projects.

1.7. Organization of the research

The thesis is structured as follows. **Chapter 1** provides a general background for the research, the research problems, the objectives of the research, as well as the significance of the study. To be precise, it briefly reviews the needs of value for money assessment in PPP decision-making process as well as the selection of the best option to finance a proposed project. Preliminary information on the needs for a VFM analysis in PPP road projects in Vietnam is also provided. In addition, information on the methodology applied in the research is briefly mentioned, which aims to provide an overall understanding of the methodological framework used to undertake this study. At the end, it illustrates the structure of the research.

Chapter 2, the literature review, presents the current state of knowledge in the existing studies on PPP and VFM assessment. Specifically, it reviews the definitions of PPP, the types of PPP, and a comparison of the differences between the PPP model and the conventional delivery model.

Furthermore, chapter 2 clarifies the concept of VFM assessment from both quantitative and qualitative perspectives. In relation to the quantitative perspective, chapter 2 examines the components of the Public Sector Comparator (PSC) and its use in identification of the procurement method that is better for a given project. With respect to the qualitative analysis, this chapter has also explored the evaluation criteria that are used to assess the viability of PPP. Additionally, in this chapter, a summary of the actual VFM assessment best practices in several countries is presented.

Chapter 3 discusses the methodology that is used to evaluate a PPP project's VFM, particularly those in the road sector in Vietnam. It begins with a modified methodology of VFM analysis that includes a set of new items introduced by Tsukada (2015) in relation to the computation of the PSC and Shadow Bid Price (SBP). Quantification of risks is also provided in this chapter. These are then followed with a description of how the Monte Carlo Simulation is used to estimate the expected value of the quantitative VFM, as well as the degree of confidence at which the PPP (when compared to the traditional public finance approach) becomes the preferred model of procurement for any given project.

Additionally, this chapter discusses sensitivity analysis to quantify the effects of key variables on VFM outcome. Then, bootstrap method is also introduced to measure the probability of the PPP suitability to develop road projects in general. Besides, this chapter explains how the Structural Equation Model is used to investigate the qualitative factors that influence the viability of the PPP. Correspondingly, this chapter characterizes the process of data collection to support analysis of VFM quantitative and qualitative.

Chapter 4 provides a general background to PPP projects in the road sector in Vietnam. The chapter begins with a summary of contemporary economic developments in Vietnam. It then introduces the unique problems associated with the road transport system in Vietnam, such as the road quality, road density, and the increase in the volume of road users. Additionally, a background on the current status of the road project financing and the road transport development plans in Vietnam is also provided. This chapter also looks into the legal framework and regulations, as well as the regulatory amendment that aim to enhance the use of PPPs in Vietnam.

As mentioned earlier, some of the 62 projects that have been implemented (since the enactment of the BOT regulations in 1993) are facing some serious problems. The ranges of the problems include -delayed completion, construction cost overrun, or revenue shortfalls. These problems have been attributed to the lack of a VFM analysis prior to implementation of the bid processes. Thus, in the conclusion of this chapter, the need for incorporating the VFM analysis in PPP decision-making process in Vietnam is examined and re- emphasized.

Chapter 5 presents the first case study, the implementation of the Phu My Bridge. This chapter starts with a general description of the project's characteristics and the problems involved in the selection of its procurement model. Thus, this chapter examines whether the decision to use BOT/PPP scheme to implement the project is correct. In order to deal with the issue objectively, a combination of the VFM analysis and Monte Carlo Simulation is used to estimate the confidence level that BOT/PPP model is better than traditional procurement to finance the project. The sensitivity analysis is also used to examine the changes in the VFM in respect of movements in some of the input factors.

Chapter 6 presents the second case study, Trung Luong-My Thuan Expressway. The aim of this chapter is to examine whether BOT/PPP model is appropriate for this project based on the standpoint of the quantitative PPP decision-making. Accordingly, the chapter presents estimates of the VFM indicator and probability of a positive VFM output, using the Monte Carlo Simulation. Next, a sensitivity analysis is used to examine the effects of input variables on the VFM indicator.

Chapter 7 presents a case study of the My Loi Bridge. The objective of this chapter is to test whether BOT/PPP model could bring better value compared with traditional delivery to implement the project. In order to support for the test, quantitative analysis are applied in the section. Additionally, a Monte Carlo Simulation is used to simulate the outcome while a sensitivity analysis is used to simultaneously compute the impacts of the input factors on the VFM.

Chapter 8 focuses on generalized VFM analysis in BOT/PPP projects. In terms of the quantitative approach, this chapter shows how to use the bootstrap method to estimate the quantitative VFM indicator of road BOT/PPP projects in general. The data used for the demonstration are generated from the quantitative VFM associated the three case studies. From a qualitative perspective, this chapter also examines how some important qualitative factors affect the viability of road BOT/PPP projects in Vietnam. A Structural Equation Model is then used to find the best-fit model that describes the relationship between the evaluation criteria and the viability of BOT/PPP.

Chapter 9 the conclusion, presents a review of the research findings and contributions. It also presents a summary of the points that make a VFM assessment vital in PPP decision-making processes in Vietnam. The limitations of the research and suggestions for future research are also included in this chapter.

Chapter 2: Literature review

2.1. Introduction

For many decades, PPP has played a pivotal role in the development of road infrastructure projects in both developed and developing countries. The widespread use of the PPP approach could be explained by the fact that the demand for new infrastructure still remains one of the greatest challenges in many countries (ESCAP, 2011). Since the capacity of traditional forms of public procurement and state budgets are insufficient for financing many essential projects, PPP has become an attractive alternative for infrastructure financing.

Nevertheless, some debatable questions still remain in relation to choosing between the PPP model and the conventional models of public infrastructure delivery. In this regard, most of the debates center on how to evaluate and support such decision-making processes. Accordingly, the National Council for Public-Private Partnerships (2012) argues that any effective method for evaluating the potential benefits associated with a PPP should involve a VFM analysis, a process that facilitates the comparison of the cost components of the PPP approach against those of conventional procurement methods. It is therefore argued that such an analysis could provide policymakers with a viable quantitative tool that would help them select the option or course of action that would lead to the most desirable outcome.

In this chapter, the existing literature on PPP has been reviewed. In so doing, this chapter provides some background information on the definitions, features, and models of PPP. Also, varying views on value-for-money analysis are examined. There are then complemented with a comparative analysis of actual VFM assessments in some countries.

2.2. Concept of Public private partnership

2.2.1. Definitions of Public private partnership

To date, there has been no single definition for the term "public- private partnership". This has led to a large number of competing and complementary definitions. According to the ADB (2008), the term public–private partnership (PPP) describes "a range of possible relationships among public and private entities in the context of infrastructure and other services" (ADB, 2008, p.1). Similarly, in the view of the Organization for Economic Co-operation and Development (OECD), a PPP is defined as:

> “an agreement between the government and one or more private partners (which may include the operators and the financers) according to which the private partners deliver the service in such a manner that the service delivery objectives of the government are aligned with the profit objectives of the private partners and where the effectiveness of the alignment depends on a sufficient transfer of risk to the private partners” (OECD, 2008, p.17).

Additionally, the International Monetary Fund (IMF) defines PPP as “arrangements where the private sector supplies infrastructure assets and services that traditionally have been provided by the government” (IMF, 2004, p.4). The definition in IMF (2004) and has some similarities with the definition in World Bank (2012), where a PPP is defined as a “long-term contract between a private party and a government agency, for providing a public asset or service, in which the private party bears significant risk and management responsibility” (World Bank, 2012, p.11). Yong (2010) defines a PPP as a “long-term contractual arrangement between the public and private sectors for the delivery of public services” (Yong, 2010, p.8). In addition, Cruz and Marques (2012) define a PPP as “a procurement model where both public and private sectors commit themselves to a long-term relationship” (Cruz and Marques, 2012, p.782).

Apart from these above-stated definitions of PPP, different countries also come up with different definitions. As an example, New Zealand defines it as:

> “A long-term contract for the delivery of a service, where the provision of the service requires the construction of a facility or asset, or the enhancement of an existing facility. The private sector partner finances and builds the facility, operates it to provide the service and usually transfers control of it to the public sector at the end of the contract.” (New Zealand Government, 2009, p.1)

Likewise, Infrastructure Australia (2008a) defines a PPP as “a service contract between the public and private sectors where the Government pays the private sector (typically a consortium) to deliver infrastructure and related services over the long term” (Infrastructure Australia, 2008a, p.6). In addition, the Canadian Council for Public-Private Partnerships (2001) defines PPP as “a cooperative venture between the public and private sectors, built on the expertise of each partner that best meets clearly defined public needs through the appropriate allocation of resources, risks and rewards” (The Canadian Council for Public-Private Partnerships, 2001). Similarly, a PPP is defined as

> “A partnership between public sector organizations and private sector investors and businesses for the purpose of designing, planning, financing, constructing and/or operating infrastructure projects normally provided through traditional procurement mechanisms by the State. PPP is not just about the private sector financing capital projects in return for an income stream, but also makes use of private sector skills and management expertise to deliver and operate public projects more efficiently over their lifetime” (Ireland Infrastructure and PPP Section, 2003, p.6).

Based on the above-stated definitions, it is straightforward to see that there are many views on the conceptualization and definition of a PPP. In spite of the absence of a generally accepted or consensus definition of what a PPP is, most definitions of a PPP highlight the following features:

(i) A long-term agreement between government and private to supply public infrastructure services.

(ii) The existence of some form of risk allocating between two parties

(iii) The allocation of the project's design, construction, operation and maintenance responsibilities to the private sector.

(iv) The allocation of supervisory and regulatory responsibilities to the public sector.

(v) The private sector designs and decides on the inputs that will be used to achieve the desired outputs.

(vi) Service fees are paid, depending on the pre-fixed standards and the quality of the service.

(vii) Ownership of the asset belongs to public sector, since the project asset is transferred to public at the end of the partnership.

2.2.2. Types of the PPP

As with the definitions of PPP, several kinds of PPP exist. As an example, given the method of classification developed in ADB (2008), it is possible to identify six forms of PPP. These include service contracts, management contracts, lease contracts, BOT and concessions. The World Bank (2009), on the other hand, has a classification of a PPP that consists of three major types, namely, the management and maintenance contract, operation and maintenance concessions, and the build-operate-transfer concession. In addition, under the proposal in UNESCAP (2011), PPP could take any of the following five forms: the supply and management contract, turkey contract, lease, concessions, private finance initiative and private ownership. In general, the types of PPP established in World Bank (2009) seem to be the most comprehensive. The table below depicts the basic characteristics of each of the PPP types.

Table 2.1: Types of PPP

Category	**Management and maintenance contracts**		**Operation and maintenance concessions**	**Build Operate Transfer Concessions**
	Management contracts	Performance based contracts	Lease or Franchise or Affermage Brownfield	BOT/DBFO/BOO
Design				Private by concession contract
Build				
Operation and maintenance	Private by fee contract[2]	Private by performance based contract[3]	Private by concession contract[4]	
Finance	Public	Public		
Own	Public	Public	Public	Public after contract (BOT/DBFO) or Private (BOO)
Private sector revenue options			Tolls (concession model)	
			Payment	
			Government guarantees or support Other support (eg insurance)	

(World Bank, 2009)

[2] Private by fee contract means that the private sector gets a predetermined fee established at tender stage. Incentive payments may be included but will be a marginal part of overall payment (World Bank, 2009)

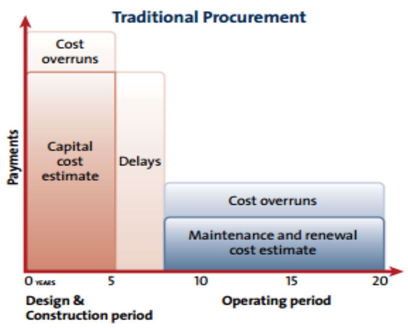
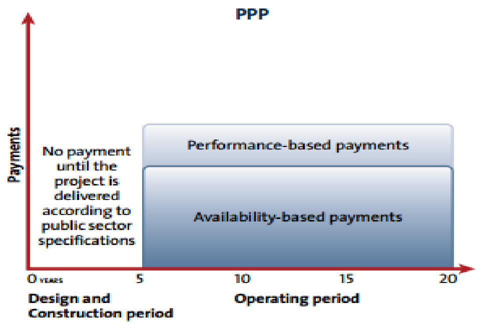
[3] Private by performance based maintenance contract means that the private sector is paid based on the level of service on the highway infrastructure; it generally comprises of a standard availability fee with penalties for below - standard performance (World Bank, 2009)

[4] Private by concession contract means that the private sector is paid based on user charges, availability payments or a mixture of both, depending on the contract -type (World Bank, 2009)

2.2.3. Comparison of PPP and traditional government procurement models

Unlike PPP model, under the traditional government procurement approach, the public sector takes charge of the design, construction, operation and maintenance for a new facility; with most of the investment capital for the project coming from public budget and taxes. In a typical case, under the traditional procurement approach, most of the investment capital for the project comes from public budget and taxes. Another distinction between PPP delivery and traditional procurement centers on the extent and types of risks that the public sector bears. The main distinctions are further depicted in the Table 2.2 that follows. The main bases for the comparison categorizes of components: funding, risk management, efficiency in the use of fund, responsibility, and payment mechanism.

Table 2.2: Differences between PPP procurement and traditional procurement models

Criteria	Traditional procurement	PPP procurement
Funding	The capital for the project comes from tax and budget	The capital for the project is raised from private equity and debt
Risk management	The state bear all the risks	Risk is allocated to the partner that are able to manage them Risk allocation may require detailed and complex procurement and contractual stipulations
Efficiency in the use of fund	Lower financial costs, although it may entail other forms of risks. Lack of incentive to reduce operation and maintenance costs Disperse competitiveness in a great number of market players	Whole life-cycle approach creates incentives for lower costs Allows for the participation of consortium for different projects, not excluding small players
Responsibility	Public sector is solely responsible for design, construction, and operation.	Private sector is responsible for the engineering or detailed design, construction, operation and maintenance. When submitting bid, the private sector indicates its construction costs, operating costs and project revenue over the course of the project life cycle.
Payment	Investors receive payment from public authority based on construction advancement  The graph shows that during the period of construction, the public sector must pay construction cost. Upon the completion of the construction, the public sector continues to pay operation expenditure during the period of operation. Budget shortage might	Investors can only be remunerated if the quality of products/services meets the required standard. It means that if the project is delayed, the authority may not have to make any payment. The degree of payment paid by the authority or service fee paid by users depends on the quality of services  In a PPP procurement contract, the public sector sets the requirements and the required service level for a given project. The private party takes charge of detailed or engineering

	potentially lead to delayed construction, and/or cost overrun.	design, construction, operation and maintenance. Payment is not made if the project meets the required standard.

(Source**:** Pricewaterhousecoopers, 2005; Cruz & Marques, 2012)

Basically, PPP model differs from conventional public procurement in the following ways:

(i) Projects implemented under PPP model are exclusively executed by the private firm, which also manages the entire stages of the projects' life cycle and phases. In other words, under PPP delivery, a single contractor assumes full responsibility for engineering and detailed design, construction and operation. In such a case, the private firm gets the chance to recoup their investments if the specified quality is realized at the lowest possible cost. This is expected to create incentives for increased efficiency and lower whole-life costs, in contrast to conventional projects, where a different party implements each phase of the project life cycle and payment is made in advance with little regard to the ex-post quality of the project or service.

(ii) In the case of PPP scheme, risk is shared between the private and public sector, while in the case of public finance, the government bears most of the risks.

(iii) In terms of funding sources, under the traditional model, capital investment is typically sourced from taxes and public budget. On the other hand, capital investment for PPP projects typically comes from private equities and borrowings from financial organizations.

2.2.4. The use of PPP in road sector development

Figure 2.1 shows the trend of investment in road transport PPP projects between 1990 and 2015 in the world.

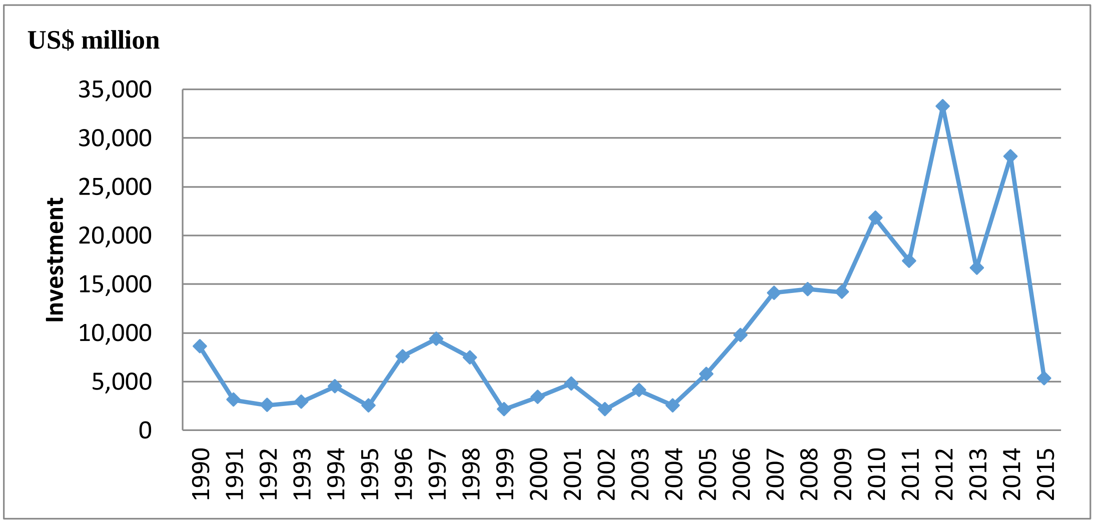


Figure 2.1: Investment in road transport PPP projects from 1990 to 2015

(Source: World Bank, 2016)

In the early 1990s, the enthusiasm of many governments on the important role of the private sectors in providing roads infrastructure projects arguably made private investors optimistic. As a result, investments in road PPP projects increased from nearly USD 2,500 million in 1995 to about USD 10,000 million 1997, as indicated in Figure 2.1. However, due to the 1997-1998 Asian financial crisis, a sharp decline was witnessed over the subsequent three years.

During the period of 2004-2008, prior to the global financial crisis in mid-2008, private investment in the roads sector increased significantly. To be precise, total investment capital in road PPP projects increased from USD 2,534 million in 2004 to USD 14,448 million in 2008. A primary reason for these increases has been attributed to the several changes that were enacted to attract more private participation in infrastructure (Queiroz et al., 2013). Shortly after 2008, investment fell slightly again, but quickly bounced back in the following years to reach a peak of USD 55 billion in 2012. A breakdown of the annual investments in different regions can be found in Figure 2.2.

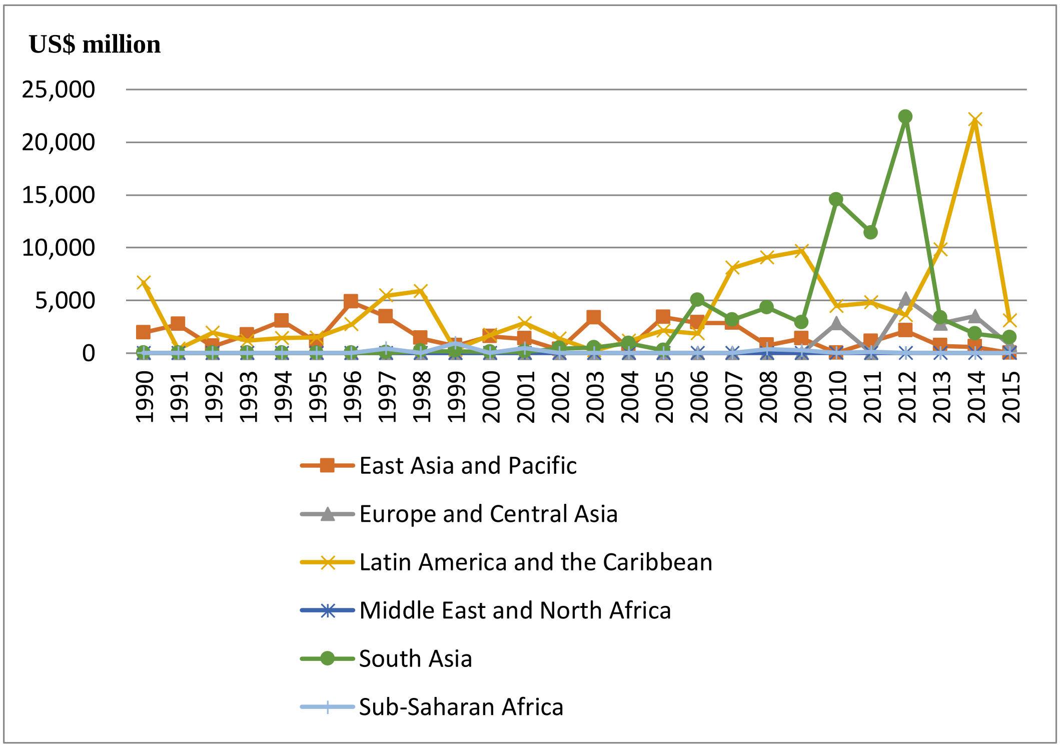


Figure 2.2: Investment in road transport PPP projects, by regions, between1990 and 2015 (Source World Bank, 2016)

As shown in Figure 2.2, Latin America, South Asia and East Asia had the most fluctuations in terms of investment in road projects between 1990 and 2016. Both regions also experienced some highs in investments that the other regions did not have. The figure for Latin America peaked at USD 22.1 billion in 2014, while that of South Asia reached a peak of USD 22.3 billion in 2012. In contrast, investments in Sub Saharan Africa, Middle East and North Africa regions did not change much.

Next, Figure 2.3 indicates the number and capital investment in road PPP projects by regions during the period 1990-2015.

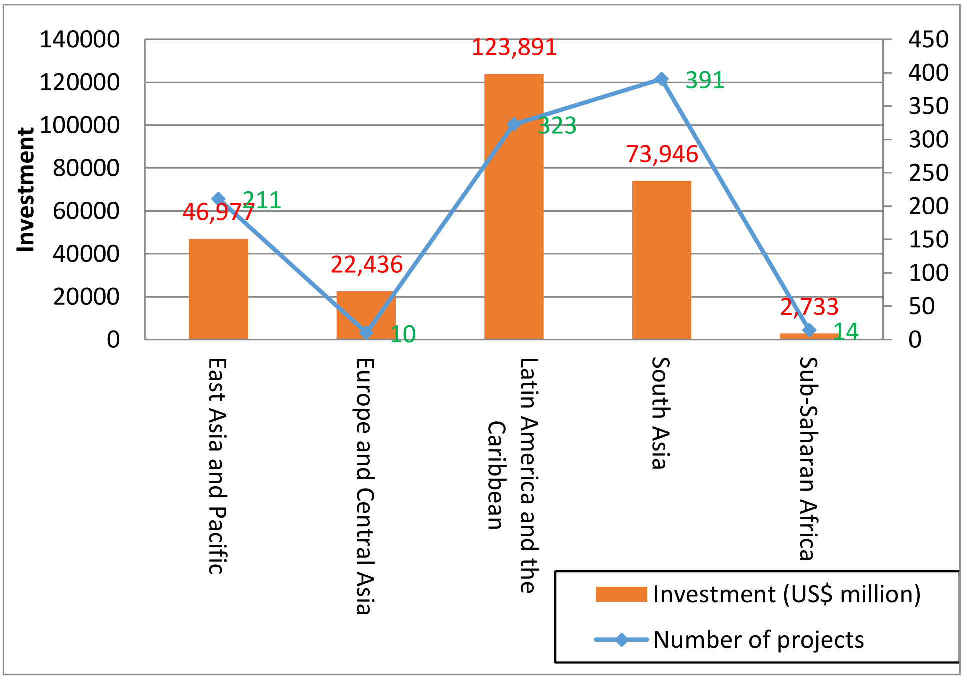


Figure 2.3: Number and capital investments in road PPP projects, by regions (1990-2015) (Source: World Bank, 2016)

As noted in the World Bank database (2016), the largest amount of investment with private participation in the road sector took place in Latin America, with a total capital investment of USD 123,891 million for the implementation of 323 projects (see Figure 2.3). This was followed by South Asia, with a total of USD 72,936 million invested in road PPP projects in this region for the implementation of 391 projects, as shown in Figure 2.3. With USD 44,291 million (for the development of 211 projects), East Asia and Pacific came third in terms of investment amount. Finally, Sub-Saharan Africa attracted the least private participation in road transport projects, with a capital investment of USD 2,599 million in 14 projects. Although there have been only 10 road PPP projects in Europe and Central Asia, the total capital investment in road projects in Europe and Central Asia totaled USD 22,436 million.

2.3. Concept of Value for Money

In order to assess the viability of a proposed project, each party, such as the project developer, the financier, and the government, uses a variety of approaches (Tsukada, 2015). The key tools used in this regard include the equity internal rate of return (equity IRR) mostly used by the developer, the debt service cover ratio (DSCR) mostly used by the financier, and the VFM that is often used by the public sector. Additionally, Morallos and Amekudzi (2008) found that VFM is one of the most effective tools available to policy planners to evaluate the value of a given project via PPP delivery against conventional method. In a similar vein, Maralos and Amekudzi (2008) argue that VFM helps the public authority and agencies to determine whether PPP model is able to cut down costs when adopted instead of relying on traditional funding method.

2.3.1. Definitions of Value for Money

Grimsey and Lewis (2005) define value for Money (VFM) as "the best price for a given quantitative and standard of output, measured in terms of relative financial benefit" (Grimsey & Lewis, 2005, p.348). Shaoul (2005) considers VFM as an important aspect of the 3Es: economy, efficiency and effectiveness. Accordingly, economy is associated with the cost of the resources, efficiency is associated with the ratio of outcome that results from a given set of inputs, while effectiveness involves checking whether the realized outcome meets the desired outcome (Eaton, 2006).

In addition, Isamil et al. (2011) state that VFM is "not the lowest cost option but an understanding of the whole life benefits and appropriate risk allocation between public and private sectors" (Isamil et al., 2009, p.349). Partnership British Columbia (2011) states that VFM "is mainly concerned with identifying the method of delivering a project that will result in the greatest value on both a financial (quantitative) and qualitative basis" (Partnership British Columbia, 2011, p.7). In the views of Infrastructure Australia (2013), the term VFM means "a quantitative and qualitative assessment of the costs and benefits of public versus private provision of services" (Infrastructure Australia, 2013, p.vi). In the definition in

World Bank (2013), VFM is defined as "the optimum combination of whole-of-life costs and quality (or fitness for purpose) of the good or service to meet the user's requirements" (World Bank, 2013, p.9). Zhen and Chen (2014) argue that VFM is "a good measure of the performance of PPP projects, which represents the philosophy of the public sector in partnering with the private sector in delivering public works and services through contract-based PPP" (Zhen & Chen, 2014, p.167). From perspective of Cruz and Marques (2014), VFM is "a measure of the utility for money spent" (Cruz & Marques, 2014, p.123). Contreras (2014) posits that VFM "not only measures the cost, but also takes into account the quality and fitness for purposes, in determining whether goods and services represent good value" (Contreras, 2014, p.100).

Overall, in spite of some differences in the definitions of the term "value for money", most definitions imply that VFM assessment should be a combination of both quantitative and qualitative methods in the selection of the best option. Kelly et al. (2004) state that there are two components of VFM: the "objective" analysis that is based on economic perspectives; and a "subjective" analysis that is based on individual perceptions of benefits. In addition, the European Commission (2003) notes that VFM assessment combines two main elements: a monetary comparison that compares the cost of the PPP with the cost of public finance; and the non-monetary comparison that deals with the factors which are not easy to measure in monetary terms.

2.3.2. Quantitative Value for Money assessment

2.3.2.1. Definitions of quantitative Value-for-Money Assessment

Morallos and Amekudzi (2008) argue that quantiative VFM assessment as “a methodology that compares the PPP bid with a hypothetical scenario called the public-sector comparator (PSC)” (Morallos & Amekudzi, 2008, p.115). Additionally, the Government of India (2010) states that a quantitative VFM test “compares the estimated cost of procuring the project in the public sector with the estimated cost of procuring it as a PPP” (Government of India, 2010, p.13). This contention also reflects the views in Partnerships British Columbia (2010), where quantitative VFM is defined as a process that “compares the preferred PPP approach to a traditional procurement method” (Partnerships British Columbia (2011, p.7). Another definition in World Bank (2013b) emphasizes that quantitative VFM “involves a comparison of the “value-for-money of a proposed PPP (or actual bids received) with a Public Sector Comparator—that is, a model of the project if implemented through traditional public procurement" (World Bank, 2013b, p.14). Tsamboulas et al. (2013) note that VFM "is used to compare the required public funds for two cases: the first case refers to the implementation of the project with PPP, while the second case to the delivery of the project by public sector" (Tsamboulas et al., 2013, p.123).

Based on these definitions, it is straightforward to see that a quantitative VFM involves a comparison of the values associated with the PSC with the values associated with the PPP approach. These are further illustrated in Figure 2.4.

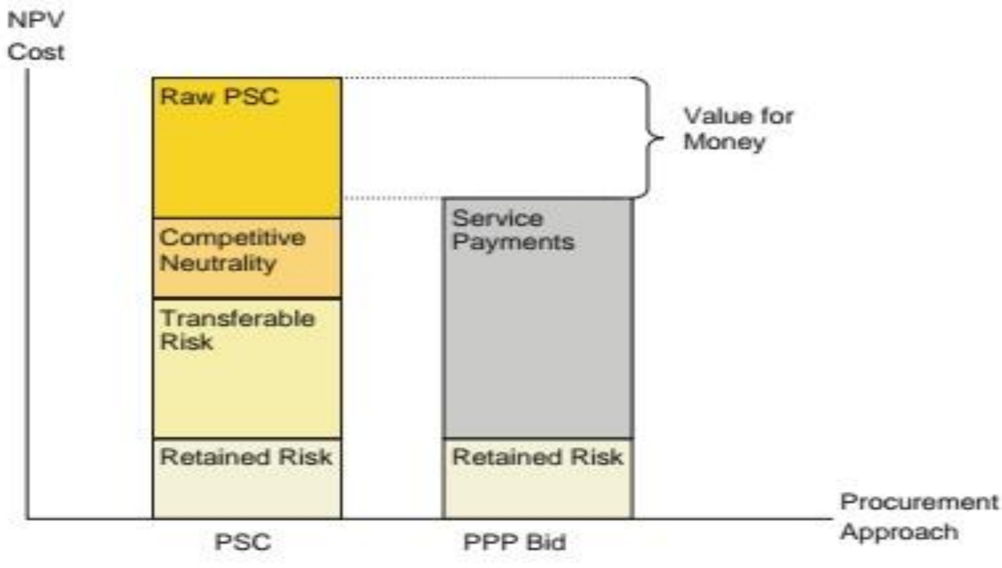


Figure 2.4: Comparison of PSC and PPP bids
(Adapted from Marollas et al., 2009)

In Figure 2.4, the PSC column represents the whole cost of a project if it is implemented by the public sector, while the PPP bid column represents the whole cost of a project if it is implemented under a PPP. VFM is achieved when the value of the PSC is larger than that of the PPP. In other words, if the quantitative VFM is positive, PPP delivery should be used to implement the project. On the other hand, if the quantitative VFM is negative, PPP scheme should not be used to implement the project.

Although most countries have their own view of how to make a PSC-PPP comparison, the components of the PSC seem to be similar. Based on the Australian methodology, the components of the PSC include raw costs, transferable risks, retained risks, and competitive neutrality factor (Infrastructure Australia, 2008). These are further explained in Figure 2.5.

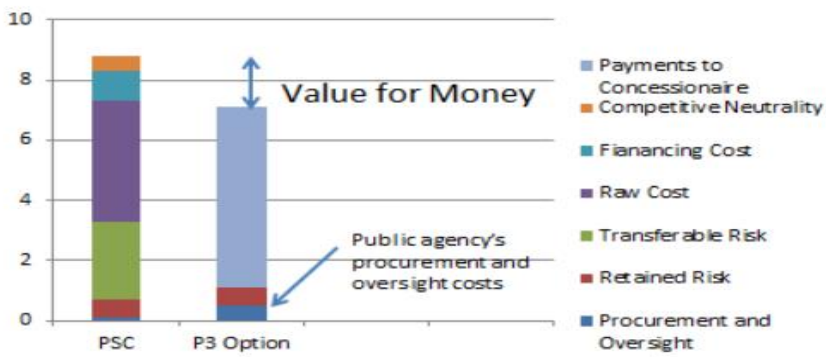


Figure 2.5: Comparison of PSC and preferred bid for an availability payment concession in Australia

(Adapted from US Department of Transport, 2012)

Alternatively, the PSC-PPP comparison, in terms of the Canadian methodology consists of capital costs, operating costs, tax, risks, and optimism bias. Accordingly, the raw costs of the Australian methodology on PSC computation are somewhat similar to the capital costs and operating costs in the Canadian methodology. Likewise, the competitive neutrality factor in the PSC under the Australian methodology is equivalent to tax in the Canada methodology. The transferable risks and the retained risks in Australia are also similar to the risks in the Canadian framework (Partnerships British Columbia, 2011). Basically, it is safe to conclude that there are four main components in the PSC. These include: retained risks, transferable risks, competitive neutrality and raw the PSC.

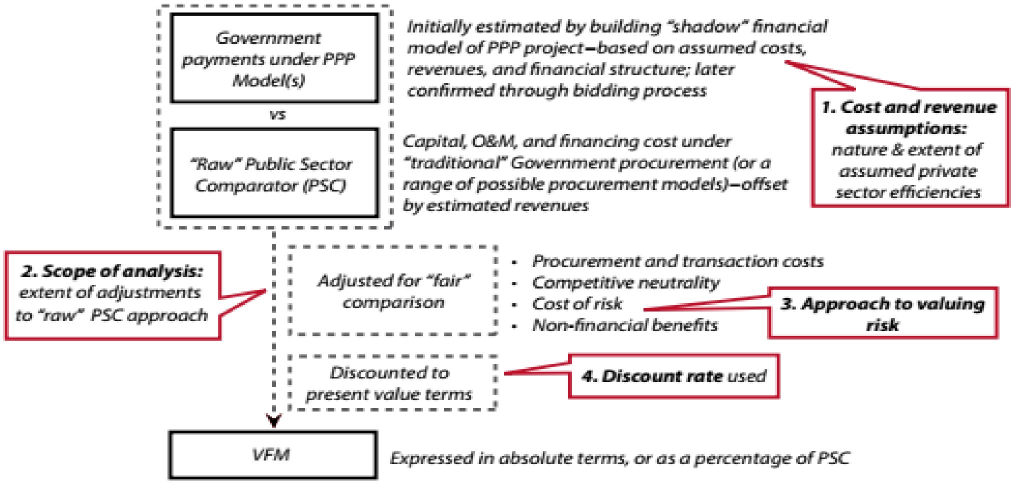
The term raw PSC entails the whole life cycle costs of a public project. It includes the entire direct and indirect costs that are relevant to the construction, operation and maintenance of a project.

Competitive neutrality involves the removal of “any net competitive advantages that accrue to a government business by virtue of its public ownership” (Partnerships Victoria, 2001, p.7). For example, land tax exemption is one of the advantages of that public enterprises have over private firms, given the fact that the private firms must pay land taxes to the government. Therefore, competitive neutrality facilitates a like-with-like comparison between the PSC and PPP bids (Infrastructure Australia, 2008a; Korea Development Institute, 2010; Partnership Victoria, 2001)

Transferred risks refer to those risks that are allocated from the government to the private investors (Infrastructure Ontario, 2007). In other words, if the project is implemented under a PPP, that evaluation of the cost of risks will take note of its allocation or transfer to the private sector. The retained risks refer to the risks that the government will bear if the project is implemented under PPP (Grimsey & Lewis, 2005).

According to the World Bank (2013), the process of quantitative VFM assessment, as shown in Figure 2.6, consists of four stages that include (1) an estimation of the costs of the project under PPP delivery and the conventional procurement, (2) adjustments for fair comparisons, (3) risk assessment, (4) the discounted cash flow of the PSC and the PPP, and (5) a calculation of the value-for-money.

Figure 2.6: Overview of quantitative VFM assessment



(Adapted from World Bank, 2013b)

<u>2.3.2.2. Calculation of raw PSC</u>

In Australia, the PSC is calculated with a set of guidelines provided by the Partnerships Victoria (Partnerships Victoria, 2001). This guideline consists of four steps that include: (1) the identification of the raw cost of the PSC, (2) the assignment of all direct costs, (3) the assignment of indirect costs, (4) and the calculation of the raw PSC. These steps are further illustrated in Figure 2.7.

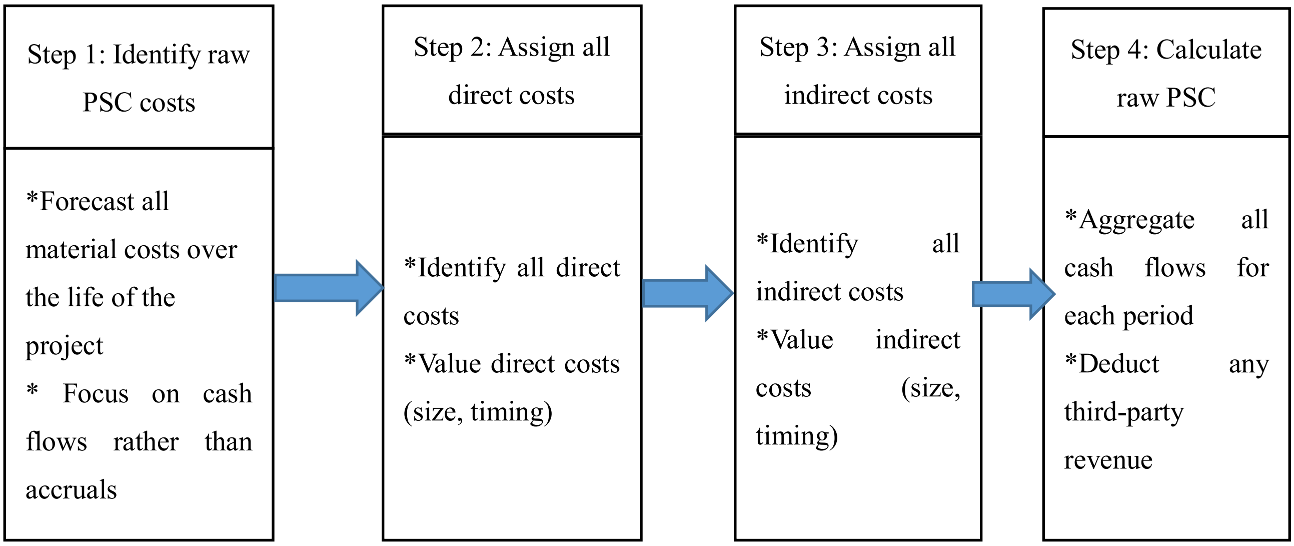


Figure 2.7: Stages of raw PSC computation

(Adapted from Partnership Victoria, 2001)

Regardless of the differences in the classifications of the cost components of the raw PSC, conventionally, direct costs and indirect costs are associated with CAPEX (capital expenditure) and OPEX (operation expenditure). With respect to revenues, two categories are suggested: direct revenues and third party revenues (Cruz & Marques, 2012). Table 2.3 shows the types of costs and revenue involved in the computation of the raw PSC.

Table 2.3: Types of costs and revenue used for raw PSC calculation

Types of costs	**Examples**
Direct costs	
Capital costs	Land, material, design, equipment, construction, plant, external providers, procurement process, external advisers
Operating costs	Costs of inputs, service provision (wages, training, superannuation, annual leave), management costs and insurance.
Indirect costs	
Capital costs	Partial commitment of plant and equipment, partial usage of new administration buildings
Operating costs	Corporate overheads (ancillary running costs, non-core IT and equipment), administrative overheads (employees not directly involved in the service provision, facilities management and overall project management)
Revenue	
Direct revenue	Tolls, user fees, commercial revenues
Third party revenues	Sales of surplus land, sale of surplus plants

(Adapted from Partnership Victoria, 2001; Cruz & Marques, 2012)

2.3.2.3. Discount rate

When computing the whole life-cycle cost of a project, it is necessary to compare annual revenues and costs. It is recommended to "convert projected cash flows into a present value to enable comparison of competing options for which the cash flows reflect differences in both timing and amounts" (Infrastructure Australia, 2013, p.8).

There are three common approaches to calculate the discount rate. These include (1) the Weighted Average Cost of Capital (WACC), (2) the Capital Asset Pricing Model (CAPM), and (3) the Risk-Free Rate.

Weighted Average Cost of Capital

The Weighted Average Cost of Capital (WACC) is defined as an approach that "incorporates the financing principle that the cost of obtaining finance is separate from the cost of using finance, risk is inherent in a particular asset, and investors in the marketplace are the best estimators of risk value" (US Department of Transport, 2012, p3-3). WACC is calculated with this formula that follows:

$$WACC = [(1\text{-}t) \times r_b \times L] + [r_s \times (1\text{-}L)]$$

where,

t: corporation tax

r_b: cost of capital for liabilities

L: deb ratio

r_s: cost of capital for equity capital

The Capital Asset Pricing Model (CAPM)

In the CAPM model, the capital cost describes the return on investment that an investor requires to implement a given project. This return is similar to the risk-free rate, plus "a risk premium for the systematic risks retained by the investor" (Partnerships Victoria, 2003, p.15).

Under the CAPM, the discount rate, known as the cost of capital, is expressed as:

$$R_a = R_f + \beta_a(R_m - R_f)$$

where,

R_a denotes the cost of capital or the required return on the assets whose risk class are designed by the asset beta or the systematic risk

R_f denotes the risk-free rate

$ß_a$ denotes the asset beta, which reflects the degree to which the asset's return is expected to vary with the entire market returns, also known as the systematic risk.

R_m - R_f denotes the market risk premium that an investor would expect to receive before investing in an asset, depending on the market.

Risk-Free Rate

Risk-free rate involves the use of interest rate of the government's long-term borrowing rate if the risks of the projects are displayed in the cash flows (US Department of Transport, 2012).

2.3.3. Qualitative Value for Money assessment

2.3.3.1. Definitions of qualitative Value for Money

The success of a given PPP project is not attributed to cost alone, other qualitative factors are also taken into considered, so a qualitative assessment is also necessary to provide a complete view and realistic evaluation (HM Treasury, 2006). Accordingly, besides using a quantitative assessment, a qualitative assessment is also important in the evaluation of the viability of a PPP (Takim et al., 2009; Grimsey & Lewis, 2005; Cruz & Marques, 2014). In addition, Morallos et al. (2009) argue that although the quantitative analysis plays an important role in the VFM assessment, several agencies put equal importance on the qualitative factors in VFM evaluation. Infrastructure Australia (2008b) also notes that a combination of quantitative and qualitative factors is essential for a comprehensive VFM assessment. Since the notion of VFM involves three dimensions: "economy, efficiency and effectiveness", Loû (2012) notes that, while it is possible to use the PSC to assess the economy and efficiency components, effectiveness is best evaluated via a consideration of qualitative factors. This makes a qualitative assessment for VFM calculation quite crucial.

The HM Treasury (2006) defines that qualitative VFM as a process that involves the analysis of “factors, like a service’ quality, which are not easy to quantify” (HM Treasury, 2006, p.7). This definition also reflects the views in Morallos and Amekudzi (2008), where it is argued that “unlike the quantitative assessment, the qualitative assessment is often less prescriptive, depending on the project and other conditions” (Morallos & Amekudzi, 2008, p.115). In Government of India (2010), a qualitative VFM tests “for qualitative factors that have an impact on the ease or difficulty of doing the project as a PPP” (Government of India, 2010, p.11). According to the National Audit Office (2013)

> “The qualitative assessment, unlike the quantitative assessment, does not require project teams to compare PFI to the public sector comparator. Instead, all the questions in the qualitative assessment are focused on whether or not PFI will meet the intended outcomes of the project” (National Audit Office, 2013, p.11).

Hence, although there are varying perspectives in the literature, most views agree that a qualitative VFM is a process that facilitates the evaluation of the impacts of qualitative factors on the viability of PPP.

2.3.3.2 Determining the factors for qualitative VFM assessment

In order to apprise the qualitative VFM of a PPP project, some criteria are used. In the guideline for value-for-money analysis specified in United Kingdom (2006), the computation of the qualitative elements is based on 39 questions. These questions are designed to capture three dimensions – a project's viability, desirability and achievability. In detail, these aspects are associated with the value of the project, the technology, the allocation of risks and incentives, the government's economic policy, the existence of a favorable legal framework, and the flexibility of contracts to changes in output. Likewise, according to the detailed guideline for value for money test in Korea (2010), the set of qualitative criteria are divided into four main components. These include questions regarding the suitability of PPP, efficiency in project's implementation, the easiness of the project's implementation, and the effects of risk sharing. These aspects are related to a set of 14 items that consists of the level of services, competition, improvements in technology, improvements in management skill, the project's conformity to national policy, the consumers' capacity, the interests of every party involved, the operation independent of projects and the easiness of the execution of the contracts.

In addition to government documents regarding PPP guidelines, empirical studies have also identified some criteria for a qualitative VFM assessment. As an example, a study by Ozdogan and Birgonul (2000) identify four different approaches for the assessment of BOT/PPP projects' viability. These include financial and commercial factors, political and legal factors, and technical factors and social factors. These approaches are further sub-classified into 37 factors. The sub-classifications include the experience of the government, the political environment, the project's size, the economic environment, the ability to attract foreign investors, and the legal framework.

Additionally, using a survey that explores the views of PPP experts in 13 countries, Zhang (2006) argues that the four characteristics that can create the best value for the public in PPP infrastructure projects must involve the enhancement of infrastructure development, improvements in the construction and management process, the cost effectiveness of the project's procurement, and the promotion of the development priorities. These are associated with 21 elements, such as risk transfer, technical innovation, low cost, improved construction and maintenance, optimized resources utilization, and long project life cycle. Furthermore, Zhang (2005) suggests that the aspects needed to evaluate the feasibility of PPP projects, should include financial considerations technical considerations, safety and health concerns, and a close look at the environmental and managerial aspects of a project. Likewise, having conducted a survey of 150 respondents to investigate the willingness of investors to invest in PPP projects in Vietnamese road sector, Giang (2012) demonstrates that there are five groups of factor that encourage private participation in PPP road transport infrastructure projects in Vietnam, namely bankability of projects, legal framework, allocations of risk, economic environment and reliable partners. Correspondently, through a survey of 320 PPP stakeholders in Vietnam, Si et al. (2016) suggests that there are four groups of factors impact the performance of PPP projects in Vietnam, including bidding process, finance issues, laws & regulations, and project evaluation issues.

Furthermore, Regan (2014) conceptualizes the qualitative factors used in a VFM analysis under the following terms: construction management, contractor experience, minimal environmental impacts, and improved community access. In the views of the European Commission (2003), the six main drivers of VFM in a PPP project include: risk transfer, the long term nature of the contracts, the use of the output, performance measurement, and private sector's management skills.

Other studies that deal on the main qualitative factors that contribute to the viability of PPP include a set of 34 evaluation criteria developed in Thomas et al. (2010) and Wong (2006) for determining the feasibility of PPP projects. These factors are classified into the following groups: financial & economic factors, technical factors, social factors, political and legal factors, and others. Similarly, based on 27 papers published between 1990 and 2013, Kyei and Chan (2015) have also come with a slightly different set of factors. In comparison, however, the set of factors in Thomas et al. (2010) and Wong (2006) seem to be more comprehensive. These are further explained in the table that follows.

Table 2.4: Evaluation Criteria for the viability of PPP

Financial performance &Economic environment
Project is more cost effective than traditional forms of project delivery
Project can be substantially self-funded
Project value is sufficiently large to avoid procurement disproportionate procurement costs
Project is of financial interest to private sector
Project can attract foreign capital
Project is bankable and profitability to attract investors and lenders
Economic environment is stable and favorable
Existence of a sound governmental economic policy
Competition from other projects is limited
There is a long-term demand of the products/service in the community
Level of toll/tariff is acceptable
Technical sophistication
Project size is technically managerial by a single consortium
Possibility of innovative solutions
Availability of government experience in packaging similar PPP projects
Available of experienced, strong and reliable private consortium
Service quality can be easily defined and objectively measured
Contract is flexible enough for frequent change in output specification
Social system
The community is understanding and supportive
Project can create more job opportunities
Project is environmentally sustainable
Political and legal environment
Project is not political sensitive
Political environment is stable
There is political support for the project
The project is compatible with current statutory and institutional arrangements
There is a favorable legal framework
Managerial capacity
Fairness of new conditions to employees
Possibility of significant redundancy
Supportiveness and commitment of staff to the project
Existence of a resolution for any civil service staff redundancy
Flexibility do decide appropriate risk allocation
Support from the Government is available
Authority can be shared between public and private sector
Possibility of an effective control mechanism over the private consortium
Matching governments strategic and long-term objectives

(Source: Thomas et al., 2010)

2.3.4. Comparison of Value for Money assessment in many countries

In the early 1990s, the United Kingdom pioneered the use of VFM analysis in the evaluation of PPPs. This practice quickly gained popularity in the Commonwealth countries, such as Australia, Canada, Ireland and Hong Kong. It became known as an efficient tool to support governments in determining whether PPP model results in better value than traditional procurement. Table 2.5 shows the models of VFM analysis used in different countries.

2.3.4.1. Australia

In Australia, there are two main steps involved in the use of VFM as a decision-making tool in PPP assessment. The first step involves carrying out a PSC test, while the second step involves the implementation of a qualitative assessment that takes into account the effects of the factors related to private bids. The PSC, as used in the Australian state of Victoria, is computed before the initiation of the process through which a bid is implemented. The components of the PSC in Australia are similar to those used in the UK; they both consist of the raw PSC, the competitive neutrality factor, the transferable risk and the retained risk. The Australian state of Victoria uses the Capital Asset Pricing Model (CAPM) to compute the NPV of cash flows. The risk-free rate is set to the value of a 10-year government bond. As for the qualitative assessment, the State of Victoria conducts the evaluation of non-monetary factors such as the qualifications of the bidder, differences in the deliverable services, the social benefits, and the reasonableness of the assumptions that are used to develop the PSC (University Transportation Center for Alabama, 2010).

2.3.4.2. Canada

VFM assessment is implemented after bids are submitted. It is continuously conducted throughout the project's phases, from the selection of winning bid till the financial closure. In essence, the VFM assessment model used in Canada is almost identical to those used in the UK and Australia. A clear distinction between the Canadian model of and the UK's and the as Australian is that, when analyzing VFM, the qualitative factors are neglected under the Canadian methodology. Meanwhile, the UK and Australia conduct both quantitative and qualitative assessments. In addition, in Canada, the WACC of private investor is used to discount the cash flow of projects.

2.3.4.3. The Netherlands

In the Netherlands, a VFM assessment is conducted in two different stages. In the first stage of the process, a comparison of the public private comparator (PPC) and the PSC is done to identify the procurement option that is most suitable. This assessment is carried out; even before the bidding process takes place. In the second phase, the government compares the PSC and the PPP bids to determine the VFM of a bid. The second stage is usually done after the bidding process.

The PSC in the Netherlands include both crude PSC, and the risks and supplementary financial costs and incomes. Unlike the components of the PSC used in Canada or the UK, risks are not classified according to transferred risks or retained risks in the Netherlands. However, as with the UK and Australia, in addition to a quantitative assessment, a qualitative analysis is also performed to determine whether the characteristics of a proposed project are appropriate to a PPP in the Netherlands.

2.3.4.4. Republic of Ireland

There are 4 stages involves in a VFM assessment in Ireland. These include a qualitative VFM assessment, a quantitative VFM assessment, a VFM comparison test and a final VFM test. The qualitative VFM assessment as well as the quantitative VFM assessment is conducted before the bidding process starts, while the last two stages are implemented after a winning bid is selected.

Generally, the quantitative VFM entails a comparison between PPP bids and the public sector benchmark (PSB). The components of the PSB in Ireland are similar to those used in Partnerships Victoria. The PSC and PPP's cash flows are discounted, using a risk-free cost of debt (such as the long-term government bond). The criteria used in the qualitative VFM analysis include the following: "the alignment of the interests of the concessionaire and the public agency", "the possibility of achieving efficiency in project's life cycle costs and long term O&M", "the responsibility of the public sector and its effect on public acceptance", "the possible expansion of the highway network in the future", "the allocation of toll management responsibilities", and "considerations for long term plans for a transport corridor" (University Transportation Center for Alabama, 2010).

2.3.4.5. South Africa

In South Africa, the VFM test is conducted after the issuance of the invitations for bids. The process also involves both quantitative and qualitative approaches. In relation to the quantitative assessment, the adjusted PSC and PPP are compared. This is done in a manner that incorporates capital and operating costs and the adjusted costs of risk in the PSC.

2.3.4.6. Hong Kong

A VFM evaluation in Hong Kong is initiated before the issuance of invitations for bids. Under the Hong Kong model, a comparison is made between the components of the PPP bid and the public-sector benchmark (PSB). The VFM assessment in Hong Kong only focuses on a quantitative appraisal.

2.3.4.7. United Kingdom

The process of VFM assessment in the UK comprises of three stages – namely, annual budgeting, an outline of the business case, and an assessment of development. A quantitative test is incorporated as well. Under the process, the net present value of PSC and PFI are evaluated. Besides the quantitative assessment, a qualitative approach is also carried out in the UK. The qualitative analysis centers on the following set of criteria: viability, desirability and achievability. The chosen discount rate for the cash flow of the PSC and PPP is the risk-free rate. The country implements VFM analysis for a project from the bidding stage till the project reaches financial closure.

Table 2.5: VFM assessment best practices

Agency and Source	**When analysis is conducted**	**Quantitative and Qualitative Components**	**Risk and Discount Rate**	**Use of VFM analysis in decision making**
Partnerships Victoria	Development of PSC con- ducted before invitation to bid. However, formal VFM test conducted to evaluate bids against the PSC (benchmark)	Quantitative: raw PSC + competitive neutrality + risks (transferable and retained) Qualitative: Identify material factors not included in the PSC	Risk-free discount rate of 3% (in real terms) plus a risk premium that is dependent on classification of the risks into very low, low, or high-risk band.	PSC is used as the bench- mark to evaluate bids. However, both qualitative and quantitative factors are considered in the final decision to award the contract.
United Kingdom's HM Treasury	VFM approached in three stages of procurement process: (1) during the annual budgeting round, (2) to outline business case prior to	Quantitative: prepared quantitative spreadsheet for comparing the conventional procurement option (PSC) to the PFI option. Considers similar factors as Partnerships Victoria	Risk-free discount rate of 3.5%	PSC is used as benchmark and compared with PFIs. However, affordability calculations are conducted prior to VFM and must be met in order to proceed with procurement process. The

	invitations to bid, (3) after bids submitted in selection process. Continuous assessment of VFM until contract close	Qualitative: considers three factors: viability, desirability, and achievability		decision to undertake PFI investment, once affordability has been confirmed, is taken on VFM (quantitative and qualitative) grounds alone
Partnerships British Columbia	PSC development begins before invitation to bid. For- mal VFM test conducted after bids submitted. VFM is updated after winning bid selected but before financial close to account for the modifications in the agreement.	Quantitative: similar to Partnerships Victoria Qualitative: not as explicit as Partner- ships Victoria, but additional non- quantifiable factors, such as how the bid is able to achieve the goals and scope of the project	Discount rate is based on the private sector weighted average cost of capital (WACC), which reflects the minimum rate of return investors would require in deciding to invest in a project. WACC = public cost of debt + project risk premium.	PSC costs and its baseline required improvements are used as the benchmark to evaluate bids. Cost is not the only factor.

Netherlands Ministry of Finance: Public Private Partnership and Asset Management PPP Knowledge Center	Public–private comparator (PPC) assessment is con- ducted in very early stages to determine which tender process (conventional or PPP) is preferred for project. PSC drawn up after invitation to bid and used in selection.	Quantitative: PSC is similar to base. It includes crude PSC (same as raw PSC) + risks + supplementary financial costs and incomes (similar to competitive neutrality). Qualitative: after comparison of PSC and PPP, the PSC team deliberates over outcome. Specific considerations unspecified; varies by team and project	Discount rate applied to government projects is the same as the nominal interest on government bonds for a similar period as the duration of the project. For the PPP the market-related spread risk is incorporated into the dis- count rate as a surcharge to the risk-free interest rate.	A PPC is conducted before invitation to bid. PPC qualitatively and quantitatively compares public and PPP procurement option. PSC created after PPC and used as a bench- mark for choosing between bids.
Central Public Private Partnerships Policy Unit in the Department of Finance (Ireland)	Four tests: (1) qualitative VFM prior to bid invitation; (2) quantitative VFM and creation of PSB also before invitation; (3) VFM comparison test used to compare	Quantitative: PSC called public sector benchmark (PSB) and compared with NPV of PPP costs. Similar components to Partnerships Victoria Qualitative:	Discount rate should be the same for PSB and PPP. Identified by National Development Finance Agency. It should be based on the risk-free cost	Quantitative VFM assessment includes comparing the PPP bid with public- sector benchmark (PSB). However, VFM and affordability

	bids to PSB; (4) final test conducted to incorporate any modifications.	considers the following of the PPP: sufficiently large-scale, potential for risk transfer to the private sector; potential to be output- based; potential for revenue generation	of debt to the public sec- tor (i.e., yield on appropriate long-term government bond).	of the project must be considered in order to proceed.
Guidance provided by South Africa National Treasury PPP Unit– National Treasury	VFM considered before invitation to bid, but formal VFM test (quantitative comparison) done after invitation to choose between submitted bids	Quantitative: construct a base PSC costing, including all capital and operating costs. Risk-adjusted PSC model includes a costing for all risks associated with the project. Qualitative: prepares needs analysis: evaluate how	National Treasury does not prescribe specific dis- count rate, but it is assumed to be the same as the risk-adjusted cost of capital to the government. Some institutions have used government bond yield	A risk-adjusted PSC and risk-adjusted PPP are compared and VFM deter- mined, but benchmark value is affordability limit. Project must meet affordability to be viable

		the project aligns with goals and budget of agency		
Efficiency Unit of the Government of the Hong Kong Special Administrative Region	Early as possible; typically prior to invitation to bid has been released	Quantitative: contains same elements as Victoria's PSC Qualitative: no formal qualitative assessment mentioned	Discount rate not specified	PSC is created and compared with PPP projects that involve some public unitary payment; not necessary for PPPs that are financially free-standing (i.e., financed through user charges).

(Adapted from Morallos et al., 2009; US Department of Transport, 2012)

Generally, the following aspect are considered: (1) the timing of the implementation of the VFM analysis, (2) the components of the VFM's quantitative and qualitative analysis, (3) the choice of the discount rate, and (4) how the VFM is used to decide on a procurement option that is most suitable for a given project. Table 2.5 compares the similarities and differences between the methods of VFM assessments used in seven government agencies. At the first glance, it is easy to see that, the entire seven agencies assess a project' VFM both quantitatively and qualitatively. With respect to the quantitative assessment, most of the agencies compare the net present value of the hypothetical cost of a project under public finance, and the whole-life cost of a project under PPP model. The hypothetical cost is usually referred to as the PSC by most agencies, with the exception of Ireland, where it is known as the public sector benchmark (PSB).

The components of the PSC or the PSB both include the raw PSC, a competitive neutrality factor and some risks parameters. These are similar to the PSC evaluation criteria proposed by Partnership Victoria. Regarding the qualitative VFM assessment, the elements considered in a qualitative analysis may be different, depending on the agency. However, the evaluations basically center on the viability and suitability of a project based on the contract's quality, and the skills and the resources of the parties (Morallos et al., 2009).

In terms of the discount rate, agencies in South Africa, France and Ireland use interest rates that are based on the government bond to discount the cash flow of the PSC and the PPP. This method of discounting the PSC cash flow is dissimilar to those used in Canada and Australia, where the former opts for the weighted average cost of the capital (WACC), while the latter uses the capital asset pricing model (CAPM). The timeline of the VFM assessment also varies among the agencies. As an example, it is carried out before the issuance of invitation to bid in some countries, and in some other countries, it is referred to as a constant review process that takes place before, during and after the contract.

2.4. Previous studies on Value for Money assessment

In recent years, a quantitative value for money assessment is increasingly playing an important role in the development of transport projects. It has increasingly become a basic tool for decision-making in relation to whether to implement PPP model or conduct conventional procurement. Several countries have been very successful in using the quantitative VFM to select the best procurement option. Leading examples in this regard include Canada, United Kingdom, Australia, United States and among them. Based on their experiences, it is possible to come up with a set of guidelines or technical notes on VFM quantitative analysis. Some examples include the "value for money quantitative assessment user guide" (HM Treasury of United Kingdom, 2011), the "public-sector comparator - A Canadian best practices guide" (Industry Canada, 2002), the "public sector comparator of Australia" proposed by the Australian Government in 2008, and the "detailed guideline for value-for-money test for Building-transfer-operation (BTO) and PPP projects of Korea" published by the Korea Development Institute (2010).

In addition to the guidelines on value-for-money, a lot of advancements have been made in several academic papers in relation to VFM. Some examples include Tsukada (2015), Gil (2013), Park (2014), Cruz and Marques (2014), and Sarmanto and Miranda (2010). In particular, Sarmanto and Miranda (2010) use quantitative VFM to find out whether PPP model creates VFM for the public sector in Portugal. In Gil (2013) and Park (2014), VFM is used to compare the BOT and the BTL model in the context of the procurement and implementation of transport projects in Korea. Similarly Tsukada (2015) focuses on the use of the VFM methodology to evaluate PPP programs in India.

Based on the exiting VFM guidelines, it can be seen that most countries make the PSC-PPP comparisons on the basis of their individually preferred method. Nevertheless, the components of the public sector comparator and the bid pricing criteria seem to be similar. Basically, there are four main components in a PSC. These include the following: (1) the retained risks, (2) the transferable risks, (3) the competitive neutrality factor, and (4) the raw PSC. On the other hand, the evaluation of the bid price comprises of the following: (1) opex, (2) capex, and (3) the financing cost. In any case, a possible disadvantage of the traditional approach centers on the absence of certain cost considerations. In particular, the computation of the PSC ignores the financing cost. For bid prices, the return on investment is sometimes omitted. It is therefore argued that, when certain necessary items are ignored, the VFM indicator could lead to poor decisions in the selection of the best procurement method. To respond to these issues, Tsukada (2015) provides a new comprehensive approach for VFM assessment.

Also, the Australian Government (2008) emphasizes that a comprehensive VFM requires not just a quantitative analysis but also a set of qualitative factors. Clearly, the main drawback of the quantitative VFM assessment comes from the exclusion of non-monetary factors. This has led to an increasing call for the inclusion of a qualitative VFM in framework of the VFM analysis (Park, 2014).

Essentially, in comparison to the quantitative VFM, a qualitative assessment is not widely used by many governments to evaluate the suitability and feasibility of PPP over the conventional procurement approaches. However, the case for a qualitative VFM analysis seems to be getting stronger in the literature. As an example, Gil (2013) uses a qualitative VFM assessment to determine the suitability of the BOT and BTL model in the implementation of Korean transport projects. Likewise, Cheung and Chan (2011) use a survey questionnaire to appraise the suitability of PPP projects in Hong Kong. In addition, Zhang (2006) uses a survey to explore the perspectives of experts in PPP from 13 countries on “the best-value contributing factors” in PPP projects. Li et al. (2001) also use a survey questionnaire to investigate the factors that lead to the success of a PPP in the United Kingdom. Ismail (2013) examines the attributes that improve the VFM of PPP projects in Malaysia through an analysis that focuses on the perspectives of both the public and the private sectors.

Additionally, Giang (2012) conducted a survey of 150 respondents to investigate the willingness of investors to invest in PPP projects in Vietnamese road sector. Likewise, Si et al. (2016) implemented a survey of 320 PPP stakeholders to explore the key factors that impact the performance of PPP projects in Vietnam.

Visibly, most of the existing studies in this field have only focused on one of the two aspects of value-for-money analysis. Specifically, in the existing international studies, the focus has been on either the quantitative VFM assessment or the qualitative VFM assessment. Moreover, there seems to be few of researches on quantitative VFM assessment of PPP projects in Vietnam. It is argued that ignoring one of the two aspects of VFM assessment may lead to an incomplete appraisal. Thus, the use of a comprehensive method of VFM (that involves both quantitative and qualitative considerations) to evaluate PPP projects in Vietnam is the main focus of this research.

2.5. Conclusion

Despite starting in developed nations, PPP has increasingly become an important alternative to traditional procurement approaches in both in developed and developing countries. In this regard, a quantitative VFM assessment is used to determine the best procurement option. This typically involves an identification of the values of the components that are used to make a quantitative VFM assessment. However, it has been pointed out that certain problems may arise when non-monetary factors are overlooked. For this reason, a qualitative VFM assessment is proposed. It is argued that this makes an assessment comprehensive. This chapter has examined some of the definitions of a qualitative VFM and explored factors to assess the viability of PPP projects in terms of some qualitative aspects. In addition, some of the best practices for the evaluation of value-for-money of PPP projects in different countries were also examined. Based on this review, one can conclude that the exclusive focus on either quantitative or the qualitative criteria is a major gap in this existing literature. On this basis, it is hypothesized that an analysis that takes into accounts both quantitative or the qualitative factors may lead to better decisions.

Chapter 3: Research methodology

3.1. Introduction

Chapter 3 focuses on the methodology that is used for the VFM analysis in this study. The chapter consists of the three main sections. The *first section* introduces a revised method of quantitative VFM assessment proposed by Tsukada (2015). *The second section* discusses the method of sensitivity analysis as well as the Monte Carlo Simulations to carry out the VFM assessment. In addition, the process that guided the application of the Bootstrap method is also introduced in the second section. Next, *the third section* explains the Structural Equation Model (SEM) that is used to identify the factors that enhance the viability of PPP projects in road infrastructure sector.

3.2. Methodology for the quantitative VFM assessment

3.2.1. Modified method of quantitative VFM assessment

Determining the PSC cost

Fundamentally, the conventional computation of the PSC is based on the total net present value of the following four components – the raw PSC, the competitive neutrality, the transferred risk and the retained risk. However, a potential weakness of the PSC accounting approach is lack of an explicit inclusion of financial costs. According to Tsukada (2015), "the allocation of government funds to an infrastructure project entails opportunity costs to nations because these funds would no longer be available for other purposes" (Tsukada, 2015, p.8). In this regard, Tsamboulas et al. (2013) notes that the government's payments for the construction and operation of transport projects may lead to a financial burden, "either because it borrows the money or because these funds could have been used for other public purposes". Therefore, it is argued that the costs of financing should be reflected in the PSC calculation. Following Tsukada (2015), the revised formula for the PSC is therefore defined as follows:

PSC = Transferable risks + retained risks + competitive neutrality + financing cost + raw project cost - future revenue.

The PPP cost

Regarding the cost of PPP, the basic and prevalent approach involves the use of the bid price. However, a problem with this approach is that the actual PPP price cannot be made available until the bidding stage, which is an advanced stage of the procurement process. The policy planner has to select, much earlier, the procurement method that would be used for a specific project. This means that, the VFM cannot be calculated at the planning stage, when the private sector has yet to submit its bid price. The only way to overcome this problem is to estimate the bid price likely to be submitted by the private sector, in other words, "shadow bid pricing".

Essentially, the concept of shadow bid pricing was introduced by Infrastructure Ontario, which is also called the adjusted shadow bid price (ASB). Despite the fact that the use of this approach helps to overcome the above-mentioned problem, its use still needs further refinement. In this regard, Tsukada (2015) has identified some difference between the shadow bid price (SBP) and the adjusted shadow bid prices (ASB). According to Tsukada (2015), the SBP is an effort to estimate the bid price likely to be submitted by the private sector. Meanwhile the ASB does something similar, however, it is designed for the calculation of VFM by enabling a like-to-like comparison between PSC and PPP. For this reason, the ASB is calculated by adding the retained risks to the SBP. Tsukada's approach is not a criticism toward Infrastructure Ontario, but an effort to clarify the difference between the raw PPP price and the adjusted PPP price for the purpose of calculating VFM.

A major contribution of the methodology proposed by Tsukada (2015) lies in the modification of the traditional VFM approach in a manner that is applicable to BOT type of PPP. This is due to the fact that the existing VFM guidelines appear to be primarily intended for the unitary payment type of PPPs in which the costs are mostly paid by the government on annuity or installment basis.

Unique elements of Tsukada's approach in the calculation of VFM for the BOT type PPPP project are as follows:

(i) Revenue should be explicitly estimated for both the PPP and the PSC (since most VFM guidelines do not explicitly require the estimate of the revenue, an important element of the BOT type of PPP)

(ii) Financing costs need to be included in both the PPP and the PSC (most VFM guidelines do not require financing cost to be included in the PSC)

(iii) Return on investment is to be included in the PPP, which is an important element (since it would correspond to the transferable risk in the PPP)

(iv) Distinctions should be made between the SBP and ABP, the latter of which is not exactly the bid price likely to be submitted by the private sector.

Since estimates of the retained risks are often difficult and relatively small in the case of BOT type projects, this research uses the SBP to estimate VFM.

The modified formula for the shadow bid price (SBP) for a PPP project is given as follows:

SBP = Capital expenditure + operating expense + financing cost + return on investment (profit) - future revenue.

The following diagram illustrates the process used to modify the VFM methodology

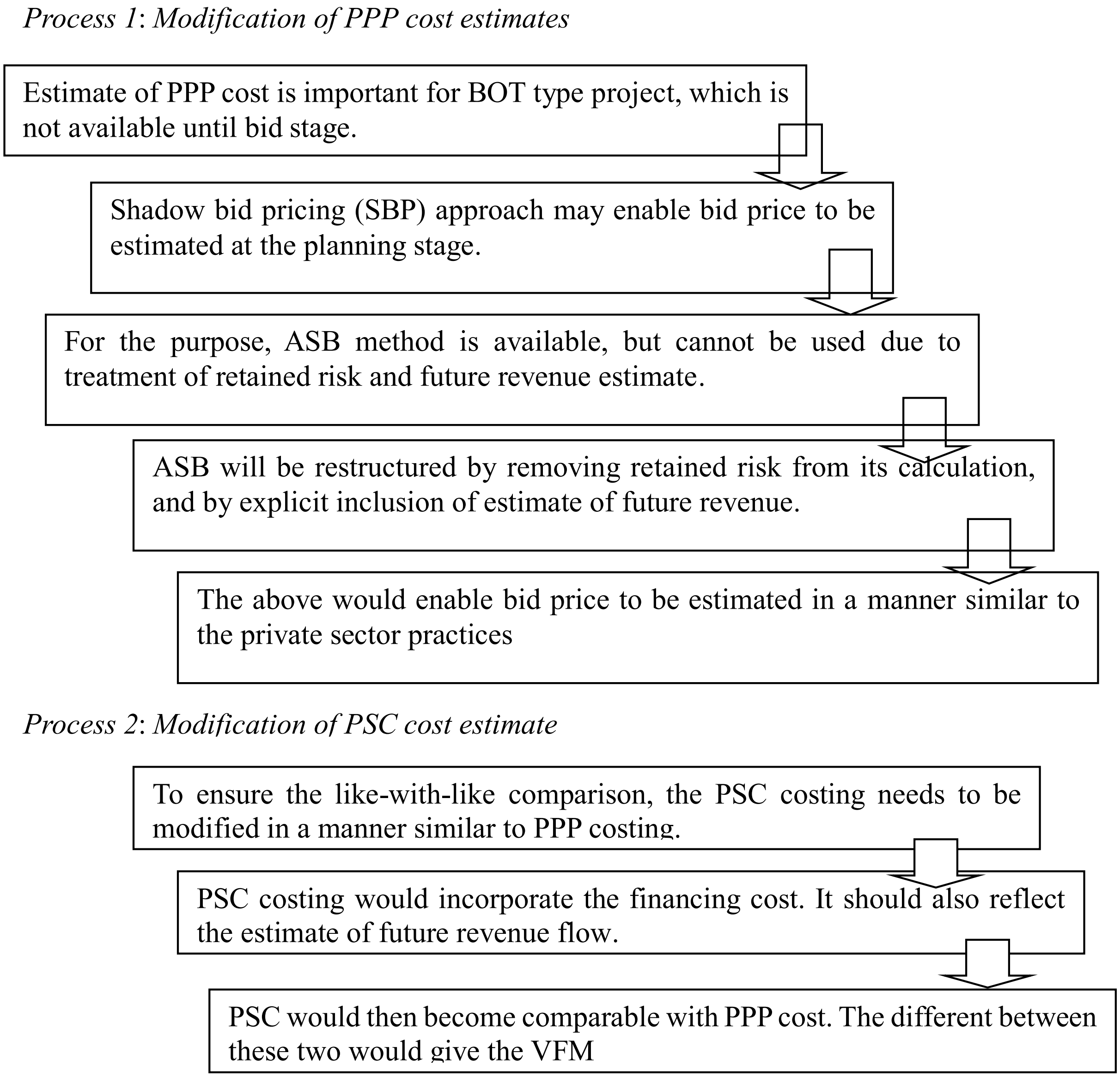


Figure 3.1: Process of the modification of the VFM methodology
(Source: Tsukada, 2015)

In essence, if the net present value of the PSC and SBP are calculated and known, it is possible to make a systematic comparison. Theoretically, a project will create a VFM if the net present value of the PSC is greater than that of the SBP. In other words, if the VFM is greater than zero, it will be justified to implement the proposed under a PPP. On the other hand, if the VFM is less than zero, the decision should be to implement the proposed project under the traditional public procurement method.

3.2.2. Choosing the discount rate methodology

In Vietnam, to finance public transport projects under the traditional procurement model, the government usually relies on the state budgets and the issuance of bonds. Sometimes, the government also mobilizes money through international Official Development Assistance. In this research, to implement projects through public finance, it is assumed that the government of Vietnam will issue bonds to mobilize capital. Accordingly, this research assumes that the discount rate for the cash flow of the PSC is risk-free. According to Arrow and Lind (1970), the discount rate used in public sector investments should be the risk-free, since governments can share the risks with taxpayers when they make investments (Checherita, 2009). On the other hand, for private projects, investors must mobilize capital from a combination of sources–through equity and borrowings. Hence, the discount rate for cash flows under the SBP should be the weighted average cost of capital (WACC).

3.2.3. Risk quantification

3.2.3.1. Risk identification

In project procurement, there are countless risks that are unique to the public sector and the private sector. Based on the review of the literature, these can be grouped into three key groups: (1) the risks inherent at the development phase, (2) the risks associated with the construction phase and (3) the risks associated with the operation phase. More specifically, there are 17 risk factors associated with PPP projects. Among these risks, construction cost overrun and traffic volume risks are some of the main risks that are encountered if the project is executed by the public sector.

3.2.3.2. Quantification of risks

The construction cost overrun risk

Based on an assessment of 258 projects, Flyvbjerg (2005) demonstrates that the risk of cost overrun occurs in 9 out of 10 transport project. Park and Preston (2013b) also observe that construction cost overrun is the proportion of difference between actual construction costs and contract costs. Following Park and Preston (2013b), construction cost overrun ratio is defined as follows:

$$a = \frac{(\text{construction cost}_{\text{completion}} - \text{construction cost}_{\text{contract}}) \text{x} 100\%}{\text{Construction cost}_{\text{contract}}}$$

where,

a is the extent of construction cost overrun

Construction $cost_{completion}$ represents the real costs that investors pay at the project's completion, while construction $cost_{contract}$ denotes the costs at which the implementation of the project was contracted upon, before project's commencement.

The traffic volume risk

Traffic risk is associated with the risk that real traffic volumes may not reach the forecasted value during the lifetime of a project, which negatively impacts the cash flows of the project, as well as the capacity of the concessionaire to repay debt and get sufficient equity returns (Infrastructure Ontario, 2007). Flyvbjerg (2005) defines the inaccuracy of a traffic forecast as the actual traffic minus forecasted traffic multiplied by 100. The ratio of traffic volume's inaccuracy is defined as follows:

$$I = \frac{(Ta - Tf) \times 100\%}{Tf}$$

where,

I = traffic volume inaccuracy

Ta = actual traffic volume

Tf = forecasted traffic volume

In practice, the actual demand is basically calculated for the first year of the operation period, while the calculation of the forecasted demand is based on the time at which the decision to construct the project is made (Flyvbjerg, 2005).

3.2.3.3. Risk allocation

According to the Korea Development Institute (2004), it is best to allocate the project's risk to the partner that can manage it effectively. In this regard, the US Department of Transport (2012) argues that risks related to construction cost overruns and traffic volume should be borne by the private partner. These are also known as the transferred risk. This view is also in line with Li (2003). As a result, it is assumed in this research that the two risks (related to construction cost overruns and traffic volume) are transferred to the private sector.

3.2.4. Sensitivity analysis

A sensitivity analysis has become a useful tool for exploring the variations in VFM outcome that arise from movements in the values of the input variables. Scottish government (2011) emphasized that a sensitivity analysis may help in identifying some inaccuracies in the estimation of the impact of the net present value of the project. In practice, a key challenge of a sensitivity analysis is to determine the appropriated input variants that drive the uncertainty in the evaluation results.

As mentioned earlier, a VFM analysis depends on a comparison of the values of the components of the PSC and the PPP bid. While the PPP bid could be estimated by private sector once the bid is submitted to the authority (Partnership Victoria, 2001), PSC is a hypothetical estimation of the cost and risks, which is affected by "the ambiguity and complexity problems" (Ismail et al., 2012). Therefore, instead of considering the impact of estimates of the PPP's cost on the VFM, it may be better to focus on the effects of changes in the values of the PSC items on the variations in VFM. More specifically, one should explore the impact of different values of the PSC's capital cost, the PSC's operating and the PSC's revenue on the VFM output as well as viability of PPP, using a simple sensitivity analysis.

The VFM methodology proposed in Partnership Victoria (2001) argues that variations in VFM analysis could be done subjectively in a sensitivity analysis. This may involve the allocation of subjective values to the PSC's capital cost, the PSC's operation and maintenance costs, the revenues, the discount rate and inflation. On the other hand, the quantitative VFM is often related to the risk factors inherent in the risks of construction cost overrun and traffic demand shortfalls. Hence, in addition to a simple sensitivity analysis, an advanced sensitivity analysis is carried out to measure the stochastic uncertainty of the factors that influencing the VFM in a given project.

3.2.5. Monte Carlo Simulation

A quantitative computation of VFM involves many uncertain input variables, such as construction cost overrun risk and traffic demand risks. It is therefore reasonable to incorporate these uncertainties in the computation of quantitative VFM. This is where the use of the Monte Carlo Simulation comes in.

According to Glasserman (2003), a Monte Carlo Simulation (MCS) is a method used to simulate a function with a large number of uncertainties in the input variables through stochastically repeated runs that are based on an input's probability distribution. This is then iterated many times to examine the distribution of the resulting values that the probability distribution of the input elements induces. Most guidelines on quantitative VFM analysis consider the MCS as an essential for a comprehensive VFM test.

Table 3.1: Previous researches using MCS in VFM analysis

Government Agencies/Researcher	**Purpose of research**	**Input variables**
US Department of Transport (2012)	VFM assessment for PPP: A Primer	Transferred risks, retained risk, and toll.
Partnerships British Columbia (2009)	Methodology for quantitative procurement options analysis	Base capital cost (range of potential efficiencies), operation, maintenance, rehabilitation, transferred risk, and retained risk
Park (2014)	Transport PPP decisions in Korea: Value for money assessment and risk quantification	Transferred risk, operation cost, inflation, and interest rate of exchequer bond

(Adapted from US Department of Transport, 2012; Partnerships British Columbia, 2009; Park, 2014)

Given the suggestions in US Department of Transport (2012), it is desirable to use the MCS to simulate the changes in the VFM in respect of the changes in transferred risks, retained risks and tolls. Partnerships British Columbia (2009) also recommends that the application of the MCS is essential for the simulation of the changes in VFM in respect of the changes in uncertain factors, including capital costs, operation costs, maintenances costs, rehabilitation costs, transferred risks, and retained risks. Moreover, Park (2014) also contends that an analysis of VFM that is based on MCS should be used to assess the impact of transferred risks, operation costs, inflation, and interest rate of exchequer bonds.

Accordingly, throughout this research, the MCS is used to generate the distributions of the simulated VFM, based on the probability distribution of some uncertain inputs (such as transferred risks, inflation and the interest rate of government bonds).

In order to use the MCS for the computation of the VFM for particular case study, the following four stages were involved: (1) the determination of the key uncertain input variables, (2) the identification of the probability distributions of the key input variables and the resulting simulation, (3) the estimation of the PSC cash flow and that of the SBP, and (4) the generation of the VFM distribution output.

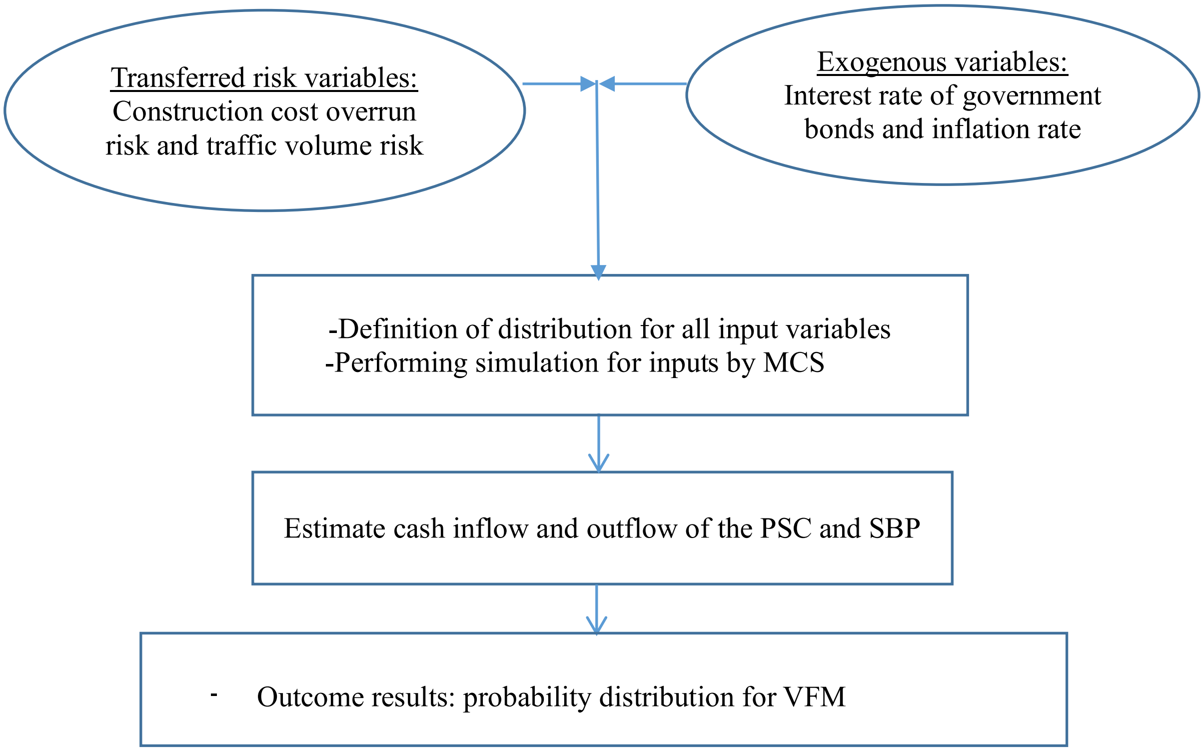


Figure 3.2: Flow research for simulation model

Figure 3.2 shows the flowchart for the MCS model used throughout this research. Further details of the process are described as follows.

Step 1: The Determination of the Input Variables

The model in this research consists of two main types of uncertain input variables, namely: (1) transferred risk variables, and (2) exogenous variables.

The transferred risk variables

Transferred risk variables are associated with the construction costs overrun risk and traffic volume risk. These risks may not be measured accurately in advance. Hence, according to Malini (1997), these variables should be incorporated into the model "in the form of probability distributions" in order to make the analysis more meaningful and adequate for decision-making.

The exogenous variables

The interest rate of government bonds and inflation rates mentioned in the three case studies carried out in this research are defined as exogenous variables in the simulation models. This is due to the fact that these variables depend on the country's economy. These variables can therefore be considered as uncertain inputs that influence VFM. As Malini (1997) explains, while developed countries try to keep their inflation rates below 5 percent per year, other developing countries sometimes suffer from high inflations level, a sign of higher risks in terms of the return on the investment. Likewise, the interest rates of government bonds are affected by the demand and supply of capital.

Step 2: Defining the probability distribution of the input variables

Identifying the probability distribution of the input variables is a very important aspect of Monte Carlo Simulations. According to Park (2007), if there are sufficient historical data, the probability distribution could be determined from such sources. However, Park (2007) also notes that, if these data are absent, the distribution could be supposed by an individual or institution. Likewise, Cruz and Marques (2012) emphasize that determination of the distributions of the cost items should be based on historical observations or specialist judgment. In the model used in this research, the probability distribution of uncertain input variables is determined based on the historical data, using the Palisade's @ Risk software version 7.5.

Step 3: The estimation of cash flows

The estimates of the cash inflow under the SBP come from equity, borrowings and tolls. The cash outflow of the SBP as well as that of the PSC is calculated on the basis on the costs incurred during the construction and operation phases, together with debt services that take place during the concession period.

Step 4: The output of the simulation

The output of the simulation of the model is the net present value of the VFM, which is expressed in the form of a stochastic variable that depends on the probability distributions of the input variables. The result of the simulations provides values that show the likelihood of the VFM being positive or negative. In addition to this basic result, an advanced sensitivity analysis that has the capability to evaluate the interactions of stochastic input variables with the value of the VFM was also carried out.

3.2.6. Bootstrap method

As mentioned in the preceding sections, one of the main objectives of this research is to quantify the likelihood of a positive VFM for projects in general. However, the sample size of the research - three case studies is not sufficient for deriving an entire distribution. In order to address this issue, the Bootstrap method is used to derive and estimate the probability distributions.

The method of Bootstrap was originally introduced in 1979 by Bradley Efron (Hardi et al., 2015). The method is a resampling technique for evaluating uncertainties (Davison & Kuonen, 2013). Additionally, Efron and Robert (1998) found that Bootstrap is a "computer-based method" for quantification the quantification of statistical estimates.

Since then, the bootstrap method has become a common statistical tool for analyzing the quantitative estimates of uncertainties in cases where analytical methods are not insufficient, or modeling supposition are worthless (Neto, 2015).

One of the Bootstrap method's characteristic is that, based on a given sample, it is possible to derive and simulate new samples are through a non-parametric or parametric process. The non-parametric approach is done through a resampling process that involves replacements, while the parametric approach is implemented through a pre-defined parametric distribution of the original sample, which is then stochastically calibrated to derive new sample distributions (Thomas & Rossukon, 2015).

The research adopts the Bootstrap method to simulate distribution because this method provides some underlying benefits, especially:

- According to Cogneau and Zakamouline (2012), this method does not need any parametric assumption on the probability distribution of the observed variable, and it may be effectively employed with sample sizes of less than 30.
- Furthermore, this method provides an efficient tool for characterizing the uncertainties in the probabilistic models, especially for the models extracted from a finite sample (Li et al., 2015).

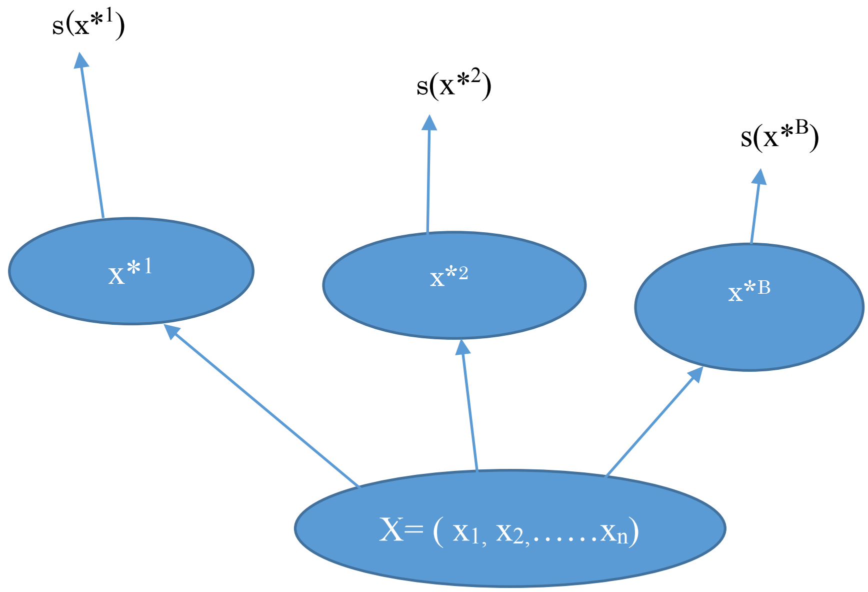


Figure 3.3: Schematic diagram of the bootstrap process
(Source: Efron & Tibshirani, 2000)

Figure 3.3 provides the schematics of the bootstrap process. $x^* = (x^*_1, x^*_2, \ldots\ldots x^*_n)$ is a bootstrap sample, which is generated through a sampling and resampling process that involves n times replacement from the existing data range, $x(x_1, x_2, \ldots\ldots x_n)$. Along with the bootstrap samples, Bootstrap statistics $s(x^{*1})$, $s(x^{*2})$.… $s(x^{*B})$ is found by computing and solving for the value of s(x).

3.2.7. Checking the fitness of the hypothetical distribution

According to Paolo (2014), to check whether empirical data fit a particular probability distribution, one should use the chi-square or the Kolmogorov-Smirnov test. The chi-square goodness-of-fit test involves testing the hypothesis that the fitted distribution of the sample data corresponds to the actual data. To define the best probability distribution for an uncertain variable, the chi squared goodness of fit test is conducted at a significant level 0.05.

The formula for the chi squared is given by the following equation (Vose, 1996):

$$X^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$$

where:

Oi is the observed frequency in category *i*

Ei is the expected frequency in the corresponding category *i*

The null hypothesis will be rejected if $X^2 > X^2_{1-\alpha,\ m}$ ($X^2_{1-\alpha,\ m}$ is the quantitative of the chi-square distribution). Accordingly, we let *a* denote the significant level of the test, while *m* denotes the degrees of freedom.

3.3. Methodology for the qualitative VFM assessment

3.3.1. Determining the evaluation criteria and the questionnaire instrumentation

Determination of evaluation criteria

Ismail et al. (2011) emphasize that the correct selection of elements used to evaluate PPP bids is essential for a successful best value analysis. In order to assess the viability of PPP projects, in terms of the qualitative approach, the research will use a set of 34 factors that are based on the evaluation criteria proposed for a feasibility study of PPPs in Thomas et al. (2010).

The administration of the questionnaire

A survey was conducted among Vietnamese BOT/PPP stakeholders. The respondents comprise of the governments' officers, financiers, engineers and insurance brokers, and the contractors who work on BOT/PPP projects. To get useful information from the respondents, the questionnaire used in the survey focused on the following (1) demographic information (2) the importance of factors that enhance the viability of PPP in road sector based on the 5-point Likert Scale, and (3) the respondents' level of satisfaction with the viability of road PPP projects in general.

3.3.2 Data analysis

Statistical tools for data analysis were used throughout the research to carry out the Cronbach's alpha analysis, the explanatory factor analysis, and the implementation of the structural equation model.

3.3.2.1. Reliability test

By definition, "reliability is an assessment of the degree of consistency between multiple measurements of a variable" (Hair et al., 2010, p.125). In this study, a reliability test is used to verify the consistency of the survey on the factors that affect the viability of PPP. The Cronbach's alpha indicator is used to measure the consistency of a scale. The threshold values used in the Cronbach's alpha assessment is given as follows:

Table 3.2: Thresholds values in Cronbach's alpha assessment

Internal consistency				
Excellent if α ≥ 0.9	Good if 0.7 ≤ α<0.9	Acceptable if 0.6≤ α<0.7	Poor if .5≤ α<0.6	Unacceptable if 0.5 ≥α

Note: α means Cronbach's alpha

(Source: George & Mallery, 2003)

3.3.2.2. Explanatory factor analysis

As noted in Henson and Roberts (2006), one of the main aims of an explanatory factor analysis (EFA) is to discover the key dimensions that would be used to summarize a theoretical model from a series of the latent constructs that are based on a set of components. In other words, the main aim of an EFA is to reduce and classify the observed variables into a few latent groups.

One of the most important issues in EFA is to determine the number of variables to eliminate or retain. In order to support the decision on the number of variables to remove or retains, one of the most popular approaches is to the test screen plot. According to Hair et al. (2010), "the screen test is derived by plotting the latent roots against the number of factors in their order of extraction, and the shape of the resulting curve is used to evaluate the cutoff point" (Hair et al., 2010, p.110). In addition, Hair et al (2010) note that these factors that have eigenvalues larger than one should be retained. Many studies also suggest that the Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity be used in an EFA. In particular, a KMO of 0.5 is generally considered appropriate for a factor analysis, while The Bartlett's Test of Sphericity that is significant at $p<0.05$ means that factor analysis is suited (Williams et al., 2010). On the other hand, the percentage of the variance criteria should be considered. The proportion of the variance measure allows one to stop the iteration process if a factor achieves a suitable threshold. However, so far, there is no consensus on desired threshold, even though certain percentages have been recommended (Williams et al., 2010). Hair et al. (2010) recommends that in the social sciences, the percentage of the variance of a criterion should be at least 60%.

3.3.2.3. The development of the Structural Equation Model

In order to measure the effects of the qualitative factors on the viability of PPP projects, a Structural Equation Modeling (SEM) was used. As defined in Blunch (2013), SEM is "a collection of tools for analyzing connections between various concepts in cases where these connections are relevant either for expanding our general knowledge or for solving some problem". Hair et al. (2010) on the other hand, define SEM as a group of statistical models that explore the relationships across multiple variables.

There are two principal types of variables in a SEM (i.e. the manifest variables and the latent construct). The calculated variables can be quantified directly based on the data collected, while the latent variables can only be computed indirectly based on manifest variables. Traditionally, a SEM comprises of two models - a measurement model and a structural model. The measurement model characterizes the relationships between the computed and the latent variables, while the structural model displays the relationships among the latent variables. An advantage of the SEM over other mathematical methodologies in social sciences is that, the SEM measures not only the relationship between independent and dependent variables but also the relationships among independent variables. In this research, the need for using this method of analysis is as follows:

(1) To facilitate the evaluation of the hypothesized models regarding the relationships among observed and unobserved variables.

(2) To facilitate a statistical test of the theoretical model quantitatively against the actual evidence.

(3) To help to provide a best-fit model that explains the relationships among the variables.

Fundamentally, the SEM process consists of three steps: (1) the estimation of the hypothetical model, (2) the test of the validity of the indices for the computation of the latent variables, and (3) the identification of the factors as well as predictors in the structural model to establish the relationship among variables.

3.3.2.4. Model estimation

Traditionally before the initiation of the analysis of the SEM, the model should be estimated based on theory and practical results drawn from previous studies. Relevant researches provide the evidence for the factors, directly and indirectly, and how affect the success of PPP projects. Accordingly, a hypothesized model that is derived from the literature is presented in Figure 3.4. The structural model for measuring the relationship between financial performance and the economic environment, the degree of technical sophistication, the social system, the political and legal environment, the managerial capacity and the sastifaction of respondents on the viability of PPP projects, as it is defined in the hypothesized model for the evaluation of the viability of PPP projects is given as follows:

H1: Financial performance & economic environment positively impact the viability of PPP projects

H2: Technical sophistication positively contribute to the viability of PPP projects

H3: Social system positively contributes to the viability of PPP projects

H4: Political and legal environment positively influences the viability of PPP projects

H5: Managerial capacity positively impact the viability of PPP projects

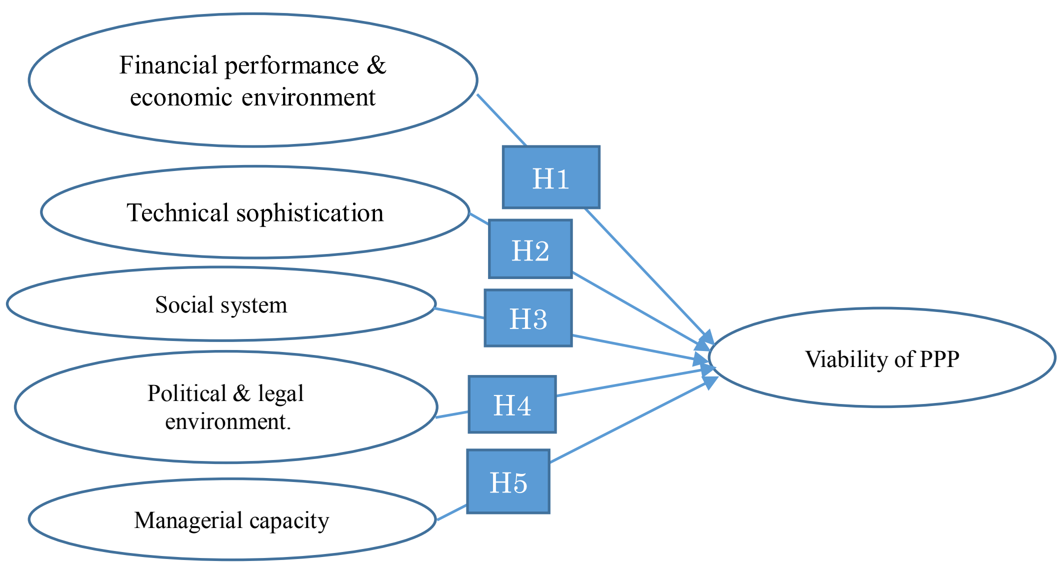


Figure 3.4: A Hypothesized model of assessing factors impact on the viability of PPP.

In this hypothesized model, the viability of PPP projects is the dependent variable. It is hypothesized that viability of PPP projects is affected by the five independent variables.

Estimation of model parameters

The SEM model in Figure 3.4 can be written as:

$$Y = \alpha + \beta Y + \Gamma X + \zeta$$

where, β is the matrix of coefficients that links dependent variables to each other

Γ is the matrix of coefficients that links dependent to independent variables

α is vector of structural intercepts

ζ is disturbance

The model parameters in a SEM are usually associated with (1) the variances and covariance of independent variables included in Φ (2) the variances and covariance of disturbance included in ψ (3) regression coefficients included in β and Γ.

We denote Ω as parameter vector which includes Φ, ψ, β and Γ. The purpose of estimation is to compute $\hat{\Omega}$ that minimize $F(S, \hat{\Sigma})$, with $\hat{\Sigma} = \sum \hat{\Omega}$, and $F(S, \hat{\Sigma})$ is a "scalar that measures distance between the sample covariance matrix S (data) and the fitted covariance matrix $\hat{\Sigma}$ based on model estimated" (Kaplan, 2009). In particular, the fitting function is displayed as following (Kaplan, 2009):

$$F(S, \hat{\Sigma}) = \log|\Sigma(\Omega)| + tr[S\,\Sigma^{-1}(\Omega)] - \log|S| - t$$

where, t is number of independent and dependent variables

After estimating variances of errors or disturbance $\hat{\psi}$, standardized regression coefficient $\hat{\beta}$ can be estimated as following equation (Hoyle, 2012):

$$\hat{\beta} = \sqrt{1 - \frac{Variance\ residual}{Variance\ total}}$$

In order to examine whether regression coefficient is statistically significant, one should test critical ratio (CR). The ratio is formed by dividing regression coefficient by its standard deviation. If having a larger sample, the critical ratio can follow the standard normal distribution (Hox & Bechger, 1998). Therefore, with the critical ratio of larger than 1.96, the coefficient is significant at the p-value of 5% level. It suggests that there is a significant relationship between dependent variable and independent variable

3.3.2.5. Model fit indices

In order to test whether a hypothesized model is acceptable or not, some tests of goodness-of-fit are used to evaluate the fit between the theoretical model and collected data. These goodness-of-fit indices are: (1) the minimum fit function chi-square ($\chi 2$) ratio degree of freedom test (Wheaton et al., 1997), (2) the root mean square error of approximation (RMSEA) (Steiger, 1990), (3) the comparative fit index (CFI) (Jöreskog & Sörbom, 1989), (4) the non-normed fit index (NFI) (Bentler & Bonett, 1980), (5) Tucker-Lewis Index (TLI) (Tucker & Lewis 1973), and (6) the standardized root mean square residual (SRMR) (Hu & Bentler, 1999).

Chi-square/Degree (CMIN/DF)

The drawback of the Chi-square test is typically its sensitivity to sample sizes. In particular, Niels (2013) notes that if the sample size is small, any model can be accepted, while if the sample is larger, the model might be refused. One of the first fit-statistics to address this problem is the χ2 ratio/degrees of freedom (Wheaton et al., 1977). Following Byrne (2010), the value of the CMIN/DF is given as follows:

$$\text{CMIN/DF} = \frac{\chi 2}{DF}$$

where, X^2 means the chi-square of the model, and DF denotes the model's degree of freedom.

The Non-normed Fit Index (NFI)

The NFI is a measure that compares the difference between the target model and the hypothesized model. The value of the NFI is given by:

$$\text{NFI} = \frac{X^2_{null} - X^2_{target}}{X^2_{null}}$$

Accordingly, X^2_{null} is the chi-square of the null model, while X^2_{target} denotes the target model or the proposed model. If the indicator is close to 0, it means that proposed model is not as good as the null model. In contrast, if the index is close to or equals to 1, it suggests that the proposed model is much better than null model.

The Tucker-Lewis Index (TLI)

The value of the TLI is given by the following equation:

$$\text{TLI} = \frac{X^2_{null}(DF_{null} - X^2_{target})DF_{target}}{X^2_{null}/\ DF_{null} - 1}$$

Accordingly, DF_{null} denotes the degree of freedom for the null model, while DF_{target} denotes the degree of freedom for the target model.

The Comparative Fit Index (CFI)

The value of CFI is given by the following equation:

$$\text{CFI} = \frac{(X^2_{null} - DF_{null}) - (X^2_{target} - DF_{target})}{X^2_{null} - DF_{null}}$$

The Root Mean Square Error of Approximation (RMSEA)

The NFI, TLI, and the CFI goodness-of-fit indices utilize probability ratios - the chi-square (Kaplan, 2009). However, it is not always possible to achieve a perfect model fit. The RMSEA is therefore proposed by (Steiger, 1990) to assess whether the model approximately fits the population. The value of the RMSEA is given by the following equation:

$$\text{RMSEA} = \sqrt{\frac{F0}{DF}}$$

where, F0 = NCP/n, with NCP = | $\chi 2$ – DF, 0| and n the sample size.

The Goodness-of-Fit Index (GFI)

The Goodness-of-Fit Index (GFI) is a measure of the relative amount of variance and covariance in *S* that is jointly explained by Σ (Byrne, 2010). The value of the GFI is given by the following equation:

$$\text{GFI} = \frac{(weighted\ sum\ of\ the\ variances\ in\ \Sigma(\theta))}{(weighted\ sum\ of\ the\ variances\ in\ S)}$$

Table 3.3: Threshold of the fitness indices

Indices	Good model fit	Accepted model fit
RMSEA	Values <0.05	<0.08
CFI, GFI	Values >0.95	>0.90
SRMR	Value = 0	<0.08
Chi-square (χ2)/degree of freedom (CMIN/DF)	Value <2	<5
Factor loading	>0.5	
TLI	>0.95	>0.9

(Source**:** Hooper et al., 2008; Hu & Bentler, 1999; Browne & Cudeck, 1993; Hair et al., 2010)

According to Hooper et al. (2008), a value of CMIN/DF that is smaller than 2 suggests that the hypothetical model is a good-fit with the collected data. Equally, if the value is between 2 and 5, the model is also accepted as fit. In Hu and Bentler (1999), it is argued that, if the CFI and TLI are larger than 0.95, it suggests a close model fit. Under the RMSEA, the hypothesized model is a good fit with the sample if the RMSEA is close to 0.05. Generally, an RMSEA value between 0.5 and 0.8 is accepted (Browne & Cudeck, 1993). Once again, Hair et al. (2010) note that the factor loading of variables should be greater than 0.5.

f. Testing the reliability and validity of the model

In order to measure the validity and reliability of the SEM model, some studies (such as Fornell & Larcker, 1981; Hair et al., 2010; Wong, 2013) suggest several indicators. The suggested indicators include the Composite Reliability (CR) and the Average Variance

Extracted (AVE). The value of the Average Variance Extracted indicator is given as follows:

$$\text{Average Variance Extracted} = \frac{\sum_1^n Li^2}{n}$$

Where:

Li is the standardized factor loading,

i is the number of items

Next, the value of the composite reliability indicator is given as follows:

$$\text{Composite Reliability} = \frac{(\sum_1^n Li)^2}{(\sum_1^n Li)^2 + \sum_1^n ei}$$

Where: *ei* is the error variance terms for a variable.

Table 3.4: Test of reliability and validity

Indicator	**Suggested level**
Reliability	
Composite Reliability (CR)	CR should be at least 0.7
Validity	
Average Variance Extracted (AVE)	AVE should be exceed 0.5
Discriminant validity	
Maximum Shared Squared Variance (MSV)	MSV < AVE
Average Shared Square Variance (ASV)	ASV < AVE

(Adapted from Hair et al., 2010)

Following Hair et al. (2010), the threshold of the preferred composite reliability (CR) is 0.7. However, they also state that in some cases, a value under 0.7 may be accepted.

According to the suggestion in Bagozzi et al. (1991), a composite reliability (CR) greater than 0.6 indicates that the measurement scale is reliable. Furthermore, to ensure the convergent validity of the construct, the value of the Average Variance Extracted should be greater than 0.5 (Hair et al., 2010). On the other hand, Netemeyer et al. (2003) suggest that the value of the Average Variance Extracted should (AVE) exceed 0.45.

g. The Multi-group analysis

A multiple group analysis facilitates the identification of whether or not the same SEM can be utilized among various groups. This process, according to NC State University (2016) involves an unconstrained test of the model for all groups, in which individual parameters are limited to be equal for groups. If the chi-square difference test does not demonstrate that there is a significant disparity between the unconstrained and the constrained model, this implies that we can apply the same SEM model among different groups. On the other hand, if the chi-square difference test is significant, it means that there is a difference between the unconstrained model and the constrained model. In other words, one cannot apply the same SEM model across all groups.

In this research, a multiple group analysis is applied to compare the perceptions of various groups (in terms of gender, sector, number of projects and organizations) on the factors that impact the viability of PPP road projects. In the other words, a multiple group analysis is used to examine whether there are differences in the perspectives of different groups on the factors that affect the feasibility of PPP.

h. Determining the sample size in SEM

The identification of the required sample size is very important aspect of any study, due to fact that it may affect the contents of the research, particularly the methods to be used, the fitness of the model, and the power of the estimated parameter in the model (Inanmi et al., 2013). It should be noted that there is no general agreement on what an adequate sample size for SEM is. However, Kline (2005) suggests that sample a size is considered small if it is less than 100, and medium if it is between 100 and 200. A sample size is considered large enough if it is more than 200. Furthermore, Hoyle et al. (2015) recommend that a sample size in SEM should be at least 200. In addition, Ding et al. (1995) suggests that the minimum sample size is somewhere between 100 and 150.

Furthermore, a sample size that based on a variable ratio is used in Raykov and Marcoulides (2006), Mitchell (1993), Bentler and Chou (1987), Hatcher (2013) and Hair et al. (1998). According to Bentler and Chou (1987), sample size may be five times as many as the observed variables. As an example, for a model that has 30 observed variables, a sample size of 150 is considered acceptable. Following Hair et al. (1998), the respondents for each variable should be at 10.

3.4. Data collection

3.4.1. Data collection for the quantitative VFM assessment

To generate data for the quantitative VFM assessment, the research used secondary data, based on historical data on road transport projects. The data comprises of information on construction costs, project completion time and traffic demands. The data was obtained from the Vietnamese Ministry of Transport's webpage and the Ministry of Investment and Planning's webpage. The purpose of the data collection was to calculate the cost and risk components involved in road transport projects. Additional data on financial information and financial feasibility reports were also obtained from the projects' companies. The financial data consists of capital expenditure, operating expenses, financing costs and the estimated future revenue of each project. The aim of the data collection was to facilitate the calculation of the shadow bid pricing in the quantitative VFM analysis.

3.4.2. Data collection for the qualitative VFM assessment

To obtain data for the qualitative VFM assessment, this study collected primary data to examine the perspectives of the stakeholders that have actual working experiences in BOT/PPP projects in the road sector. The snowball sampling method was used to facilitate the data collection process. According to Vogt (1999), "snowball sampling is a technique for finding research subjects. One subject gives the researcher the name of another subject, who in turn provides the name of a third, and so on". Some of the advantages of this method lie in its ability to facilitate the distribution of a large number of questionnaires to a large population, as well as its ability to enhance higher rate of a questionnaire's completion in a relatively short time. In addition, this method can help save costs when collecting data.

The survey questionnaire was initially given to 25 respondents who are working on BOT/PPP projects in Vietnam. They then were required to introduce other new participants that can take part in the survey. At the end of the process, 300 questionnaires were distributed to BOT/PPP stakeholders in Hanoi, Ho Chi Minh City and Nghe An Province. These areas were selected because of some strategic reasons. As an example, Hanoi is the center of economic activities, politics and the society in Vietnam. Most of BOT/PPP decision policy makers work in this city in leading state organizations such as the Ministry of Finance, the Ministry of Transportation, the Ministry of Planning and Investment, the State Audit Office and many others are located in Hanoi. Thus, the target participants in Hanoi were mostly state officers and contractors. Likewise, Ho Chi Minh City is at the center of road projects in Vietnam; it also has the largest number of BOT/PPP road projects being executed in the region. Some examples of the projects include: the Phu-My Bridge, the Trung Luong-My Thuan Expressway, and the My-Loi Bridge are in Ho Chi Minh City. In addition, most of the financial organizations that provide capital for the implementation of BOT/PPP projects are based in Ho Chi Minh City. Therefore, the target interviewers in Ho Chi Minh City were bank loan officers and insurance agents. In comparison with both Hanoi and Ho Chi Minh City, Nghe An province is less developed. However it has a larger number of Civil Engineering Construction companies that specialize in the construction of BOT/PPP road projects in Vietnam. Hence, the target respondents in the Nghe An province are mostly contractors.

3.5. Conclusion

This chapter outlines the methods that are used in this research to achieve the aims of the study. The main contents of the chapter's sections centered on (1) the modified quantitative VFM analysis, (2) the use of the Monte Carlo method to estimate the probability of a positive VFM in a given BOT/PPP project, (3) the use of the Bootstrap method to compute the VFM indicator for BOT/PPP projects in general, (4) the development of the structural equation model to qualitatively explore the factors that improve the viability of PPP projects, and (5) the quantitative and qualitative data collection processes.

Chapter 4: PPP projects in road sector in Vietnam

4.1. Introduction

The development of transport infrastructure projects has significantly contributed to the nation's rapid economic development over the last two decades. Hence, most international organizations such as the ADB, the World Bank and the IMF suggest that further investments in transport infrastructures could help to maintain the pace of economic growth in Vietnam. However, problems often arise when country's debts constantly increase. In addition, ODA inflows are expected to fall. In view of these challenges, the Vietnamese government intends to enact more PPP-friendly policies to stimulate private participation in infrastructure development in a systematic and appropriate manner (World Bank, 2013).

Chapter 4 begins with an overview of the socio-economic landscape in Vietnam. Next, the recent developments in the road transport system in Vietnam are also introduced. The third section summarizes the current legal framework and the status of PPP projects in Vietnam. The chapter then concludes with a summary of the above-mentioned topics.

4.2. Socio-economic overview of Vietnam

Vietnam is located in Southeast Asia. It shares borders with the People's Republic of China (PRC), Laos and Cambodia. Its total land area is about 330,000 square kilometers (km2). With a population of approximately 90 million, it is the third most populated country in Southeast Asia and the fourteenth in the world.

Historically, Vietnam used to be a French colony in the nineteenth century. During the first half of the 20th century, Vietnam fought two wars, one with France and another with the United States of America. The country regained independence from France in 1954. Nevertheless, Vietnam was later divided into two states -the Northern Vietnam and the Southern Vietnam. During the 1950s and 1960s, Vietnam fought a war against the United States. The war ended in 1975, when Northern Vietnam won the war. Thereafter, the country finally regained its independence.

In terms of economic development, Vietnam took some unprecedented steps to transition from a planned economy to a socialist-oriented market economy in 1986. Shortly after, in 1992, an "open door" economic policy was enacted to further stimulate domestic growth. More than 30 years have passed since these landmark economic reforms were made. Some remarkable achievements have also been made in terms of economic development. Particularly, between 1986-1997, the yearly real GDP growth rate steadily improved to reach a high of around 7% per year. Despite the fact that there was a slight decrease in the GDP rate (from a high of 7% to a low of 5.8%) in 1998 due to the Asian financial crisis in 1997, between 1998 and 2015, the annual GDP growth rate recovered and reached a new high of 8.5% in 2008 (see Figure 4.1). However, not only did the GDP continue to grow rapidly, the rate of inflation was also controlled to a great extent. As an example, the government had little or no control over the 3-digit rate of inflation in 1986. In 1995 however, the rate was effectively controlled and kept at 12.7%. The rate even went down further to a low of 4.5% in 1996. Since then, the rate of inflation has remained at relatively stable level.

Thanks to the high rate of economic growth, the GDP per capita also increased more than tenfold, from a low of USD140 in 1990 to a high of USD 1,902 in 2015. From being one of the poorest countries in the world, Vietnam is now regarded as a lower middle-income country that has high level of access to healthcare, primary education and fundamental infrastructures (Global competitiveness report 2016).

Along with the economic growth came a boom in foreign trade. Before the 1990s, Vietnam mostly exchanged goods with the member countries of the former socialist block. However, since the implementation of the open door policy in 1992, Vietnam now trades with more than 185 countries[5]. These were accompanied with the country's ascension to the ASEAN Free Trade Area (AFTA) in 1996, and the country's ascension to the World Trade Organization (WTO) in 2007. These demonstrate the efforts of the government to integrate with the outside world to promote exports and economic development.

Following the enactment of several policies to incentivize Foreign Direct Investments (FDI), Vietnam has succeeded in attracting 2,240 FDI projects, with a total investment capital that is as high as USD13, 028 billion. These have had an immense impact on the country's economic development[6]. To put this into perspective, FDI alone accounted for 31.9 % of total investment capital in 2005, about 3.3% of the GDP (General Statistical Office of Vietnam, 2016). Over the following decade, this figure increased steadily to reach a peak of 9.7% of the GDP in 2009 (as indicated in Figure 4.1). Vietnam has become one of the most attractive destinations for foreign investors in the region.

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[6] http://ipc.mpi.gov.vn/thong-tin-du-an-fdi/giai-ngan-von-fdi-11-thang-tang-8-3-so-voi-cung-ky.html

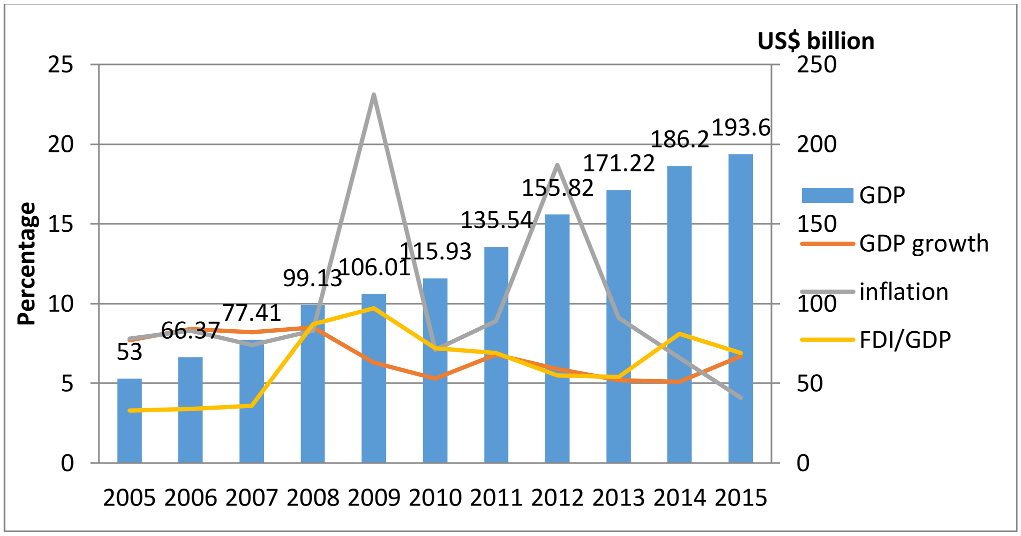


Figure 4.1: Developments in the macroeconomic indicators of Vietnam (2005-2015) (Source: World Bank, 2016b)

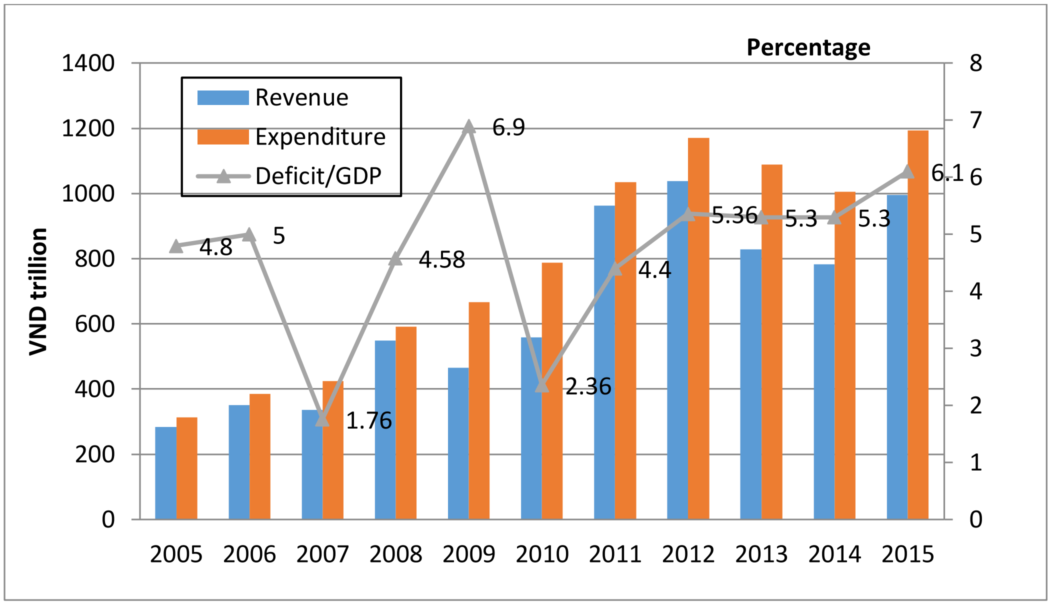
Furthermore, according to a World Bank report on the Ease of Doing Business in 2016, Vietnam was ranked the 90th out of 189 countries in the world. Some of the other countries in the region did not do relatively better. As an example, the Philippines was ranked 95th, Indonesia was ranked 109th, Lao was ranked 134th while Myanmar was ranked the 167th (see Table 4.1). This ranking seems to imply that Vietnam seems offers a more attractive business environment compared to its neighbors in Southeast Asia.

Table 4.1: Comparison of Ease of Doing Business in Vietnam and other countries in Southeast Asia

Country	Rank
Singapore	1
Malaysia	18
Thailand	49
Vietnam	90
Philippines	95
Indonesia	109
Lao	134
Myanmar	167

(Source: World Bank, 2016a)

Besides the achievements in GDP growth and modest ability to attract FDI, certain challenges still exist. As an example, in terms of fiscal policy, state budget and revenue did grow considerably (as indicated in Figure 4.2). However, expenditure has gone up much faster, outgrowing revenues every year, especially between 2005 and 2015. As a result, the national deficit has gone from - VND 40.7 trillion to - VND 256 trillion. This helped raise the budget deficit to 4.8% of GDP in 2005. The percentage of the deficit has hovered around 5% of the GDP since then (as shown in Figure 4.2).



*VND = 0.00005 USD

Figure 4.2: National budgets of Vietnam in the period of 2005-2015
(Source: Vietnamese Government, 2016)

In terms of the business environment, according to the Global Competitiveness Report (2016), one of top five problems that have had a negative impact on the costs of doing business in Vietnam is the "inadequate supply of infrastructure" (Figure 4.3). In other words, in order to improve the business environment and stimulate growth, the government needs to focus on upgrading and improving the state of the national infrastructure assets. This is in line with the government's five-year Socio-Economic development plan for the period between 2016 and 2020. Under this plan, infrastructure development is considered a top priority.

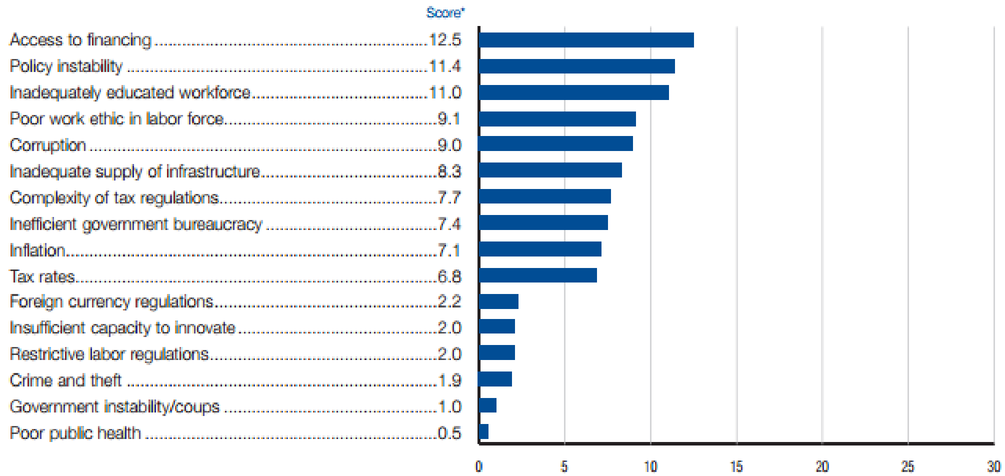


Figure 4.3: Most problematic factors for Doing Business in Viet Nam

(Source: Global Competitiveness Report 2016)

Overall, the efforts of the Vietnamese government to internationalize the country and join global trade did produce some satisfactory outcomes, especially in terms of socioeconomic development. The most significant indicator took place when the national poverty headcount became less than 10% of the population in 2010, a figure that was as high as 58% in the early 1990s. This was globally recognized as major achievement (World Bank, 2013). It also contributed to the current designation of the country as a lower middle-income country. Some ambitious goals have been set the next phase of the country's development plan (from the year 2016 to 2020). One of the targets is to allocate significant resources to modern infrastructures development, with a top priority given to road transport projects.

4.3. Road system in Vietnam

4.3.1. Overview of road system in Vietnam

The developments in the road sector are parallel to the country's historical development. The first road networks in Vietnam were built at the beginning of the 20th century, under the French rule. However, these were heavily damaged during the wars that took place between 1945 and 1975. Following the economic reforms in 1986, with the recognition of the importance of the road transport system to economic development, road systems was recognized as one of the most pressing issues that needed to be addressed by the government. This led to some expansions in the national and local roads. According to the Ministry of Transportation (2013), Vietnamese road system currently totals about 258,200 km of length[7] (ranked 25th/222 in the world), out of which 18,744 km is either a highway or an expressway. The rest are either provincial roads (23,520 km) or county road (151,187 km). These are further illustrated in Table 4.2.

Table 4.2: Length of road system in Vietnam

No	Kinds of road	Length (Km)	Percentage (%)
1	Highway, expressway	18,744	7.26
2	Provincial roads	23,520	9.11
3	District roads	49,823	19.30
4	County roads	151,187	58.55
5	Commune roads	8,492	3.29
6	Specialized road	6,434	2.49

[7] https://en.wikipedia.org/wiki/List_of_countries_by_road_network_size

(Source: Decision 356/QD-TTg of Prime Minister dated January 2013)

Next, Vietnam, as with other South Asian countries, also faces the problem of inadequate infrastructures, in terms of both quantity and quality. This has had an adverse effect on the nation's trade competitiveness and the sustainability of the economic growth. While other neighbors, such as Malaysia, Thailand, China and Indonesia, have strived to tackle this issue, the Vietnamese government has failed to allocate adequate resources to infrastructure development. As an example, according to a report on Global Competitiveness (2016), the quality of roads in Vietnam was ranked 93th out of 140 countries, while those in Malaysia and Thailand were ranked 15th and 51the respectively. These are further displayed in Table 4.3.

Table 4.3: Comparison of Vietnamese road quality and neighboring countries

Country	**Rank**
Malaysia	15
China	42
Thailand	51
India	61
Indonesia	80
Vietnam	93
Philippines	97

(Source: Global Competitiveness Report, 2016)

As the road quality continues to deteriorate, the demand for new investments in the road network continues to increase. This has led to an unsustainable increase in road density.

As can be seen in Figure 4.4, the road density doubled from a low of 0.35 km/km2 to a high of 0.7 km/km2 between 2005 and 2013. This increase is nearly twice as high as the rate of increase in the other countries in Southeast Asia (such as in Lao PRD, Myanmar, Thailand, and Cambodia). As an example, in 2013, the road density in Thailand, Myanmar, Cambodia and Lao PRD were at 0.25 km/km2, 0.26 km/km2, 0.3 km/km2 and 0.2 km/km2 respectively.

Furthermore, in 2001, there were only 666 million road users in Vietnam. This number then grew approximately fourfold to reach a high of 2,654 million in 2013. In percentage terms, this implies an annual growth rate of 10.8% (Figure 4.5). These numbers demonstrate the extent of the problem associated with the lack of corresponding increase in road infrastructures to cope with the overwhelming increase in traffic volume.

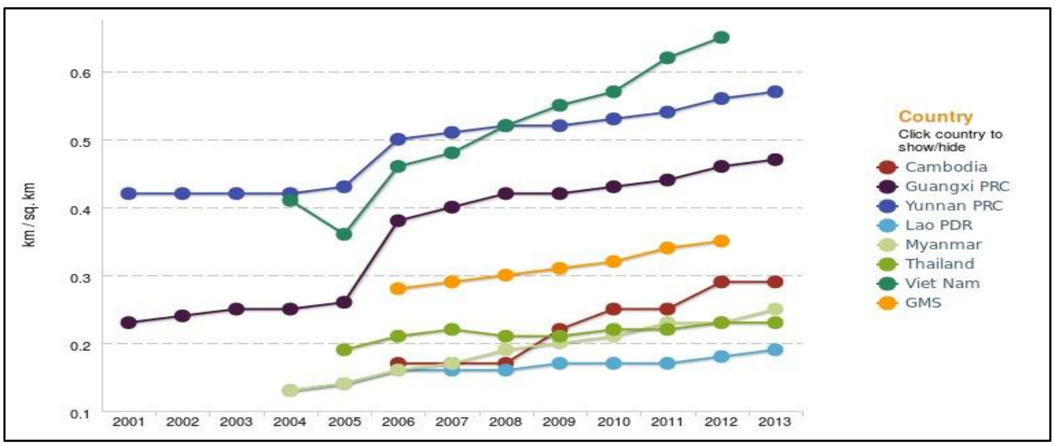


Figure 4.4: Road density in some countries

(Source: ADB, 2015)

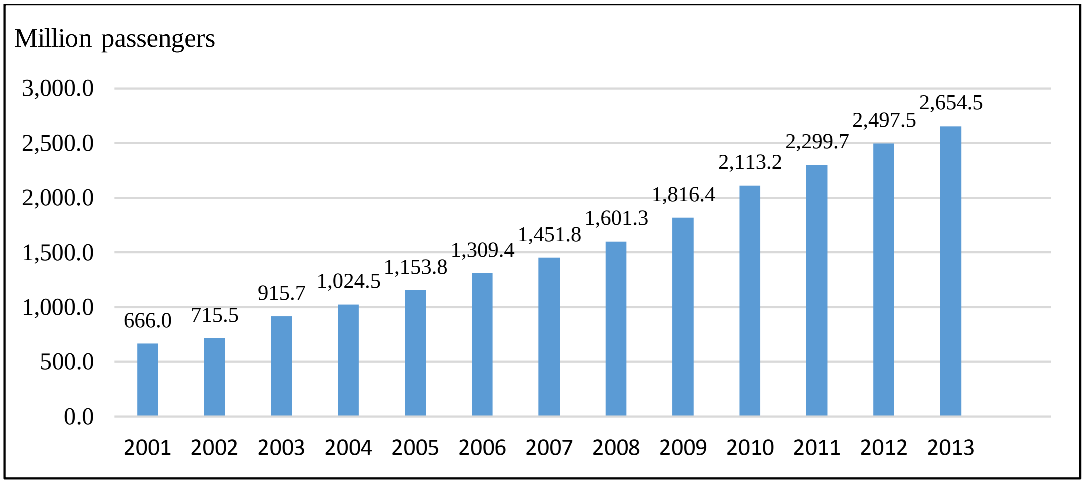


Figure 4.5: Volume of road passenger transport between 2001 and 2013

(Source: General Statistic Office of Vietnam, 2016)

4.3.2. Road infrastructure investments in Vietnam

Investment in the road sector has become a top priority in the scheme of the national development strategy. This is expected to play a pivotal role in the process of the country's industrialization, modernization and global integration. In the past two decades, Vietnam has made some modest progress in maintaining a high level of investment in transport infrastructure. Total transport infrastructure financing amounted to about VND 145,882 billion (USD 7.3 billion) during the 2001-2010 period. This accounts for 4% of total GDP during this period (Do, 2012). This level of investment helped Vietnam to gain a high rank in the list of East Asian countries that have made significant investments in infrastructure development (Tran, 2010).

It is also important to note that, at 87.6%, capital investments in the road sector represent the largest percentage of total capital investments. This is followed by investments in the maritime sector, 7.70%. These facts are further shown in Figure 4.6.

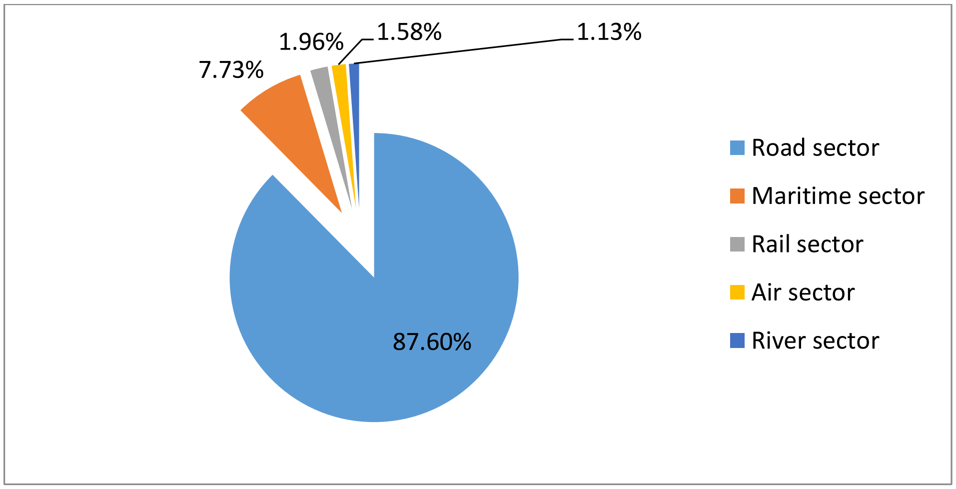


Figure 4.6: Capital investment in transport infrastructure, 2001-2010

(Source: Tuyet, 2015)

Based on the information in Figure 4.6, it is possible to see that, between 2001 and 2010, the cumulative of the investment capital in the road transport sector that comes from private financing accounts for nearly a quarter of the total investments, at 23.18 %. The remaining 76.82% mostly came from the state budget, ODA and the issuance of government bonds. This is further illustrated in Figure 4.7.

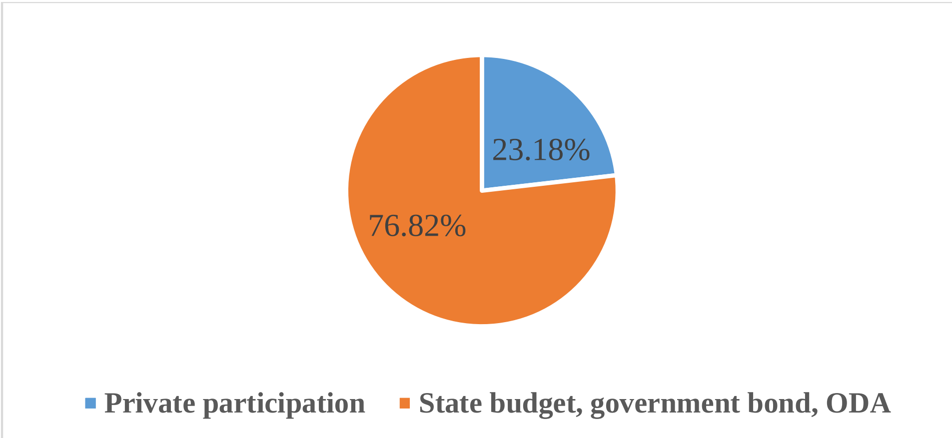


Figure 4.7: Sources of investments in transport projects, 2001-2010
(Source: Tuyet, 2015)

Next, according to the Ministry of Transportation (2016), for over five years 2011-2015, more than VND 484,000 billion (USD 24.2 billion) was allocated to investments in 62 transport projects. For these projects, the capital investment from private contractors was VND 186,600 billion, which also makes up 42% of the amount invested. These are further highlighted in Figure 4.8.

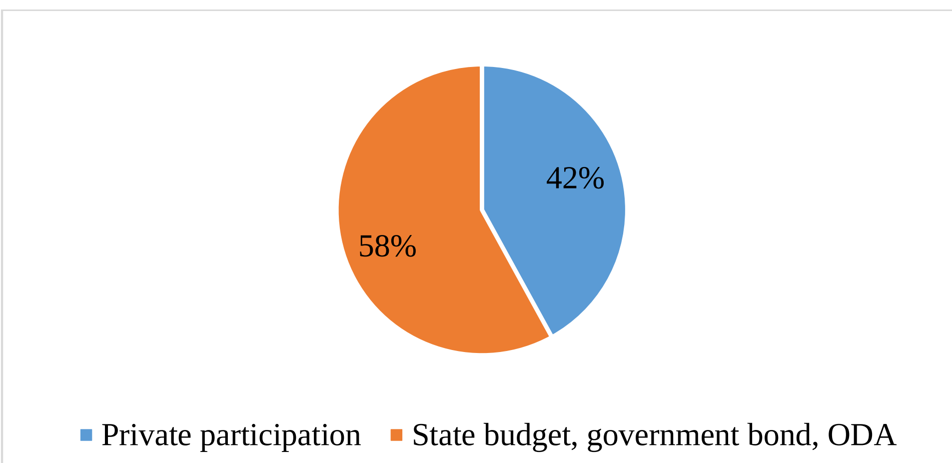


Figure 4.8: Financing model for transport projects, 2011-2015
(Source: Ministry of Transportation, 2016)

Another characteristic development in the financing of transport infrastructure projects with private participation is that, the majority of projects are in the road sector. In particular, out of the 61 BOT/BT transport projects implemented by the Ministry of Transport between 2011-2015, 58 projects belonged to road sector (see Table 4.4).

Table 4.4: Transport projects with private participation, 2011-2015

Field	Number of project	Capital investment
Road sector	58	185,070
River sector	1	1,303
Maritime sector	2	230

(Source: Ngoc, 2016)

Some of the factors behind this skewed level of investment are related to the prevailing policy. As an example, the Vietnamese prime minister issued Decree 356/QD-TTg in January 2013 to approve the "Vietnam road Transport Master Plan for the year 2020 and orientations towards 2030". Based on this proposal, the total investment capital in the road sector before 2020 is expected to reach VND 1,564 trillion, approximately USD70 billion. Investment in expressways is expected to take up the largest share (25.08%). This will be accompanied with the allocation of 16.34% to highway development. These are further explained in Table 4.5.

Table 4.5: Estimated investment capital in road sector from 2012 to 2020

Name	**Capital total (billion VND*)**	**Percentage (%)**
Highway	255,701	16.34%
Highway 1	89,362	5.71%
Ho Chi Minh highway	240,839	15.39%
Expressway	392,379	25.08%

Coastal road	28,132	1.80%
Provincial road	120,000	7.67%
Road transport in Hanoi and Ho Chi Minh city	287,000	18.34%
Urban transport	151,404	9.68%

Note: *VND = 0.00005 USD

(Source: Decision 356/QD-TTg of Prime Minister dated January, 2013)

According to the Vietnamese Ministry of Transportation (2016), between 2016 and 2020, Vietnam would need up to VND 1,039,000 billion (USD 51 billion) to invest in road transport infrastructures. Out of this amount, the state is only capable of providing 11%. The provision of this percentage would become even more challenging if the budget deficit remains exceptionally high. Moreover, the state debt has persistently stood at a high rate. If one considers the fact that ODA funding is unreliable and will not be sufficient, the picture becomes even more discouraging. Besides, Vietnam has officially been given the status of a lower middle-income country, which means that donors may no longer provide Vietnam with concessional loans. With regard to the Vietnamese capital market, it is still in an embryonic stage and will probably take a long period to mature. Therefore, instead of relying solely on limited and unsustainable resources, the government is determined to explore the possibility of private sector funds. Hence, investment from the private sector is expected to contribute to the provision of sufficient finance for the development of Vietnamese infrastructure.

4.4. Implementation of PPP road projects in Vietnam

4.4.1. Legal framework and regulations on PPP

Public policies to attract private participation were first enacted as the early 1990s. These were later revised to adapt to the changing social-economic environment. At first, there was only the BOT form of foreign investments (Decree 87/1993/ND-CP), next, a form of BOT for domestic investments (Decree 77/1997/ND-CP). These were followed by the use of BOT, BTO and BT forms of foreign direct investments (Decree 62/1998/ND-CP).

The nature of the BOT, BTO and BT models allowed investments from both domestic and foreign private investors. These were fully governed by the provisions of Decree 78/2007/ND-CP on "investment in the form of Build-Operate-Transfer (BOT), Build-Operate-Transfer (BOT) or Build-transfer (BT)", and Decree 108/2009/ND-CP on "investment in the forms of BOT, BTO and BT". However, a potential weakness in Decree 78 lies in the absence of alternatives to the Build-Operate-Own (BOO) and the Build-Lease-Transfer (BLT) models in the decree. In addition, the ADB (2012) also criticized this decree for a severe lack of

> "detailed guidelines regarding project preparation, tendering processes, when to grant government guarantees, and a basis for tariff setting and adjustment. Also, Decree No.78 did not provide guidelines for other forms of PPP such as performance-based contracts, leases, and concessions" (ADB, 2012, p.12).

As a result, in 2010, the Prime Minister approved Decision No.71/2010/QD-TTg on "Public-Private Partnership Investment Piloting". The policy, however, still failed to account for the demands of the investing public. As an example, based on Decision No.71, the portion of private participation is limited at 70 percent of total investment. Also, there is no clear distinction between the bidding process for solicited projects and unsolicited projects. For this reason, in 2015, the Vietnamese government officially enacted Decree No.15/2015/ND-CP on "Public-Private Partnership Investment Form". This was issued on 14 February 2015 as a response to the country's infrastructure constraints. It is expected to facilitate the provision of a more transparent business environment for private investment.

These Decree and Decision formed the bases for the current legal framework used for PPPs' development. Some significant changes made in the regulation of PPP are summarized in Table 4.6.

Table 4.6: Changes in legal framework on PPP in Vietnam

Period	Years	Features
1	1993-2009	Decree 87/1993/ND-CP dated 1993, regulation on BOT investment form applied for foreign investors Decree 77/1997/ND-CP dated 1997, regulation BOT investment form applied for domestic investors Decree 62/1998/NĐ-CP dated 1998, regulation on BTO and BT investment forms applied for foreign investors
2	2009-2015	Decree 108/ND-CP dated 27 November 2009, regulated the BOT, BTO and BT forms Decision No.71/2010/QD-TTg.9 dated 2010, regulation on the pilot PPP investment scheme
3	2015-now	Decree 15/2015/ND-CP was modeled on the Decree 108 and Decision 71, which added the forms of PPP investment, including the build-transfer-lease (BTL), the build-lease-transfer (BLT) and the operation and management contract

		(OMC). Decree 30/2015/ND-CP prescribes process of tendering and selection of bidders.

(Source: ADB, 2012)

These policies show how the Vietnamese government has attempted to develop an institutional framework for PPP (adapted to the Vietnamese context) to par with international standards. Despite these efforts, some issues that still need to be addressed remains. As an example, the World Bank (2013a) notes that Vietnam has not been able to sufficiently stimulate private investment in development of infrastructure. Some of the concerns raised in this regard center on the lack of progress in the recognition and use of more private sector finance and management in new infrastructure projects.

4.4.2. The PPP process

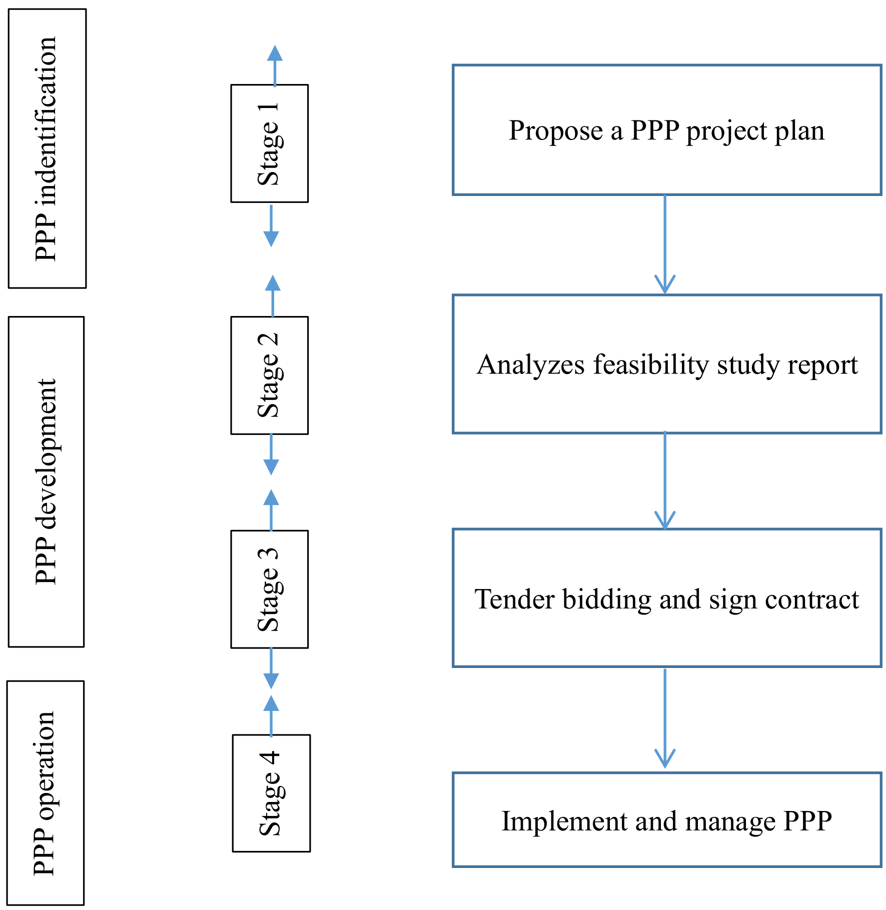


Figure 4.9: Procedure of PPP road project implementation
(Adapted from Decision No.71/2010/QD-TTg.9 dated 2010)

Figure 4.9 describes how PPP is implemented in Vietnam. The process involves four stages that start from the identification of the PPP, to the actual development and the operational stages.

Stage 1: The first stage concerns PPP identification. Based on the socio-economic development plan, the Ministry of Transportation first proposes a project be implemented through a PPP after a preliminary evaluation of the project. They then submit a recommendation to the Ministry of Planning and Investment (MPI), during which time the MPI makes some comments and forwards the proposal to the prime minister.

Stage 2: The feasibility study takes place at the second stage. The feasibility study on the proposal made under stage 1 is conducted. The MPI determines the percentage of government participation, the types of guarantees the government will provide, and so on. At the completion of the feasibility study, the proposed project is passed on to the prime minister for approval. Thereafter, an announcement on the approval of the project's feasibility study is made.

Stage 3: The third stage focuses on the bidding process and the selection of the investors. Based on the approval of the proposed project and the feasibility study, a competitive bidding process is initiated. Through the comparison of bids, the Ministry of Transportation then selects the winning bid. After the selection of the preferred bidder, the Ministry of Transportation negotiates with the winning bidder to discuss the financial plan and the payback time. If the negotiation is successful, a contract will be signed between the Ministry of Transportation and the designated investors.

Stage 4: The fourth stage focuses on the implementation and operation stages of the PPP. At this stage, the selected investors will begin the detailed design, which would be followed by actual construction and then the operation of the PPP project. The role of the Ministry of Transportation here is to supervise the implementation of PPP, throughout the project's whole life.

There are certain drawbacks associated with these four stages. As an example, according to the World Bank (2013a), this process suffers from the following:

> “lack of adequate project preparation in the feasibility stage before bidding out. This low quality of project preparation and feasibility study also brings difficulties in determining for the government if a project should be implemented as a PPP or a pure public project” (World Bank, 2013a, p.108).

In response to this problem, the government has made certain revisions in the regulations guiding PPP implementation. Some of the changes can be found in Decree No15/2015/ND-CP on “Investment in the form of PPP”. However, this legal document has yet to include a requirement for conducting a VFM test for a PPP project.

4.4.3. Forms of PPP road projects

Before 1993, no project was implemented under the PPP scheme in Vietnam. However, over the past 23 years, from 1994 to 2016, an increasing number of road projects have been implemented under a PPP. Private financing in road transport infrastructure in Vietnam is usually implemented under the BOT, BT and lease contract PPP models. Among these, the BOT model is the most popular. Under this model, the selected bidder constructs the facilities, undertakes to operate and maintain the project, and then transfers its ownership to the government at the completion of the operation phase.

There are two classifications of the BOT model in Vietnam. The first one is the BOT without financial supports from the government. Under this model, the private investors raise the investment funds for projects from equity and borrowings from financial organizations. Under the second option, the government provides financial supports for the BOT. In this case, the government could directly offer financial support via contributions to the investment fund, or the provision of concession loans to the private investors. The use of these two models is summarized in the table that follows.

Table 4.7: Forms of PPP projects constructed before 2010

Bridges and underground roads	Types
Yen Lenh bridge in National Road No.38	BOT
Ong Thin bridge in National Road No.50	BOT
Binh Trieu II road and bridge project	BOT
Co May bridge in National Road No.51	BOT
Nguyen Tri Phuong road and bridge project, HCMC	BT
Operational expressway projects	
Toll collection right in Phap Van-Gie Bridge expressway	Lease
Operational national road	
National Road No.1A, An Suong-Au Lac	BOT
National Road No.13, HCMC-Thu Dau Mot	BOT
National Road No. 1K, HCM- Bien Hoa, including Hoa An bridge	BOT
Operational by road projects	
By road of Vinh city, National Road No. 1, Nghe An province	BOT
Operational provincial road projects	
Provincial expressway Nguyen Van Linh, HCMC	BT
BOT project of 15 roads	BOT
Extended Hung Vuong road and Dien Bien Phu road	Lease
On-going bridge projects	
Rach Mieu bridge	BOT
Phu My bridge, HCMC	BOT
Phu My by-road	BT
On-going expressway projects	
Gie Bridge-Ninh Binh expressway	BOT
Lang-Hoa Lac expressway	BOT
Hanoi-Hai phong expressway	BOT
HCMC-Trung Luong expressway	BOT
My Phuoc-Tan Van expressway, Binh Duong province	BOT
Lien Khuong-Da lat-Lam Dong expressway	BOT
Ho Chi Minh – Long Thanh - Dau Giay expressway	BOT
Noi Bai – Lao Cai expressway	BOT
On-going National Road projects	BOT
National Road No. 13, Thu Dau Mot – Tham Rot bridge, Binh Duong bridge	BOT
National Road No. 13, Tham Rot-Au Lac bridge, Binh Phuoc province	BOT
National Road No. Hoa Cam, Hoa Phuoc, Da Nang	BOT
National Road No. 2 (extended), Noi Bai – Vinh Yen, Vinh	BOT

Phuc province	
TCR in national road No. 5, Ha Noi, Hai Phong	Lease
TCR in National Road No. 51, Bien Hoa – Vung Tau	Lease

(Source: Chung et al., 2010)

Between 2011 and 2016, the Vietnamese government undertook 62 PPP road projects that are worth approximately VND 186,660 billion (USD 9.2 billion). The amount invested in 26 out of the 62 projects totaled VND 74,806 billion (USD 3.7 billion); these are also currently under operation. The construction of 18 out of the 26 projects was completed before 2011. In addition, 36 projects that involve capital investments of VND 111,854 billion (USD 5.5 billion) are now under construction[8].

[8] http://www.mt.gov.vn/khcn/tin-tuc/43060/hoi-nghi-danh-gia-cong-tac-dau-tu-kchtgt-theo-hinh-thuc-hop-dong-bot-va-bt-.aspx

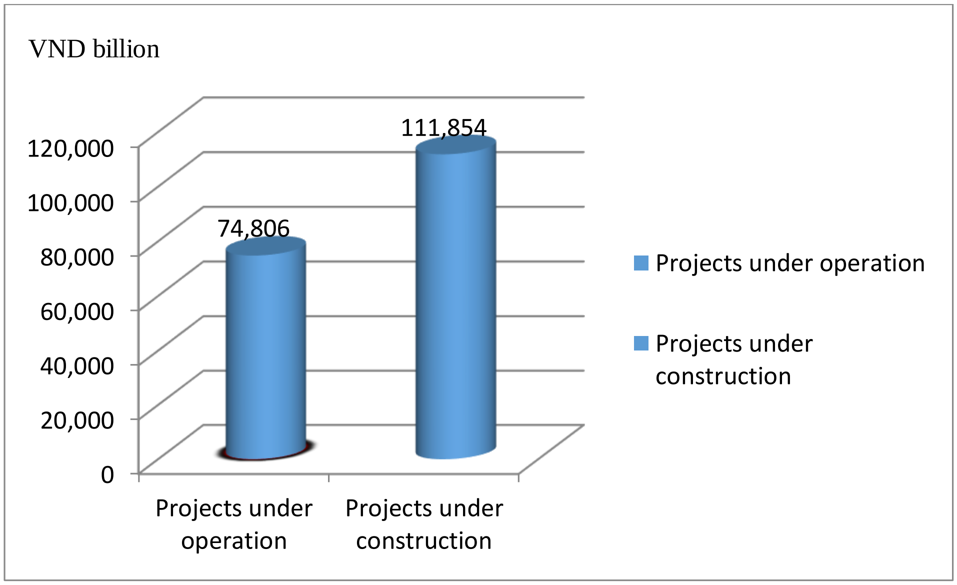


Figure 4.10: BOT, BT projects under construction and operation (2011-2016)

In the coming year, from 2016 to 2020, in order to procure additional road transport projects from, the capital investment needs are estimated to be around VND 1,039,000 billion (USD 51.95 billion). Having recognized the limitations of the traditional sources of finance (such as the state budget, ODA and national bonds), the government currently sees PPP as one of the most viable methods for financing infrastructure development (World Bank, 2013). More importantly, the Vietnamese prime minister issued Decision No.631/QD-TTg (in April 29th, 2014) to publish a list of 127 national projects that would be used to stimulate foreign private financing. Notably, 15 of the projects are in the road sector (see Table 4.8).

Table 4.8: List of national projects in road sector that need foreign investment

No.	Project	Locality	Total Capital (million USD)	Investment model
1	North-South expressway project, Ninh Binh – Thanh Hoa segment and Thanh Hoa – Nghi Son segment.	Ninh Binh, Thanh Hoa	1,867	PPP
2	Dau Giay – Phan Thiet expressway	Dong Nai, Binh Duong	757	PPP
3	Bien Hoa – Vung Tau expressway.	Dong Nai, Bà Rịa – Vung Tau	1,175	PPP, ODA
4	Trung Luong – My Thuan expressway.	Tien Giang, Vinh Long	1,381	PPP, ODA
5	Construction investment project of ring road No. 3 of Ho Chi Minh City, Tan Van – Nhon Trach segment.	HCMC, Dong Nai, Binh Duong	400	BOT, ODA
6	Noi Bai – Ha Longexpressway.		1,762	PPP, BOT
7	Cam Lo – La Son expressway.	Quang Tri – Thua Thien-Hue	1,095	PPP, BOT
8	National highway No. 19 project, from Ba Gi bridge – Pleiku section.	Binh Dinh – Gia Lai	100	BOT
9	Ring expressway No. 3 of Ha Noi city, Mai Dich – Southern Thang Long segment	Ha noi	250	PPP, BOT
10	Upgrading the National highway 91, Can Tho – Lo Te segment (sub-project 2 – KM14 – KM50 segment)	Can Tho –An Giang	120	PPP, BOT
11	Inter-port road in Nhon	Dong Nai	255	PPP

	Trach district.			
12	Dau Giay – Lien Khuong expressway.	Lam Dong	3,520	
13	Construction of a passenger terminal at the current Cho Lon bus station.	Ho Chi Minh City	50	PPP
14	Road connecting the center of Quang Ngai city to Dung Quat port No.2.	Quang Ngai	71	PPP
15	Infrastructure development for the non-tariff zone, phrase I, of the Dong Dang border gate economic zone, Lang Son.	Lang Son	28	PPP

(Source: Online Newspaper of the Vietnamese government, 2014)

4.5. Conclusions

In conclusion, it is important to note that the first road transport PPP project in Vietnam was implemented about 23 years ago. During that time, series of socio-economic policy changes were also made. Since then, the country has obtained some substantial benefits that are attributed to the policy changes. Some of the benefits have included a reduction in state budget burden, and a high rate of economic growth, especially in the urban areas where most of the PPP projects are implemented**.** Currently, some PPP projects are up and running, and have helped improve the state and quality of the public transport system. Another benefit could be attributed to the distribution of risks in a manner that puts the more efficient private party in a position to control most of the project risks. At the same time, it is possible to identify certain problems that need to be addressed. These include the problems of delayed completion, inexplicit tender procedures, construction cost overruns, inaccuracies in traffic-demand estimates, inefficient competition between SOEs and private enterprises, and high toll prices. Above all, one of the most important problems centers on the fact that most of the PPP projects were transferred back to the State before the end of the concession period. Some examples in this regard include the Phu My Bridge, the Sai Gon 2 Bridge, provincial road No. 15, the Trung Luong-My Thuan Expressway and the Ong Thin Bridge. It is possible to attribute one of the potential reasons for the termination of the PPPs to the absence of a VFM test before the construction and implementation period. It is argued that, the government could have been in a better position to avoid such early terminations if a VFM assessment is conducted prior to the PPP contract.

Chapter 5: Case study of the Phu My project

5.1. Introduction

The construction of the Phu My Bridge is one of the BOT/PPP projects that were strongly criticized in Vietnam because of so many inefficiencies. The project was initially planned to be constructed in 2005 under a concession contract that would last for 29 years. However, in 2014, exactly four years into the project's operation, it was reverted back to the public sector. In this regard, a main focus in this study is whether the project has been pursued to PPP scheme as original planned, or should be back to the public sector as has been done by the Vietnamese government.

5.2. A description of the project

The Phu My Bridge is located in Ho Chi Minh City. It spans across the Sai Gon River. Its length and width are 2.4 km and 27.5 m, respectively. It has 4 lanes that serve at a link between District 2 and District 7. The goal of the project was to eliminate traffic congestion and shorten the travel time on the roads of corridor 2, and to help eliminate traffic congestion in the urban areas of Ho Chi Minh City. In addition, the bridge is expected to contribute to economic development in districts 2, 9, 7 and the other neighboring districts. The construction of the bridge was completed in 2009. Subsequently, the private partners assumed the responsibility of operating the bridge. Under the initial agreement, the private partners will operate the bridge and transfer it back to the government in 2034.

The Vietnam Road Administration works monitored the quality of the construction and the overall implementation of the project on behalf of the Ministry of Transportation. On behalf of the Vietnamese Government, the People's Committee of Ho Chi Minh City (the local government) signed the contract with the private sector partners known as the Phu My Bridge Corporation (PMC). Essentially, the PMC is the special purpose vehicle (SPV) that received the rights to build, finance, operate and maintain the Phu My Bridge. The Phu My Bridge Corporation consists of the Ho Chi Minh infrastructure Investment Joint Stock Company (CII), the 620 Chau Thoi Concrete Company (Beton 6), Thanh Danh Construction Trading Company Limited, the Ha Noi Construction Corporation Join Stock Company, and the Investment and Construction Development Corporation (Investco). Apart from the mobilization of private investors, loans were provided by a group of banks, namely: the Joint Stock Commercial Bank for Investment and Development of Vietnam (BIDV), the Sai Gon Commercial Joint-Stock Bank (Sacombank) and the Societe Generale Bank. Additionally, the Ministry of Finance served as a guarantor for the long-term loans obtained from the financial organizations. The structure of the project is summarized by the following figure:

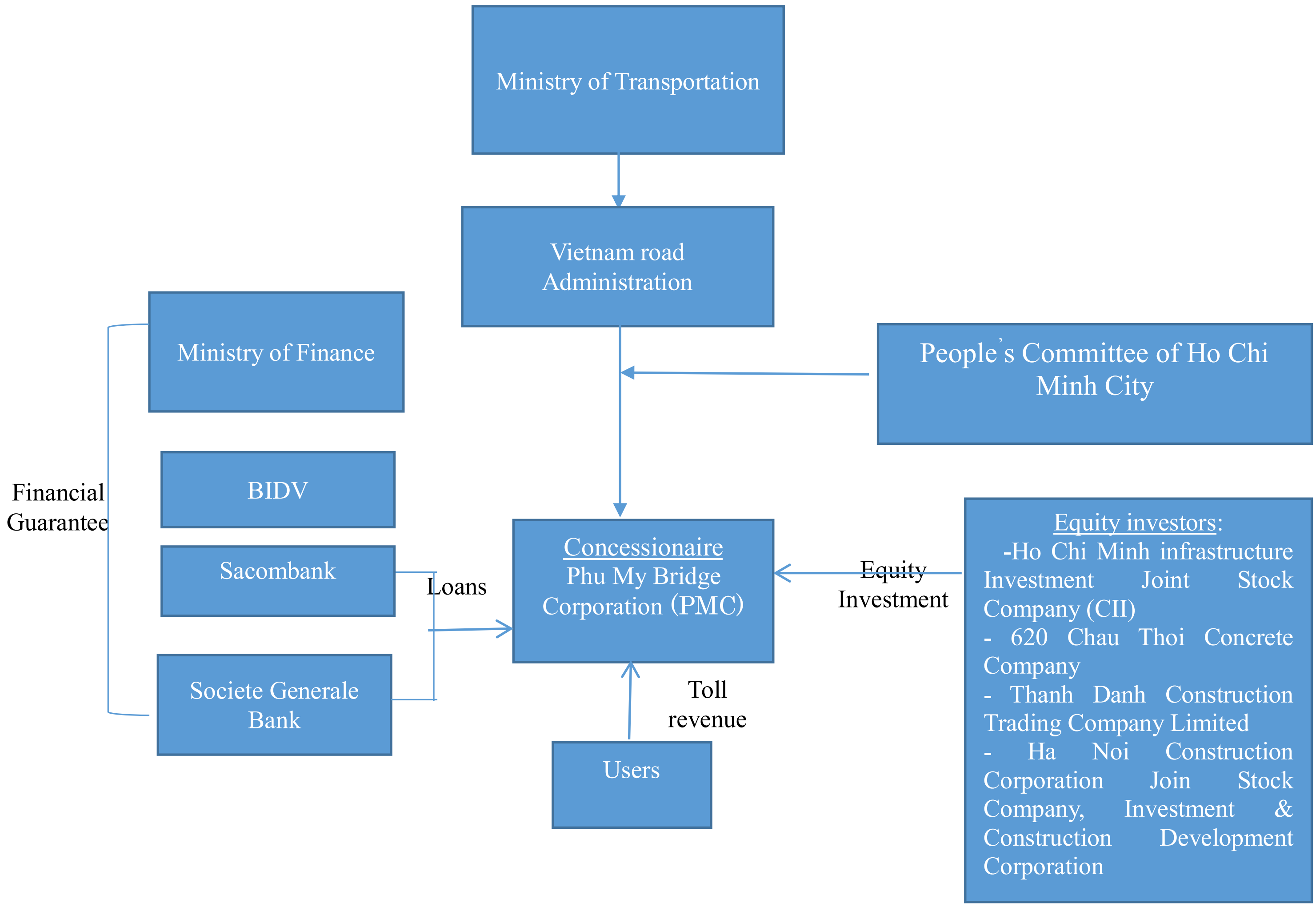


Figure 5.1: Stakeholders involved in the Phu My Bridge BOT project.
(Adapted from Thanh, 2010)

The key features of the Phu My case are summarized as follows:

Location: Ho Chi Minh City

Length of bridge: 2.4 Km (4 lanes)

Private owner's equity contributed investment is 30% of total capital.

Construction cost: VND 1,806,523 million (USD 90 million)

Construction duration: 4 years (2005 to 2009)

Operation period: 26 years (2009 to 2034)

Figure 5.2: Picture of the Phu My Bridge
(Source: VN Express, 2014)

5.3. Value for Money assessment

5.3.1. Basic assumptions for the VFM assessment

In order to carry out a quantitative VFM analysis for this project, it is essential to identify the following two components: the Public Sector Comparator (PSC) and the Shadow Bidding Price (SBP). Accordingly, the PSC is used to represent the whole cost of the project from the perspective of the government, while the SBP is considered to be the whole cost of the project if implemented as PPP scheme.

Raw cost in the PSC

The capital costs under the PSC, including the design & construction costs, the costs of equipment and land acquisition are identical to the SBP, due to the fact that there is no available data on cost estimates under the public sector procurement. Next, the maintenance costs of the project comprises of two components: the periodic maintenance cost and the costs of refurbishments. The yearly cost of maintaining the road during the operation phase is determined by the regular maintenance costs. Likewise, the refurbishment cost refers to the costs allocated to the periodic road repairs that are implemented every 8 years. According to the Ministry of Transportation[9] (2004), the annual maintenance cost ranges from USD 1,250 to USD 1,500 per km, while the refurbishment cost is estimated to be USD 250,000 per km for every 8 years.

Additionally, the cost is also associated with the management of toll collection, which includes employee salaries, ticket production, and the charges for electricity and equipment. The estimation of the project management cost is based on the Circular 90/2004/TT-BTC issued by the Ministry of Finance in 2004 on the "regime of road toll collection, payment, management and use".

Government financing under the PSC

It is hypothesized that the government could have issued national bonds to raise money for financing the Phu My project. Hence, it is possible to compute the financing cost under

[9] Thanh, 2010

the PSC on the basis of the interest rate that applies to long-term national bonds. According to the Vietnamese Ministry of Finance (2005), the interest rate of a ten-year government bond is 8.6% per year. This same rate is utilized to compute the financing cost of the PSC in relation to the Phu My project. The 8.6% interest rate is assumed to have remained the same during the period of the concession.

Revenue under the PSC

The estimated revenue under the PSC would be based on the user fees, which depends on the traffic volume and the price set for the toll fees. Due to lack of information on revenue leakage, the traffic volume of the PSC is assumed to be identical with that of the PPP. Accordingly, it is assumed that the determination of the toll fee would depend on Circular No 90/2004/TT-BTC issued by the Vietnamese Ministry of Finance. Based on this circular, the toll fee is assumed to be VND 10,000 per Passenger Car Unit (PCU).

Setting the discount rates

Discount rates play an important role in quantitative VFM assessment. In order to calculate the net present cost of the project under traditional procurement, the interest rate of a long-term government bond will be used to discount the cash flow of the whole cost of the project. Regarding discounting the cash flow of SBP, the Weighted Average Cost of Capital (WACC) will be used. Once again, the impact of inflation on each component in the PSC and SBP are also considered in order to identify changes from the real price of the cash flows to the nominal price when computing the present value of the PSC and SBP. In this research, the actual rate of domestic inflation from 2005 to 2015 is estimated on the basis on IMF reports (IMF, 2014, 2016). Also, the predicted rate of inflation in the future is 6%, based on the forecast of the Vietnamese State Bank (2016) for the period that lasts from 2016 to 2034.

5.3.2. Quantification of risks

Construction cost overrun risk

As mentioned earlier, this research has assumed that the construction cost overrun risk and shortfalls in traffic volume is prevalent in road projects in Vietnam. The estimation of construction cost inaccuracy is based on the available data on the actual and the forecasted costs of 15 road projects that were completed between 2003 and 2015 in Vietnam. However, since the sample size is not large enough to determine the probability distribution for this risk, the Bootstrapping method is used to resample the data. A Chi-Square Goodness of Fit test at 0.05 significance level is then used to show that the risk of construction cost overrun follows a log-logistic distribution. The mean value of the risk of construction cost overrun is also estimated to be 0.14, with a standard deviation of 0.54. Figure 5.3 describes the distribution of the risk of the construction cost's miscalculation.

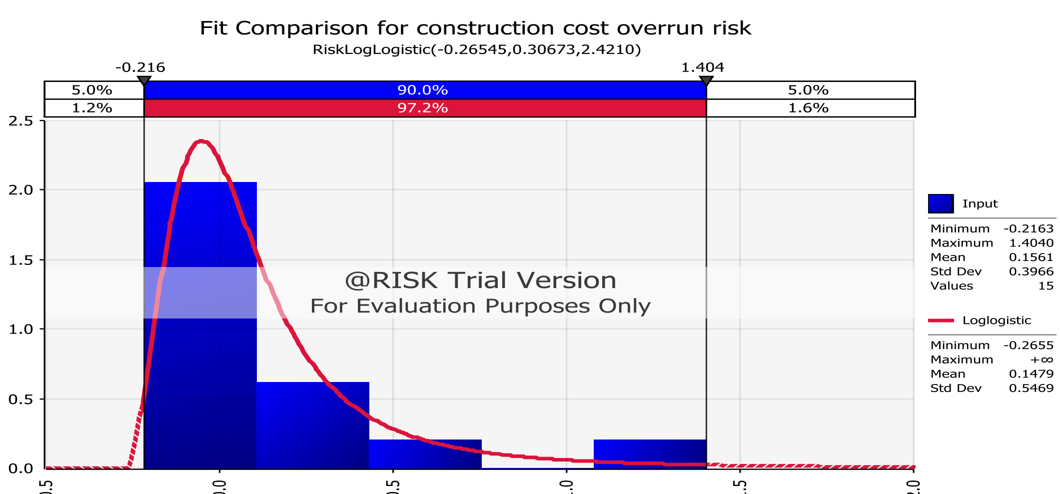


Figure 5.3: Probability density distribution for the construction cost overrun ratio

Traffic demand risk

The calculation of the uncertainty in traffic demand was based on the real and the forecasted data of 7 BOT road projects that were in operation between 2010 and 2015 in Vietnam. In order to identify the probability density function (PDF) of this risk, large amount of raw data is needed. In response to this issue, the available data was resampled, using the Bootstrapping method. Accordingly, the Chi Squared Goodness of Fit Test (at 0.05 significance level) shows that the uncertainty associated with the estimation of the traffic volume of road projects in Vietnam follows an exponential distribution, whose mean value is estimated at -0.36 with a standard deviation of 0.45. Figure 5.4 shows the histogram of a 1000 bootstrap replication of traffic demand inaccuracy.

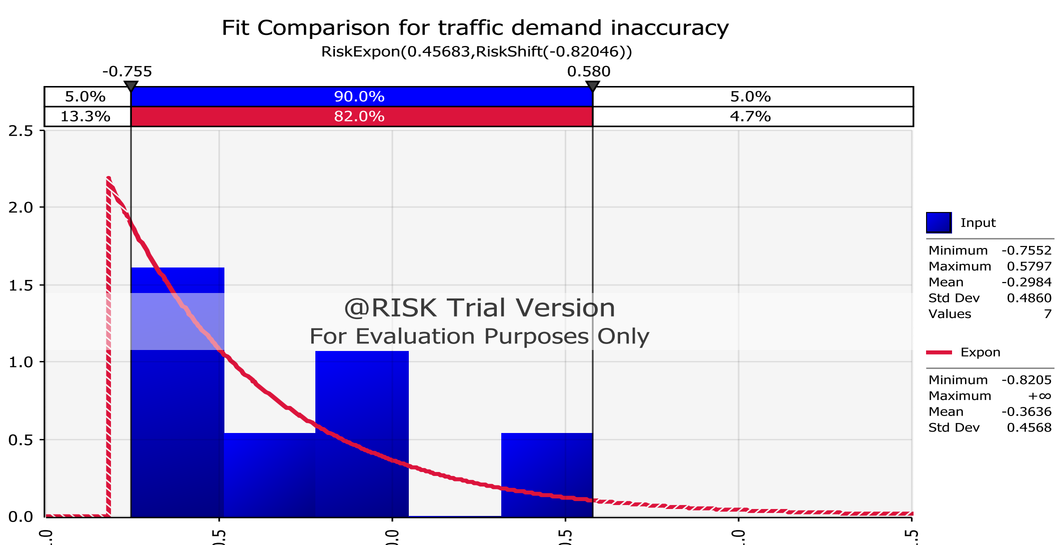


Figure 5.4: Probability density distribution for the traffic volume uncertainty

5.3.3. Determination of the PSC and the SBP

5.3.3.1. The determination of the SBP

The determination of the cash flow of the SBP is based on the value of its items retrieved from feasibility studies on the Phu My project. The highlights of the studies can be summarized as follows:

- The total investment capital for building the project is estimated to be VND 1,806,523million. The amount contributed by the concessionaire is VND 541.66billion, this accounts for 29.98% of the total capital. A total of VND 1, 264.86 billion came from borrowings, about 70.02% of the total investment capital.
- The cost of debt (before corporate income tax) is 10%. Under the agreement, the debt repayment period begins in 2009 (at the fourth year) runs through a 25 year repayment time. Also, the cost of equity is 7.25%. Hence, the value of the WACC is set at 7.21%, which is also considered to be the real discount rate.
- Return on investment is 13.47%.
- The concession term is 29 years.
- Vehicles are divided into five categories: group 1 (vehicles with less than 12 passenger seats), group 2 (buses with 12 to 30 seats), group 3 (medium trucks and vehicles with more than 30 passengers), group 4 (heavy trucks) and group 5 (special trucks). The annual traffic demand is forecasted to be 920,000 vehicles (for group 1), 440,000 vehicles (for group 2), 1,610,000 vehicles (for group 3), 830,000 vehicles (for group 4); and 210,000 vehicles (for group 5) in 2009. This number of vehicles is estimated to increase annually at a rate of 13 % from 2010

to 2021, and a rate of 0 % from 2022 onward, till the completion of the concession.

- The toll fee for the period between 2009 and 2011 was set at VND 10,000 for vehicles under group 1 and 2, VND 15,000 for vehicles under group 3, VND 20,000 for vehicles under group 4, and VND 30,000 for vehicles under group 5. For the period 2012-2016, the toll increased to VND 14,000 for group 1, VND 18,000 for group 2, VND 30,000 for group 3, VND 52,000 for group 4, and VND 75,000 for group 5. For the period 2017-2034, the toll is forecasted to become VND 15,000 for group 1, VND 26,000 for group 2, VND 35,000 for group 3, VND 65,000 for group 4, and VND 100,000 for group 5.

Table 5.1: Calculation of the SBP, at 13.64 % nominal discount rate[10]

U*nit: million VND*

This section has been deleted as it contains private information

Year	Capital expenditure	Operation expense	Financing cost	Return on investment	Revenue	SBP		
						Real price	Nominal price	NPV
2005								
2006								
2007								
2008								
2009								
2010								
2011								
2012								
2013								
2014								
2015								
2016								
2017								
2018								
2019								
2020								
2021								
2022								
2023								
2024								
2025								
2026								
2027								
2028								
2029								
2030								
2031								
2032								
2033								

[10] 13.64% as nominal discount rate = (real discount rate +1)(1+inflation)-1 = (7.21%+1)(1+6%)-1

2034								
Total								

(Source: Feasibility studies report of Phu My project[11] 2005)

5.3.3.2. The determination of the PSC

Based on the formula for the calculation of the PSC (as given in chapter 3), the computation of the PSC would depend on the raw PSC, financing cost, and transferred risk. The PSC components are displayed in the following table:

Table 5.2: Net present value of the PSC, at 15.1% nominal discount rate[12]

Unit: million VND

This section has been deleted as it contain private information

Year	**Raw PSC**			**Financing cost**	**Transferred risk**		**PSC**		
	Capital cost	**Operation cost**	**Revenue**		**Overrun cost**	**Traffic volume**	**Real price**	**Nominal price**	**NPV**
2005									
2006									
2007									
2008									
2009									
2010									
2011									
2012									
2013									
2014									
2015									
2016									
2017									
2018									
2019									
2020									

[11] For the year 2005-2014, capital expenditure, operation cost, financing cost and revenue derived from the actual data is based on the financial statement of the project 2016. For the year 2016-2034, these items are based on the forecasted data, which is extracted from the feasibility study report 2005.

[12] 15.1% = (1+8.06%)*(1+6%)-1

2021									
2022									
2023									
2024									
2025									
2026									
2027									
2028									
2029									
2030									
2031									
2032									
2033									
2034									
Total									

5.3.4. Value for Money analysis

5.3.4.1. Computation of the quantitative VFM

Table 5.3: Comparison of the costs of the project under PPP and traditional model

Unit: million VND*

Items	PSC	SBP
Present value of outflow (A)	3,188,724	6,327,867
Present value of inflow (B)	1,542,794	3,509,298
Net present value of cash flow (A) – (B)	1,645,930	2,818,569
VFM (PSC-SBP)	**-1,172,639**	

*VND=0.00005 USD

Table 5.3 shows a comparison of total life cycle cost of the project under PPP scheme and government direct investment. In particular, the whole cost of the project under conventional procurement would have been VND 1,645,930 million (USD 82 million). On the other hand, amount spent on this project under the PPP scheme was VND 2,818,569 million (USD 140 million). Clearly, the cost of doing the project via public finance is cheaper. This suggests that if the government had two options, to continue with the PPP model or to return to the public sector to procure the project, the government would be better off without PPP.

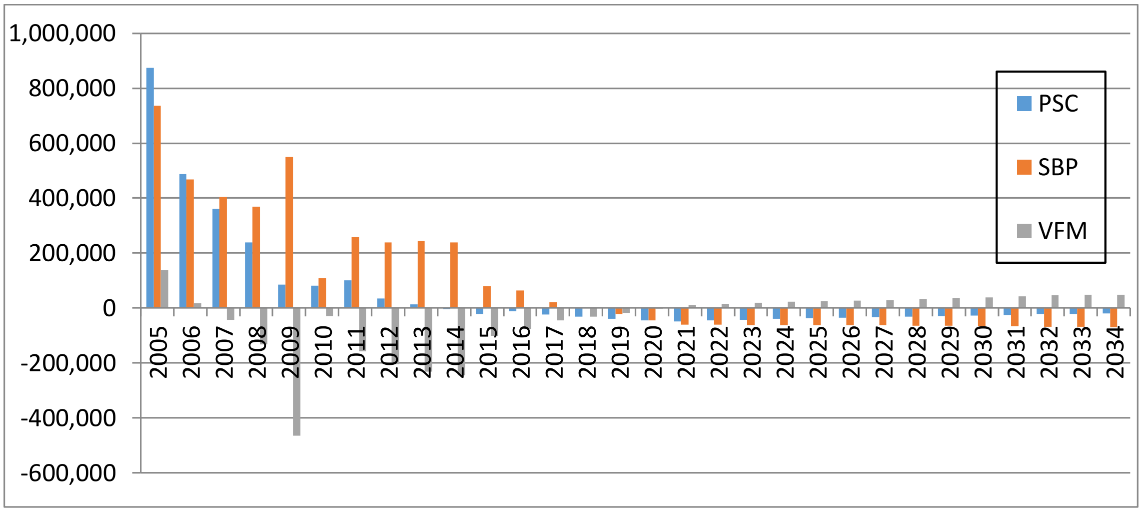


Figure 5.5: Comparison of the cash flow of the project under PPP and traditional delivery

Figure 5.5 shows the cash flow of this project under PPP model and the traditional approach in the period between 2015 and 2034. It is possible to see that the cost of constructing this project under the conventional delivery is expected to be cheaper than that of the PPP model, starting from the year 2007 to the year 2017 during the project's life cycle. In contrast, during the period that runs from 2018 to 2034, the implementation cost of this project under PPP scheme becomes cheaper than conventional delivery.

5.3.4.2. Sensitivity analysis

In relation to consideration of the effects of input factors on the VFM evaluation, a sensitivity analysis was carried out. In particular, throughout this research, a simple sensitivity is used to explore the changes in the VFM that result from movements in the values of the input variables. Some the varied variables include the PSC capital cost, the PSC operation cost, and the PSC revenue.

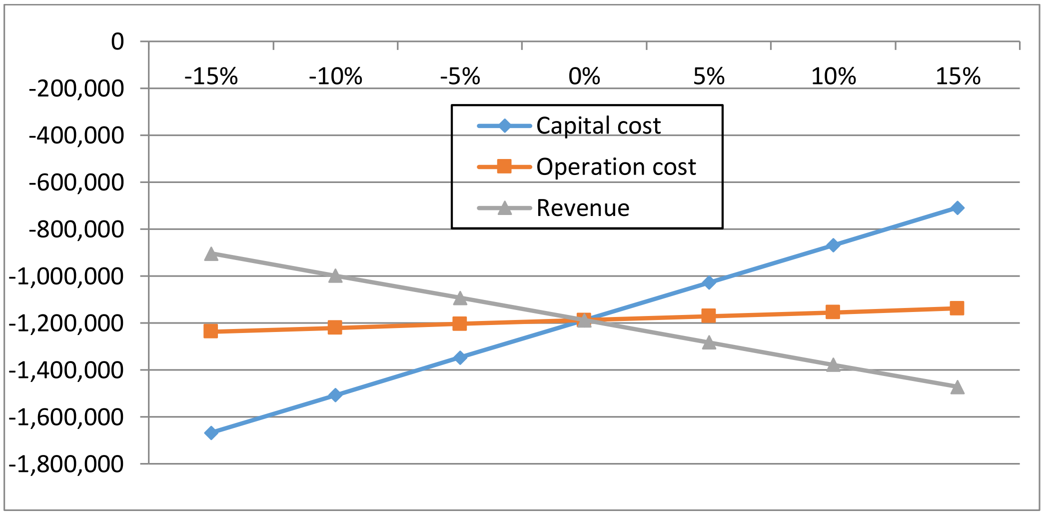


Figure 5.6: Sensitivity of the VFM to input variables

Table 5.4: Changes in the VFM due to movement of input variables

Input variables	**The change of VFM due to the one percent in increase of input variables**		
	Change	**Unit change (million VND)**	**Reasons**
PSC capital cost	Increase	28,744	The increase of PSC capital cost leads to rise of PSC, so VFM increase
PSC operation cost	Increase	5,041	The increase of PSC operation cost make the value of PSC rise, so VFM increases
PSC revenue	Decrease	18,948	The increase of PSC revenue make the value of PSC fall down, so VFM decreases

Figure 5.6 shows how movements in the cost components influence the project's VFM. As presented in Figure 5.6, the VFM is more sensitive to movements in the PSC's capital cost than to movements in the PSC's operation cost and revenue. As an example, when

there is a 1% change in the capital cost of the PSC, the quantitative VFM changes by VND 28,744 million (see Table 5.4). On the other hand, every 1% change in the PSC operation cost leads to a change of VND 5,041 million in the VFM (see Table 5.4). This means that the VFM of the project is not very sensitive to fluctuations in the PSC's operation costs. In addition to this, it can be seen that, even if the construction cost of the project (if implemented by public sector) increases by 15%, the quantitative VFM will still be negative. Thus, the PPP model cannot be more preferable to the conventional delivery, even if there is 15% change in the cost of capital. Additionally, the VFM is positively sensitive to changes in the PSC's capital cost and operation cost, and a negatively sensitive to changes in the PSC's revenue estimates.

5.3.4.3. The Monte Carlo Simulations

The computation of the VFM outcome of Phu My project may not be absolutely accurate because of the effect of some uncertain input variables such as the construction cost overrun risk, traffic demand risk, and the risks associated with the values of the interest rate of government bonds, and the rate of inflation. Inaccuracies in the computation of these uncertain parameters can lead to wrong decisions (Cruz & Marques, 2013). Hence, instead of focusing on a single value, the VFM outcome should be a probability distribution to combine the uncertainty of the quantification.

Determining the distribution of key input variables

Table 5.5: Probability distribution of input Variables

Variables	Unit	Distribution	Value			
			Minimum	Maximum	Mean	Standard deviation
Risk of construction cost overrun	%	Log-logistic			14.7	54.6
Traffic demand risk	%	Exponential			-36.3	45.6
Interest rate of government bond	%	Pareto			8.08	2.7
Inflation from 2016-2034	%	Time series				

Throughout the research, the values of uncertain input variables (including the risks of construction cost overrun, traffic demand risks, and the interest rate of government bonds and inflation) are expressed in the form of an assumed probability distribution. Accordingly, based on the historical data on the interest rates of a ten-year government bond (from 2005 to 2015) in Vietnam, the statistical fitness test that is based on Chi-Squared at a 0.05 significance level suggests that the interest rate follows a Pareto distribution, with a mean of 0.08 and a standard deviation of 0.02. As mentioned earlier, the risk of construction cost overrun follows a log-logistic distribution, while the risk of traffic demand inaccuracy follows an exponential distribution. Using historical observations from 1994 to 2015, the forecasted inflation is estimated from a time series is shown in Figure 5.7:

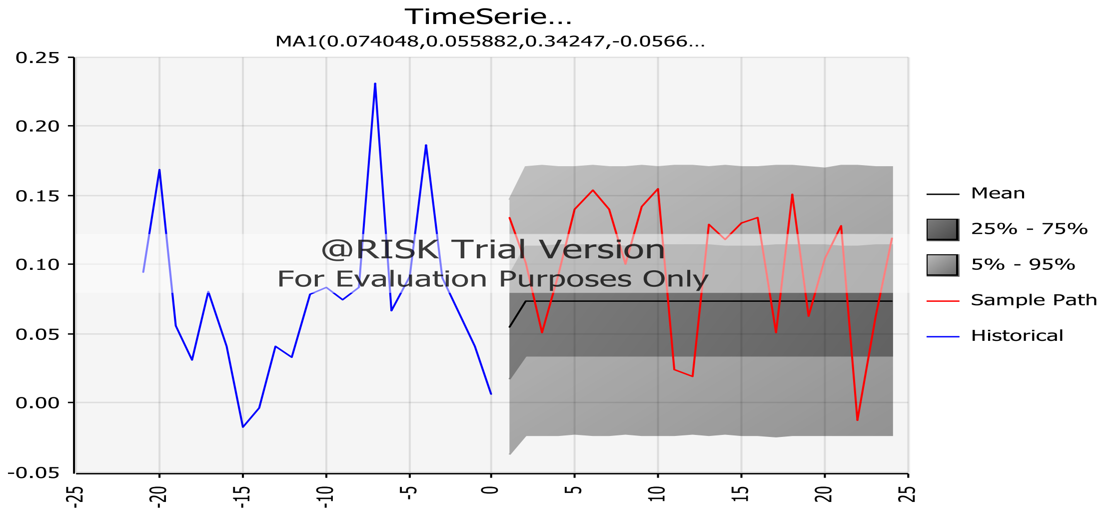


Figure 5.7: Time series of inflation rate between 1994 and 2034

Figure 5.7 shows the time series of the inflation rate between 1994 and 2034. The Y-axis represents the inflation rate, while the X-axis represents the past and future estimates when compared to the base year (the year 2016). As shown in Figure 5.8, the green path illustrates the inflation rate in Vietnam during the historical period (from 1994 to 2015), while the red line represents the forecasted inflation rate in the future (from 2016 to 2034).

The outcome simulation

A Monte Carlo Simulation with 10,000 iterations was performed to generate the distributions of the VFM for the project. The Palisade᾽s @Risk software (version 7.5) was then used to perform the simulations. Figure 5.8 shows the distribution of the project's VFM. The result of the simulation reveals that the probable VFM is likely to be –VND 1,409 billion (-USD 70.45 million), with a standard deviation of VND 795 billion (USD 39.5 million). Additionally, the probability that the VFM indicator takes a value between VND -2,500 billion (USD 125 million) and -VND 350 billion (-USD 175 million) is about

89.1%.

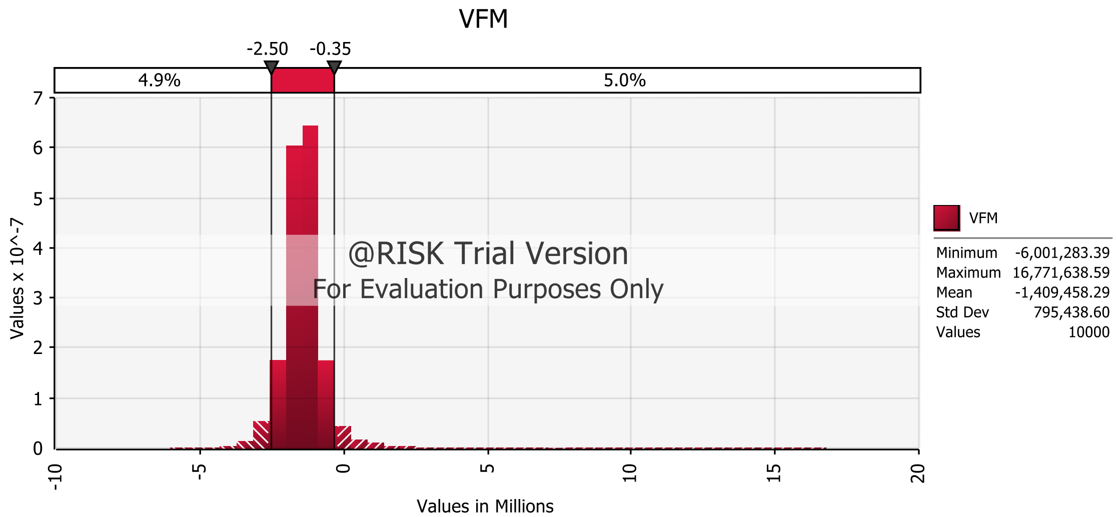


Figure 5.8: Distribution for the project's Value for money

Next, we use Figure 5.9 to show cumulative probability of VFM for this project.

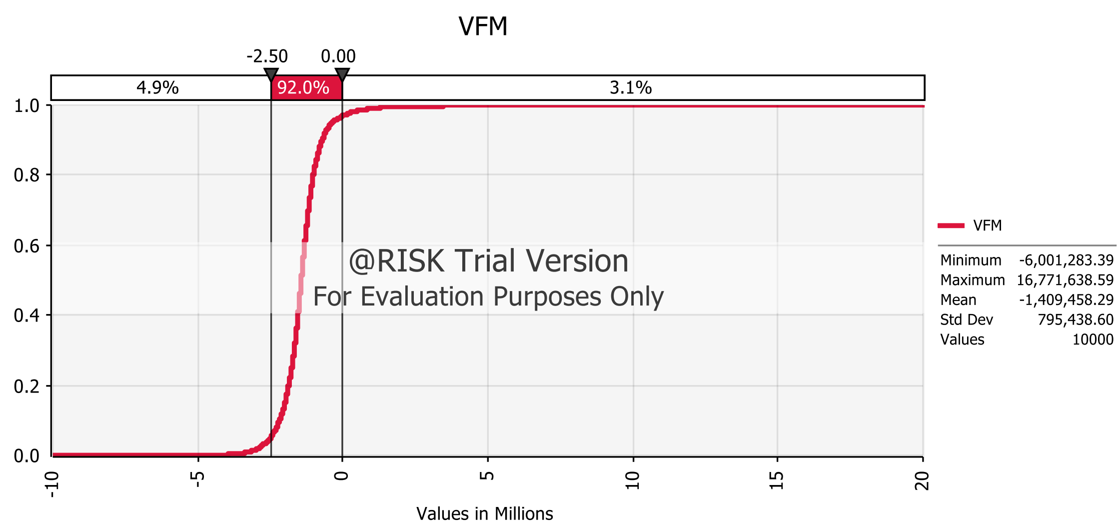


Figure 5.9: Cumulative probability of VFM

As can be seen in Figure 5.9, the degree of confidence that the VFM takes a positive value is only 3.1%. This implies that doing the project via PPP scheme is not better than the traditional government delivery. In other words, it is not finaicnally beneficial for the government to conduct the project as a PPP.

Figure 5.10 summarizes the distributions generated for the range of the VFM.

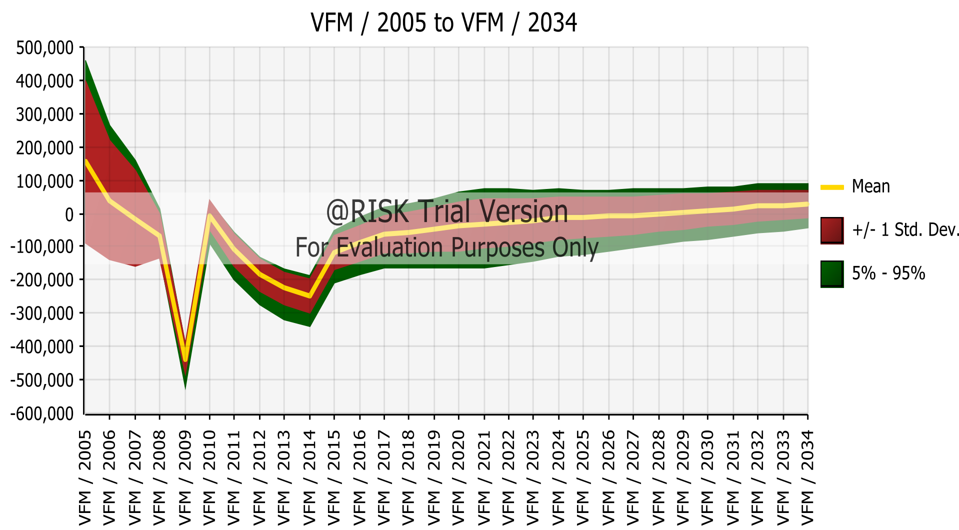


Figure 5.10: Summary graph of VFM

Figure 5.10 allows one to examine how the VFM of the Phu My project would change between 2005 and 2034. The x-axis represents the concession period: from 2005 to 2034. The y-axis represents the net present value of the VFM. It is possible to see that the cash flow of the VFM from 2007 to 2015 is negative. However, in the subsequent years, the VFM becomes positive. In other words, the public sector only does better (financially) than the private sector in the first few years of the project, while the PPP model leads to larger benefits during the period that runs from 2016 to 2034.

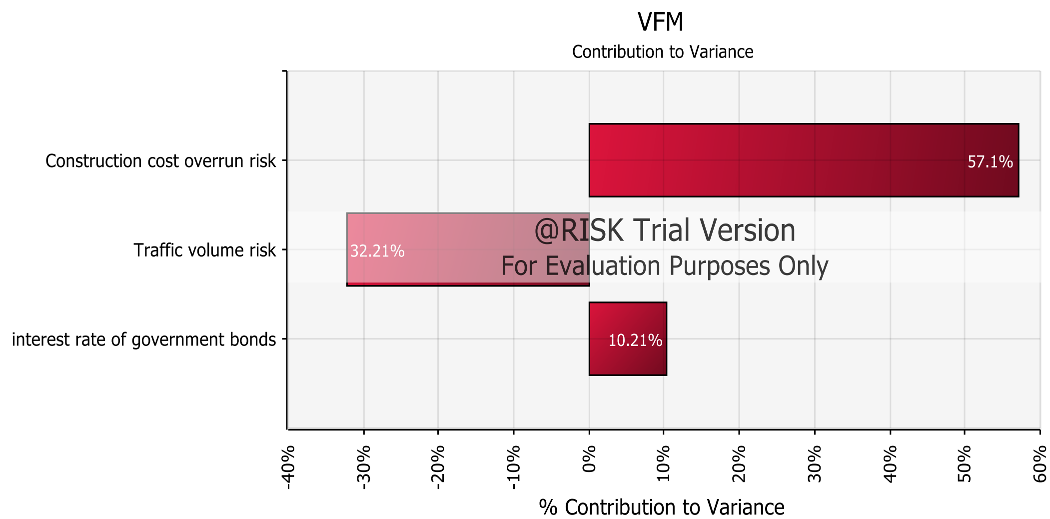


Figure 5.11: Sensitivity tornado graph for the VFM

Figure 5.11 shows the sensitivity tornado graph of the VFM. The graph describes the percentage of change in the VFM of the project as a consequence of a 1% increase in each input variable. The y-axis shows each input variable, while the x-axis represents the variations in the outcome value. For instance, a 1% increase in the interest rate of the government's bonds leads to 10.21% increase in the VFM. The means that, the larger the percentage changes in the variance of the input variable, the more significant the variable impacts the VFM. It can therefore be said that, the risk of construction cost overrun has the largest influence on the VFM. This implies that inaccuracies in the calculation of the construction cost have large impacts on the viability of the PPP model, compared to the other variables.

Next, we explore the relationship between the risk of construction cost overrun and simulated value of the VFM of the Phu My Bridge project. These are further illustrated in Figure 5.12

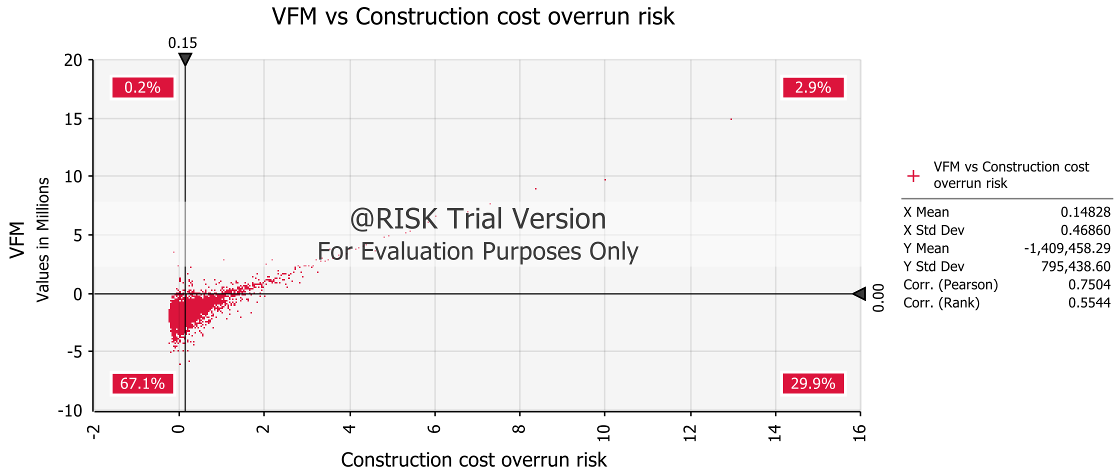


Figure 5.12: Scatter graph of VFM versus construction cost overrun risk

In Figure 5.12, the x-axis illustrates the construction cost overrun ratio, while the y-axis represents the value of the VFM. There are four quartiles in this graph. Each of the quartiles shows the confidence level of VFM regarding the effect of the risk of construction cost overrun on the VFM. It is also possible to see that, when the construction cost overrun ratio is larger than 0.15, the probability of a positive VFM becomes 2.9%. This means that, with a construction cost overrun ratio that is larger than 0.15, there is a 2.9% chance that the PPP model could better than the conventional procurement model. In contrast, if the construction cost overrun ratio is smaller than 0.15, the degree of confidence that the VFM is positive is 0.2%. This means that there is only a 0.2 chance that the conventional delivery will be better than a PPP model if the construction cost overrun ratio is less than 0.15.

Accordingly, we use Figure 5.13 to show the relationship between the value of

VFM and traffic volume risk.

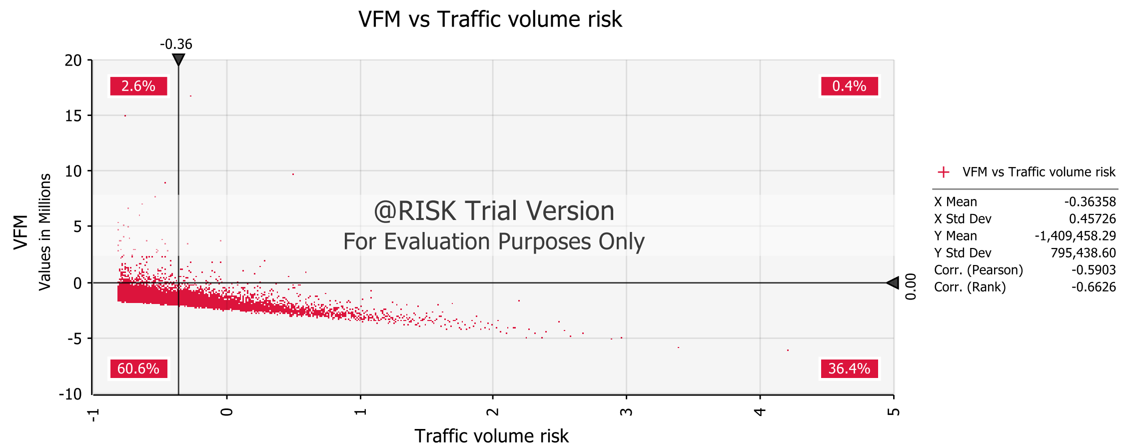


Figure 5.13: Scatter graph of VFM versus traffic volume risk

As shown in Figure 5.13, if the traffic demand risk ratio is smaller than -0.364, at a 2.6% confidence level, the VFM becomes positive. This shows that the probability that, when traffic demand risk ratio being less than -0.36, the PPP approach performs better than the traditional approach is only 2.6%. This probability falls to 0.4% if the traffic demand risk ratio exceeds -0.36.

5.4. Conclusion

Through the VFM assessment of the Phu My project, the following conclusion can be drawn.

First, the result of the VFM assessment demonstrates that it is more expensive to implement the project via a PPP. In other words, the PPP scheme surely was not better than the traditional delivery model, as far as the procurement of the Phu My project is concerned.

Second, the simple sensitivity analysis shows that the PSC's operation cost does not have much impact on the VFM. On the other hand, the PSC capital cost has significant impact on the variations of the VFM. Additionally, the VFM does not become positive, even with a 15% increase in the PSC's capital cost.

Third, the advanced sensitivity analysis confirms that the VFM is positively sensitive to the risks of construction cost overrun and the interest rate of the national bonds. On the other hand, the VFM is negatively sensitive to traffic demand risks.

Chapter 6: Case study of the Trung Luong – My Thuan Expressway project

6.1. Introduction

The Trung Luong-My Thuan Expressway is a BOT toll road project that involved a subsidy from the Vietnamese government. In 2009, the Trung Luong-My Thuan expressway was originally sponsored by the Bank for Investment and Development of Vietnam (BIDV), with a total investment of VND 28 trillion (the equivalent of USD1.4 billion). The road was designed to 8 lanes. However, two years after the implementation of the project, the BIDV decided to return it back to the government of Vietnam due to it being unable to raise the investment capital needed. The government received the project and then transferred its operation to the Ministry of Transportation in 2011.

According to Decision 2035/TTg-KTN of the Vietnamese prime minister issues on October 14, 2014, the Vietnamese government decided to pursue a BOT/PPP model as a means to attract new investments from private firms into the project. Currently, the project is under the construction phase of the BOT/PPP model under new private investors. However, debates on the rightness of the selection of the most suitable procurement option for the project are still on going. While some argue it is better to use the BOT/PPP scheme to implement the project, others have also argued that the project should be implemented via government direct investment. In this regard, using a VFM analysis, this chapter examines the validity of both sides of the debate on which procurement model best suits the project.

6.2. Summary of the project

In 2014, the Trung Luong-My Thuan project was recapitalized with a total investment capital of nearly VND 13 trillion (equivalent to USD 630 million, at the rate of USD 1 to VND 20,000). The length of the 4-lane expressway is 54.3 km. The concession period is designed to last for 33 years. Unlike the other toll projects, the level of toll fees of this project depends on the toll for a PCU per one km and the length of the road. The project is currently in its construction phase, which is expected to finish in 2019. Also, the government of Vietnam will support the subsidy for the project by allowing concessioners to collect the tolls of Ho Chi Minh- Trung Luong Expressway for 11 years. The capital for the project was provided by developers, which consist of two banks (BIDV and Vietinbank) and a 5-company consortium (Tuan Loc Construction Investment Corporation, Yen Khanh Ltd., Co, BMT Construction Investment Corporation, Thang Loi Ltd., Co, and the Lugia Mechanical Electric Joint Stock Company).

The primary objectives of the project are to shorten the travel time from Ho Chi Minh City to the Mekong Delta provinces, to contribute to the promotion of economic and social development in the region, and to reduce heavy congestion on Highway 1. The starting point of the project is at the Than Cuu Nghia (Km49 + 620) intersection, which is under the Ho Chi Minh City -Trung Luong Expressway, while the endpoint is at the intersection with the National Highway 30 (Km100 + 750)

The Ministry of Transportation signed the BOT contract on behalf of the Vietnamese government, with the private party consisting of the Trung Luong-My Thuan Joint Stock Company, which is known as the project’s special purpose vehicle (SPV). This

SPV is responsible for signing, designing, constructing, financing, operating and maintaining the road. The SPV is also changed with the responsibility of coordinating private investors and banks. The Cuu Long Corporation for Investment Development and Project Management of Infrastructure (Cuu Long CIPM) represents the Ministry of Transportation, which is responsible for monitoring the quality of the construction, the implementation of the project and the final delivery of the expressway to the government. The Ministry of Finance provided guarantees for the financial long-term borrowings from the Joint Stock Commercial Bank for Investment and Development of Vietnam (BIDV) and the Vietnam Joint Stock Commercial Bank for Industry and Trade (Vietinbank). The structure of the project is summarized in the following figure:

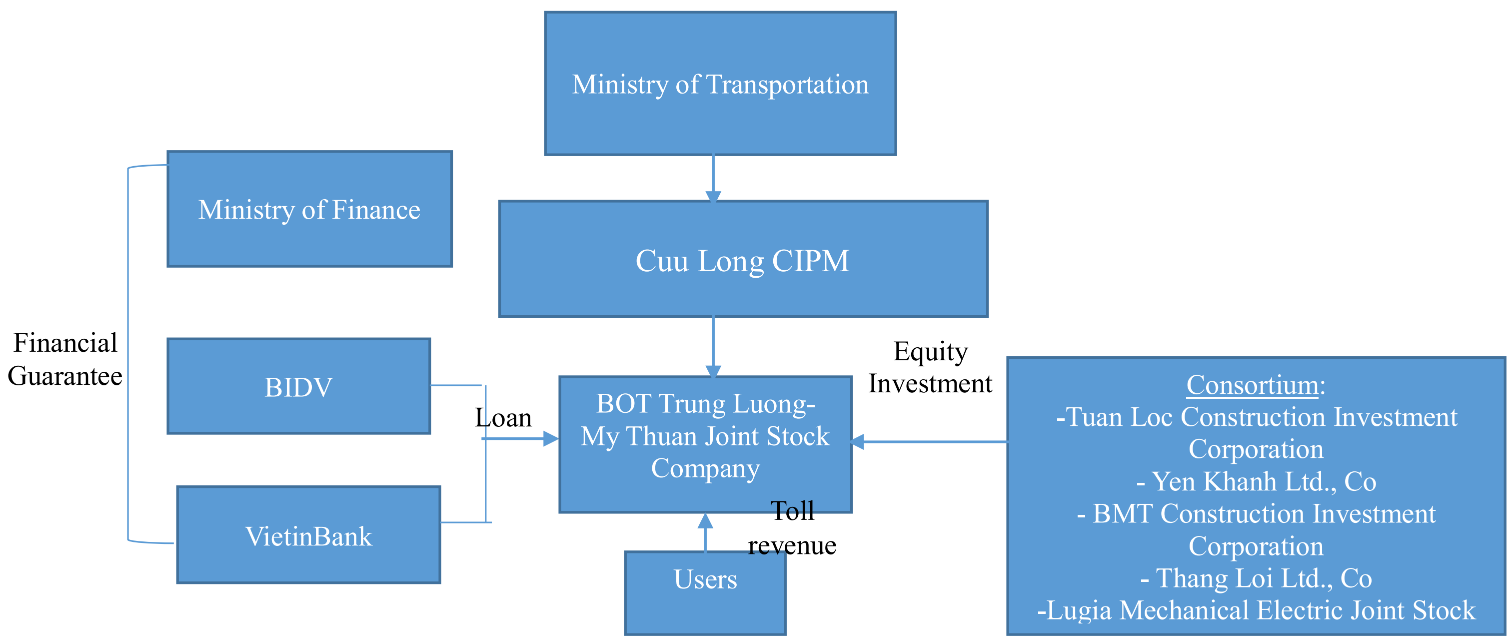


Figure 6.1 : Stakeholders involved in the Trung Luong-My Thuan Expressway project

Also, key feature of the project are shown in the image below.

Figure 6.2: Location of the project site
(Source: map.google.com)

The key features of the Trung Luong-My Thuan Expressway:

Location: Ho Chi Minh City – Tien Giang province (South of Vietnam)

Length: 54.3 km (4 lanes)

Construction cost: VND 12,616.95 billion (USD 630 million)

Construction duration: 4 years (2015-2019)

Operation period: 29 years (2019 – 2048)

6.3. Value for Money assessment

6.3.1. Basic assumptions for the VFM assessment

- Raw costs under the PSC

Due to the absence of information on the actual PSC, it is assumed that the costs of capital under the PSC (including the design and construction costs, the acquisition of land costs, and the costs of equipment), the same values as the SBP apply. However, the calculation of the maintenance cost component and the management cost of the project under the PSC depends on the Circular 10/2010/TT-BGTVT issued by the Ministry of Transport in October 2010, which states the "the management and maintenance of roads indicate the particular ratio of each item in the maintenance cost". Accordingly, the general maintenance cost of the project comprises of three components: the periodic maintenance costs, the special maintenance costs, and the cost of upgrades. The annual cost of maintaining the road during the operation stage is estimated to be 0.5% of the base construction cost. The cost for maintaining a good level of service for the road is defined as a special maintenance cost (5% of the construction cost) is incurred every 4 years. Finally, the upgrade cost is the cost incurred in the process of repairing the road. The upgrade cost is estimated to be 42% of the construction cost; it is implemented once every 12 years.

Table 6.1: Cost distribution ratios for maintenance costs

Maintenance cost	Ratio	Time
Periodic maintenance cost/ construction cost	0.5%	Once a year
Specific maintenance cost/ construction cost	5%	Once in four years
Upgrade cost/ construction cost	42%	Once in twelve years

(Source: Circular No.10/2010/TT-BGTVT of Ministry of Transport dated October, 2010)

- Financing cost under the PSCs

It is hypothesized that the government mobilizes a project's capital investment through the issuance of long-term Vietnamese national bonds. According to the State Bank of Vietnam (2014), the interest rate of the ten-year government bond is 6.38% per year. This same rate is utilized to compute the financing cost component of the PSC in the case study of Trung Luong-My Thuan Expressway project.

- Revenue under the PSC

The computation of the revenue under the PSC is based on the user fees, which of course depends on the traffic demand and the price of the toll fees. Due to a lack of data on the forecasted traffic volume under the PSC, the estimated traffic volume under the PSC is assumed to be identical with the forecasted traffic volume under the PPP. Likewise, the toll fee is estimated with reference to the Circular No 159/2013/TT-BTC of the Ministry of Finance, which guides the "collection, payment, management, and use of road-use tolls for the payback of the road construction investment capital". It regulates that the minimal toll per PCU is VND 15,000; which is amounts to VND 276 per km under the assumption that the length of the road is 54.3km.

- Setting the discount rates

To compute the net present cost of the project implemented as a conventional procurement, the interest rate of the risk-free rate will be utilized to discount the cash flow during the whole life of the project. In addition to this, WACC[13] is used to calculate the discount cash flow of the SBP; the capital cost of liabilities is set at 9.17%[14], while the capital cost of equity is set at 11.6%[15].

- The time of the project

It is assumed that the construction of the project begins and ends in 2015 and 2019,

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[13] Real WACC = 9.17%*(1-20%)*89.49%+11.6%*10.51% = 7.7%

[14], [2] The feasibility studies of Trung Luong-My Thuan Expressway project 2014

respectively. The remaining 29 years, after the completion of the project in 2019, is designated as the period of operation.

6.3.2. Determination of the PSC and the SBP

6.3.2.1. Determination of the SBP

In order to develop the cash flow under the SBP, information on the key variables are extracted from the available data, particularly the feasibility study on the Trung Luong-My Thuan Expressway project. The extracted information is summarized as follows:

(a) The total estimated investment capital for the construction of the project is VND 12,616.95 billion (USD 63 million). It is planned that the amount will be disbursed at 18%, 29%, 31%, and 22% every year during the construction period.

(b) The BOT finance structure: the debt and equity ratio of the project is 89.49% and 10.51%, respectively. The debt mobilized from banks is VND 1,993 billion (USD 99.6 million) in the first year, VND 3,211 billion (USD 160 million) in the second year, VND 3,432 billion (USD 171 million) in the third year, and VND 2,436 billion (USD 121 million) in the fourth year. The repayment period begins on the fourth year; the yearly repayment is expected to last for 24 years, at an interest rate of a 9.7%.

(c) Expected interest on equity is 11.05%.

(d) The corporate tax rate is 20%.

(e) The concession term is 33 years.

(f) The number of traffic vehicles is forecasted to be 21,801,103 PCU in the year 2019.

(g) The initial toll fee for the PCU is set at VND 1,000 per km, which is predicted to increase to 18% at the end of every three years.

Table 6. 2: Net present value of SBP, at a 14.23% nominal discount rate[16]

Unit: billion VND

This section has been deleted as it contains copyright data

Year	Capital expenditure	Operating expense		Financing cost	Return on investment	Subsidy	Revenue	SBP		
		Management expense	Maintenance cost					Real	Nominal	NPV
2015										
2016										
2017										
2018										
2019										
2020										
2021										
2022										
2023										
2024										
2025										
2026										
2027										
2028										
2029										
2030										
2031										
2032										
2033										
2034										
2035										
2036										
2037										
2038										
2039										
2040										
2041										

[16] Nominal WACC = (1+7.7%)*(1+6%) -1= 14.23%

2042										
2043										
2044										
2045										
2046										
2047										
2048										
Total										

(Source: Feasibility studies report, 2014)

6.3.2.2. The determination of the PSC

Table 6.3: Net present value under the PSC, at a 12.76 % nominal discount rate[17]

Unit: billion VND

This section has been deleted as it contains sensitive information

Year	Raw PSC			Financing cost	Transferred risk		PSC		
	Capital cost	Operation	Revenue		Overrun cost	Traffic volume	Real price	Nominal price	NPV
2015									
2016									
2017									
2018									
2019									
2020									
2021									
2022									
2023									
2024									
2025									
2026									
2027									
2028									

[17] Nominal discount rate for PSC = (1 +6.38%)*(1+6%)-1 = 12.76%

2029									
2030									
2031									
2032									
2033									
2034									
2035									
2036									
2037									
2038									
2039									
2040									
2041									
2042									
2043									
2044									
2045									
2046									
2047									
2048									
Total									

6.3.3. Value for Money analysis

6.3.3.1 Computation of quantitative VFM

Table 6.4: Comparison of the costs of the project under PPP and traditional method

*Unit: billion VND**

Items	PSC	SBP
Outflow (A)	23,022.29	20,717.70
Inflow (B)	2,817.23	7,745.83
Net present of cash flow (A) – (B)	20,205.05	12,971.87
VFM (PSC-SBP)	**7,233.20**	

*VND =USD 0.00005

Table 6.4 shows the comparison of the whole costs of doing the Trung Luong-My Thuan project under the PPP and the traditional procurement models. The information in the table reveals that the whole life cycle costs of the project under PPP scheme is expected to be VND 12,971 billion (USD 648 million) over the 33-year concession period. On other hand, the spending under the conventional model is estimated to be VND 20,205 billion (USD 1,100 million). As a result, one can conclude that the PPP model provides VFM, precisely VND 7,233 billion (USD 361 million), compared to traditional procurement. This means that the use of the PPP scheme for the implementation of this project should lead to higher economic returns. On this basis, it is therefore unreasonable to resort to public finance for the project.

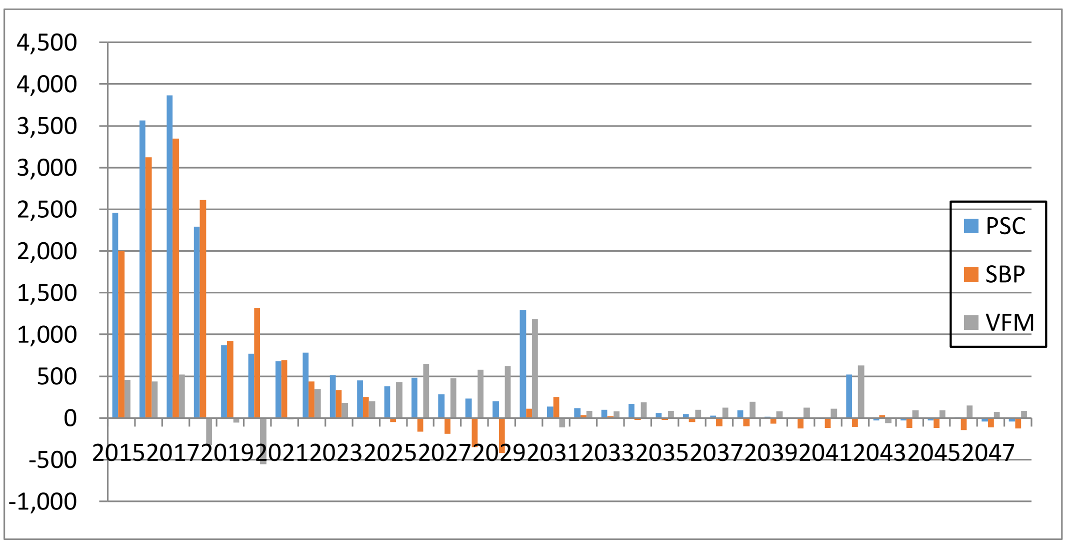

Figure 6.3: Comparison of the cash flow of the project done via PPP scheme with traditional delivery.

Figure 6.3 shows the cash flows associated with the PPP approach and the traditional approach. As shown in this figure, the cost of doing this project via PPP procurement seems to be cheaper than that via the government traditional procurement, especially in the periods 2015-2017 and 2021-2047 of the project life cycle.

6.3.3.2. Sensitivity analysis

A sensitivity analysis was undertaken to check the effect of different values in the components of the PSC (such as the cost of capital, operation cost, and revenue) on the results of the VFM to determine the best option. This is done to extract a set of the value for the VFM that results from -15% and +15% changes jumps in the input variables.

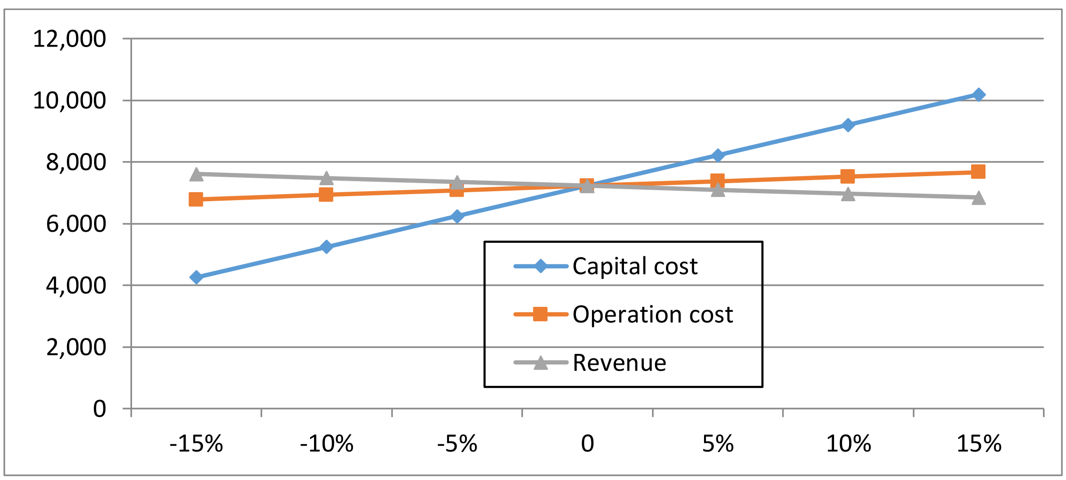

Figure 6.4: Simple sensitivity analysis of the impact of the cost components on VFM

Figure 6.4 shows how the movements in the cost components of the PSC impact the VFM of the project. The result suggests that, among three inputs varied, the PSC revenue has a negative correlation with the VFM, while PSC's capital cost and PSC's operation cost have positive relationships with the VFM. When one of these variables is changed from -

15 percent to 15 percent, the value of VFM fluctuates between VND 6,781 billion and VND 10,192 billion. Additionally, the sensitivity results reveal that VFM is most sensitive to movements in the PSC's capital cost, and least sensitive to changes in revenue under the PSC. Under this base case, the quantitative VFM of this project is positive. In other words, PPP delivery is a better choice for this project. Even if the PSC's capital cost drops by 15 percent, or if the revenue goes up by 15 percent, the VFM would still be positive. This implies that public sector procurement is not preferable to the PPP model, even when there is 15% extra revenue or a 15 percent reduction on the PSC's capital cost and operation costs.

Table 6.5: Sensitivity analysis of cost components on VFM

Input variables	The change of VFM due to the one percent in increase of input variables		
	Change	**Unit change (billion VND*)**	**Reasons**
PSC capital cost	Increase	197.77	The increase in the PSC's capital cost leads to increase in the PSC, so VFM increases
PSC operation cost	Increase	29.64	The increase of PSC's operation cost increases the value of the PSC, so VFM increases
PSC revenue	Decrease	25.41	A rise in the PSC's revenue results in a fall in the PSC: as a result, VFM decreases

Note*: 1 USD = 20,000 VND

Table 6.5 shows the movements in the VFM that results from a one percent increase in the input variable. As observed in this table, the quantitative VFM of the Trung Luong-My Thuan project increases by VND 197.77 billion and VND 29.64 billion when there is a one percent increase in PSC capital cost or PSC operation cost, respectively. It can therefore be said that an increase in the PSC's capital cost or increases in the PSC's operation cost leads to an increase in the value of PSC. Accordingly, the value of the VFM goes up. Likewise, if the PSC revenue increases by 1 percent, the quantitative VFM will decrease by VND 25.41 billion. This is because a rise in the PSC's revenue produces a fall in value of the PSC, making the value of the VFM to fall.

6.3.3.2 The Monte Carlo Simulations

The Monte Carlo Simulation was used to compute the expected value of the VFM and the probability of getting a positive VFM for this project. The variables considered in the simulation model include: the risks of construction cost overrun, traffic demand risk, inflation, and interest rate of the government bond.

Table 6.6: Probability distribution of the input variables

Variables	**Unit**	**Distribution**	**Value**			
			Minimum	**Maximum**	**Mean**	**Standard deviation**
Interest rate of government bond	%	Pareto			8.08	2.7
Construction cost overrun	%	Log-logistic			14.7	54.6
Traffic demand risk	%	Exponential			-36.3	45.6
Inflation	%	Time series				

As mentioned in chapter 5, when the sample is limited or insufficient, bootstrapping can be used as an approach to estimate the distributions of the construction cost miscalculations and the traffic demand risk. The Chi-square goodness-of-fit test shows that the distribution of the construction cost inaccuracy and traffic demand risk follows a log-logistic and exponential distribution, respectively. On other hand, the interest rate of a ten-year government bond follows a Pareto distribution, with a mean of 8.08% and a standard deviation of 2.7%. With respect to the inflation rate, based on historical data from 1994 to 2016, we have the forecasted inflation rate for 2016 to 2047, as shown in the following chart:

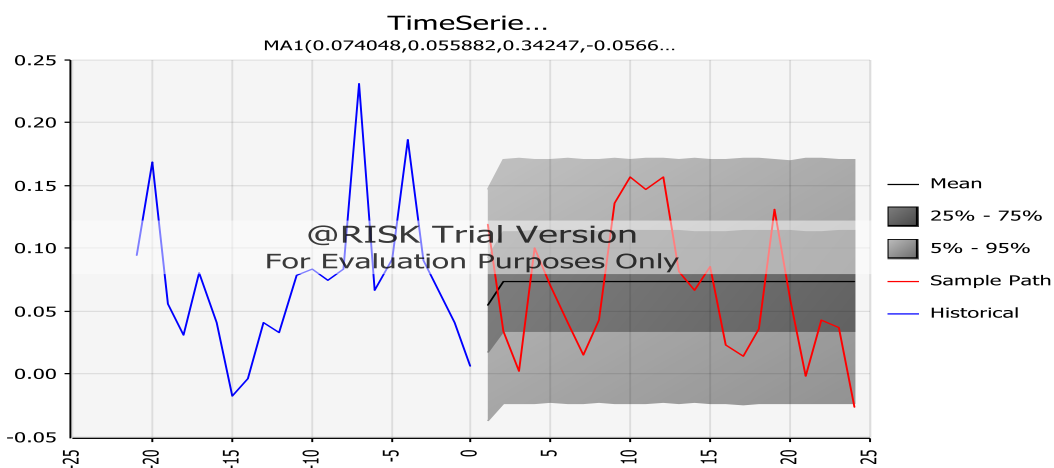

Figure 6.5: Time series of inflation between 1994 and 2047

Figure 6.5 shows the time series of inflation during the 1994-2047. The y-axis represents the inflation rate, while the x-axis represents a comparison of the past time and the future time with respect to the base year (2016). As can be seen, the green path represents the inflation rate in the past (from 1994 to 2016), while the red line represents the forecasted trend of the inflation in the future (from 2016 to 2047).

Output simulation

Figure 6.6 shows the results of 10,000 trials of the MCS. The result shows that the mean value of the VFM and standard deviation is VND 8,551 billion (USD 427 million) and VND 4,058 billion (USD 202 million), respectively. Additionally, the range of the value of the VFM is between VND 1,325 billion (USD 66.25 million) and VND 14,125 billion (USD 706 million) with a 92.5 probability.

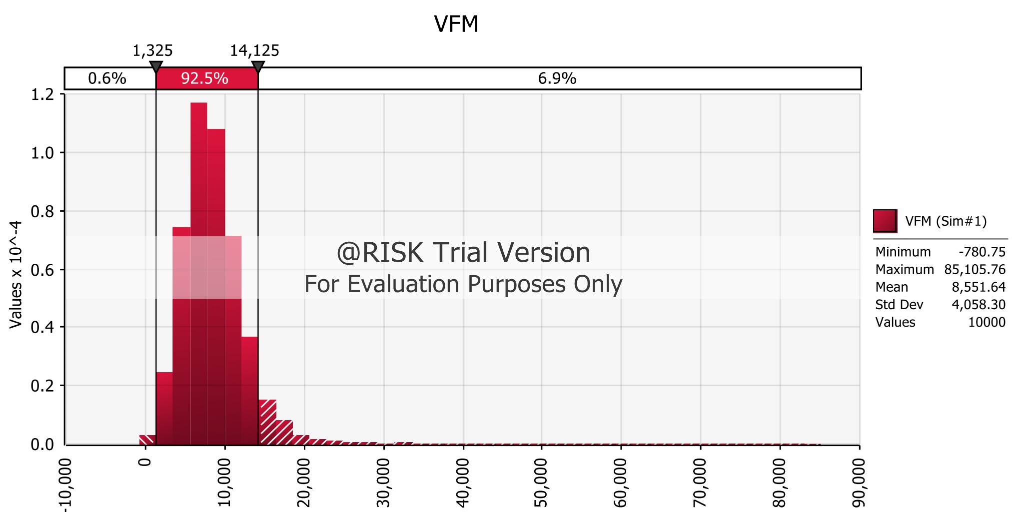

Figure 6.6: Distribution for the project's VFM

Next, we use Figure 6.7 to show cumulative probability of the project's VFM.

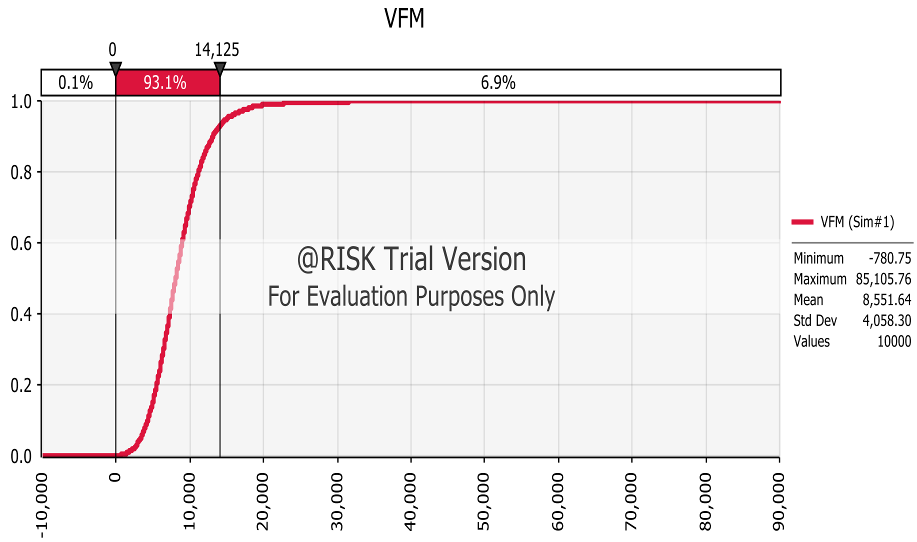

Figure 6.7: Cumulative probability of VFM

As shown in Figure 6.7, the probability of the VFM being positive is 99%. It implies that the PPP model is surely better in monetary terms than the traditional delivery model, as far the implementation of the Trung Luong-My Thuan Expressway project is concerned.

Although there are many variants of the VFM, one of the variables that impact the value of the VFM is the PSC toll fee. In order to understand the effect of using a different PSC toll fee, this research simulated the value of changes in the VFM at two different PSC toll levels. The first is a VFM simulation with the PSC toll set at VND 276/km/PCU, while the second is a VFM simulation with the toll set at VND 2,100/km/PCU. The two levels were arrived at after a review of the Vietnamese regulatory documents. In particular, according to the Circular 159/2013/TT-BTC of the Ministry of Finance issued in 2013, the minimal toll per PCU is set at VND 276 per km. Also, in the Circular 35/2016/TT-BGTVT issued in 2016, the maximum toll per PCU is set at VND 2,100 per km. These are further shown in Figure 6.8.

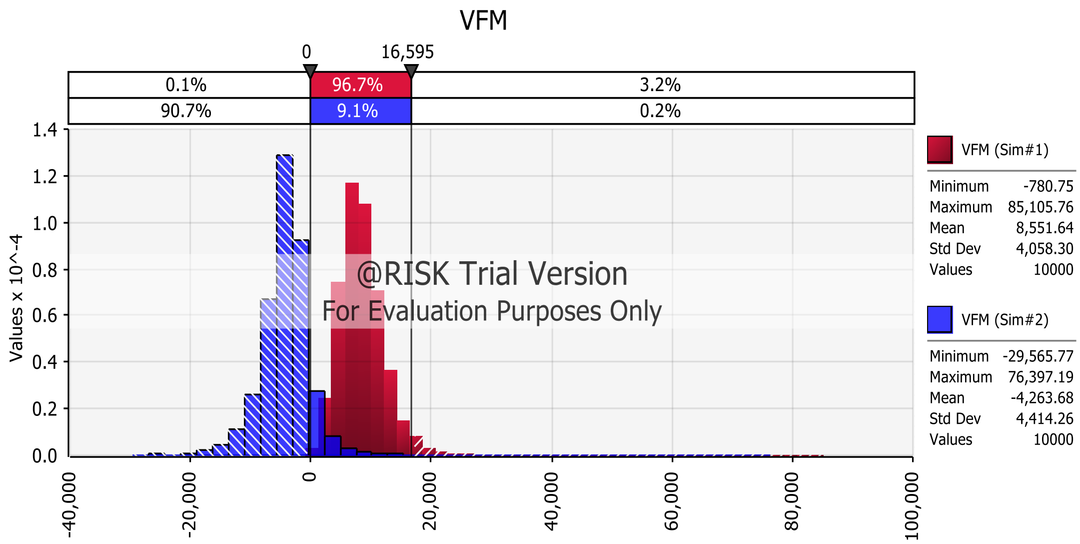

Figure 6.8: Distibutions of VFM with alternative PSC toll level

Accordingly, Figure 6.8 shows the changes in the VFM as a result of changes in PSC toll levels. The red shadow area shows the distribution of VFM when the PSC toll is set at VND 276/km per PCU. It shows that the probability of VFM being larger than zero is 99%. In this case, the PPP model performs better than public finance. Meanwhile, the green shadow area represents the probability distribution of the VFM if the PSC toll is set at VND 2,100/km per PCU. The result suggests that the probability of a positive VFM is 9.3%. This implies that, in at with such a low probability, the conventional delivery approach becomes better than PPP scheme.

Next, Figure 6.9 shows the distribution of the VFM that resulted from the simulations, from 2015 to 2048.

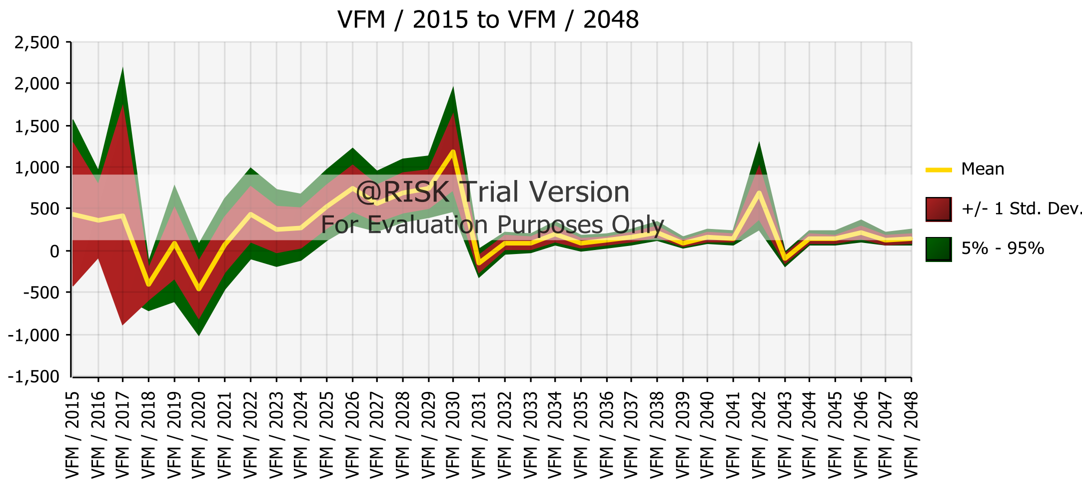

Figure 6.9: Summary trend of VFM

It is easy to see in Figure 6.9 that the cash flow of the VFM is mostly positive throughout the whole life of the project. The only exceptions, the yeas in which the VFM takes a negative value were in 2020, 2031 and 2043. As an example, the cash flow of the VFM in the first few years is nearly VND 500 billion per annum. However, it soon falls sharply in the fourth year. Furthermore, the annualized cash flow of VFM in both 2021 and 2030 is greater than VND 200 billion. However, it may drop to VND-100 billion in the year 2031. Once again, it rises steadily from 2032 to 2048. In general, the PPP model can produce better value to the government than public sector procurement in both construction and operation phases.

We use Figure 6.10 to display the sensitivity tornado graph of the VFM.

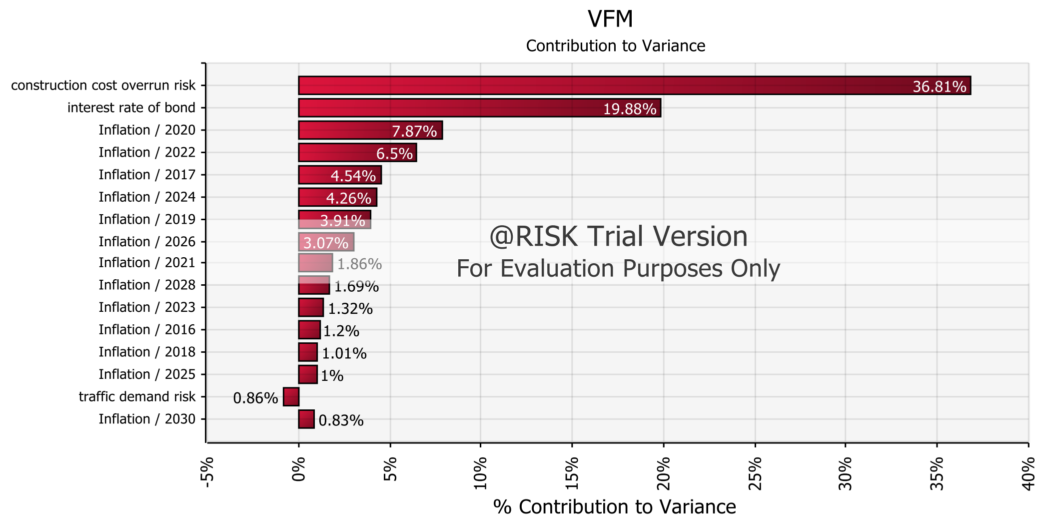

Figure 6.10: Sensitivity tornado graph for the project's value-for-money

Figure 6.10 shows the extent to which a percentage change in output varies in response changes in the input variable. The x-axis represents the variation in the outcome value, while the y-axis represents the input variable. It is easy to see that the risk of construction cost overrun leads to 36.81% variation in the VFM. Meanwhile, the error rate in calculation of traffic demand accounts for only 0.86% of the variability of the VFM. In addition, the tornado graph allows us to identify the factor that influences the VFM of the project the most. In this regard, risks arising from inaccuracies in the estimation of the construction cost have the biggest impact on the VFM.

We explore the relationship between the inaccuracies in the estimation of the construction cost and the simulated output of the quantitative VFM. These are further displayed in Figure 6.11.

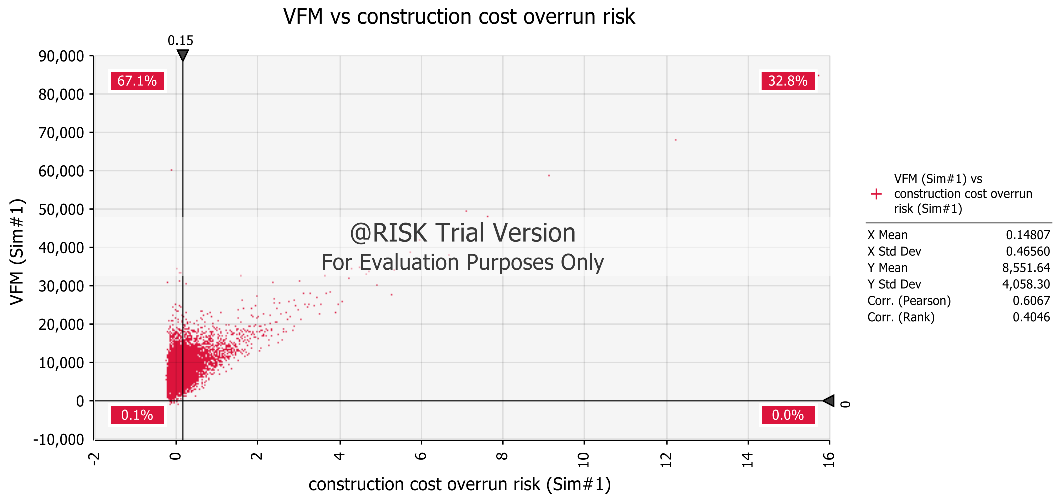

Figure 6.11: Scatter graph of VFM versus construction cost overrun risk

As shown in Figure 6.11, the x-axis represents the ratio of the construction cost overrun, while the y-axis represents the value of the VFM. As indicated in this image, if the ratio of the construction cost overrun is larger than 0.15, the probability of VFM being positive becomes 32.8%. In contrast, if the ratio is less than 0.15, the probability that the VFM indicator takes a value larger than zero is 67.1%.

Next, Figure 6.12 shows the relationship between inaccuracies in the estimation of traffic demand and the simulated VFM of the Trung Luong-My Thuan project.

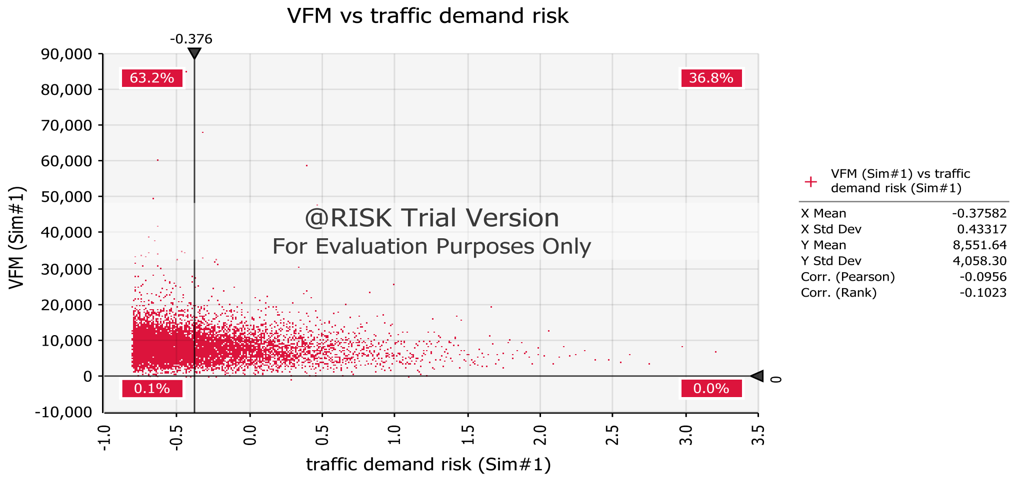

Figure 6.12: Scatter graph of VFM versus traffic volume risk

As can be seen in Figure 6.12, the x-axis illustrates the inaccuracies in the estimation of traffic demand, while the y-axis represents the value of the VFM. The information in Figure 6.12 implies that, if the rate of inaccuracies in the estimation of the traffic demand is less than -0.376, there is 63.2% confidence level that VFM would be greater than zero. On the other hand, if the rate of inaccuracies in the estimation is greater than -0.376, there is a 36.8% chance that the VFM outcome would be still be positive.

Scenarios analysis

The revenue from the Trung Luong-My Thuan Expressway is subsidized the government of Vietnam. This makes is quite unique and different from other PPP road projects implemented in the country. As stated earlier, with government subsidy, the results of the VFM quantitative assessment demonstrates that the PPP model is a better option for the project. However, the analysis will be extended to determine whether or not PPP is still a better choice for the implementation of the Trung Luong-My Thuan expressway, if the government decides to withdraw the subsidy.

Comparison of VFM cash flow in the case of PPP with and without subsidy from government

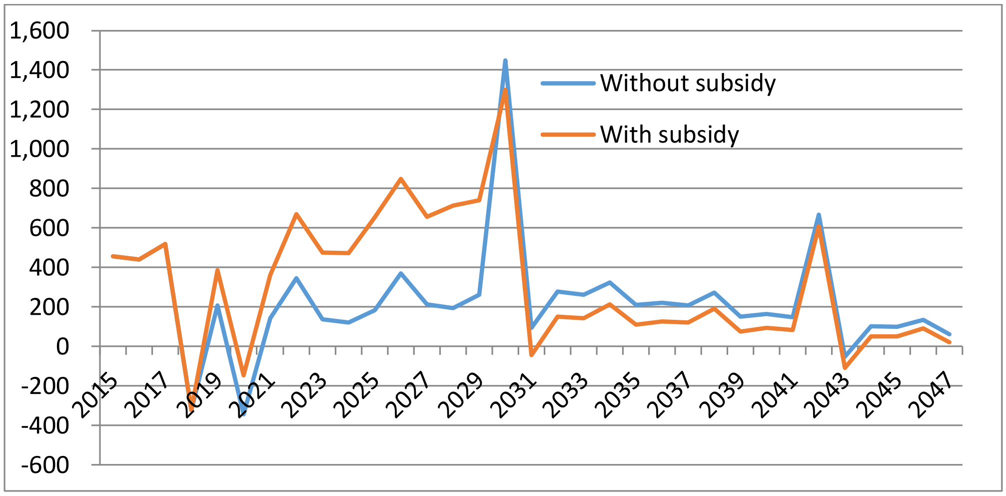

Figure 6.13: Comparison of the cash flow of the quantitative VFM with and without subsidy

Figure 6.13 illustrates the VFM of the PPP project with and without government subsidy. It is possible to see that, from the 2015 to 2028, the annualized cash flow of the VFM with the government' subsidy is larger than the VFM without the government's subsidy. However, from 2029 to 2048, the yearly cash flow of the VFM without the subsidy is larger than that of the VFM with the subsidy. In addition to this observation, it is possible to see that the cash flow of the both scenarios reaches a peak of VND 1,400 billion in 2030.

The output simulation

The result of the MCS simulation for the VFM in the absence of a subsidy from the government indicates that the mean value of VFM is VND 1,132 billion (see Figure 6.14).

Specifically, the minimum value is VND -5,897 billion while the maximum value is VND 89,758 billion. In addition, the VFM takes a value within the range of VND -3,425 billion and VND 5,961 billion, at a 93.0 percent confidence level.

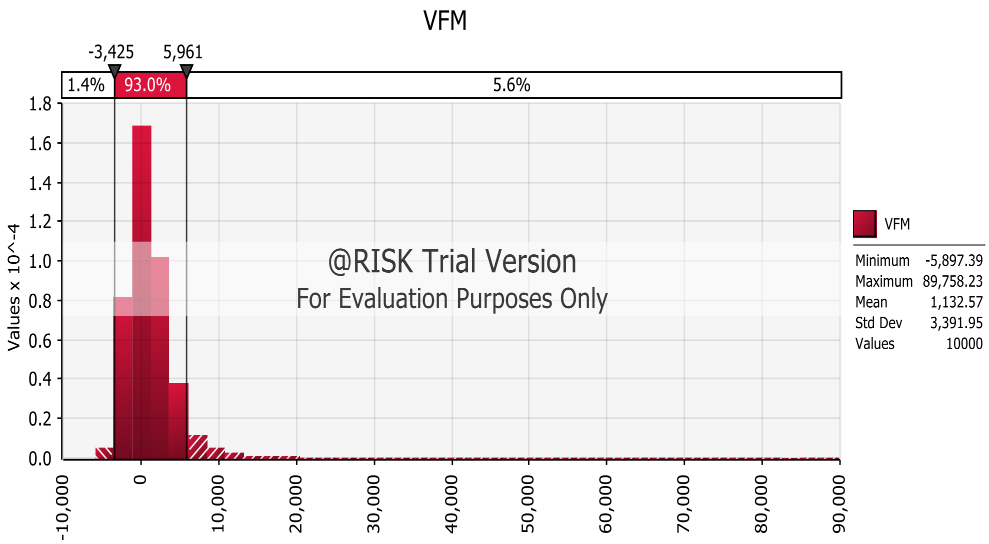

Figure 6.14: Distribution for the project's value for money without government subsidy

Next, Figure 6.15 indicates the cumulative probability of the VFM without government subsidy government

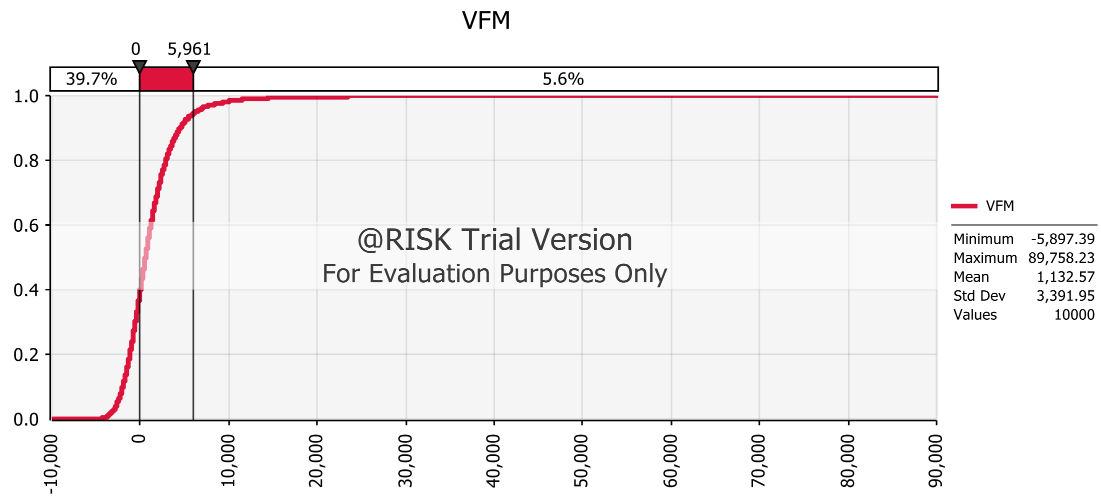

Figure 6.15: Cumulative probability of the VFM without government subsidy government

Accordingly, it can be deduced from Figure 6.15, that there is a 60.3 percent chance that the expected value of this project is positive. It implies that without the government subsidy, the PPP model would still be preferred to the public sector procurement approach.

6.4. Conclusion

Based on the VFM assessment of the Trung Luong-My Thuan, the following conclusions can be drawn:

- First, the mean of the VFM is VND 8,551 billion (USD 427 million). Also, the probability of the VFM being positive is 99.9%, which implies that the PPP model would lead to greater value than traditional procurement. In other words, the decision to pursue a PPP approach for the implementation of the project is indeed justified. One of the factors that led to the realization of a positive value-for-money is that the financial support that the Vietnamese government provides (in the forms of revenue guarantee worth VND 15,488 billion). In the absence of the revenue subsidy, the PPP model becomes less economical.

- The simple sensitivity analysis demonstrates that the input factor with the larger impact on the VFM is PSC’s capital cost. The least influential variable is PSC’s operation cost. The entire variables, with the exception of the PSC’s revenue, have a positive relationship with the VFM. Additionally, the VFM remains positive, even if there is a 15 percent drop in the PSC’s capital cost. This means that the PPP model would still the better option for the Trung Luong-My Thuan Expressway, even if when there were to be some slight drops or increases in some of the cost items.
- The advanced sensitivity analysis that combines four uncertain input variables shows that the stimulated VFM is positively sensitive to the risk of construction cost overrun, the interest rate of the national bond, and inflation. It is however negatively sensitive to error in traffic demand forecast.
- Based on these observations, one can conclude that the result of the VFM analysis shows that the use of the PPP approach for the implementation of the Trung Luong-My Thuan is financially beneficial to the Vietnamese government.

Chapter 7: Case study of the My Loi bridge project

7.1. Introduction

The My Loi Bridge was initially designed for the traditional public procurement scheme. The construction of the project started in 2009 and was scheduled for completion in 2012. However, the construction period exceeded the initial timeline. According to some practitioners, the reasons that led to the delay can be attributed to the some strains in available public resources; possibly budget constraints. Consequently, in 2013, the Vietnamese government decided to encourage the private sector to finance the completion of the My Loi Bridge. This decision led to some controversies though. Some stakeholders argued that the project would be better off if completed under the original delivery model. Some of the questions that arose centered on this; the justifications for the government's decision to opt for PPP approach, instead of the on-going tradition model.

The aim of this chapter is to use an analysis of the VFM to identify the best procurement method for completing the construction and implementation of the My Loi Bridge, to use the PPP model or the conventional delivery model. The chapter begins with summary of the project, including its history and physical features. The second section focuses on the VFM assessment. Lastly, this chapter concludes with a summary of the main findings of the research, and some recommendations for the selection of a suitable procurement method for the My Loi Bridge project.

7.2. Summary of the project

The My Loi project is located between the Long An province and the Tien Giang province.

The bridge begins at the Km33+650 of Highway 50 (which belongs to Cau Duoc district, Long An province) and ends at Km 36+543 of Highway 50 (which belongs to Go Cong city, Tien Giang province). In total, the distance is approximately 2.691 kilometers. The primary aim of the project is to enhancement the road capacity and the flow of traffic, and to eliminate high congestions of Highway 50. More specifically, it is expected to provide a better connection from Ho Chi Minh City to the Long An and Tien Giang provinces. In addition, the My Loi Bridge is expected to improve the socio-economic situation in the Long An, Tien Giang districts and the provinces in the Cuu Long Delta region. Before the construction of the My Loi Bridge began, traffic congestion was common between the ferry port exit and Highway 20. The congestion hampered the socio-economic development of the neighborhood. Infrastructure investment in the region was desperately needed to replace the aging ferry terminal and connect it to Highway 50 to facilitate a socio-economic reform in the region. The My Loi Bridge was therefore selected as the catalyst to socio-economic development. It is believed that the bridge would lead to enhanced security and defense in costal providences along the Mekong Delta and Ho Chi Minh City, in addition to other economic benefits.

The My Loi Bridge project agreement was designed as a 32-year BOT contract, with a two-year construction period and a 30-year operation period. It is estimated that the project would cost a total of VND 1,337 billion (approx. USD 66.55 million). The construction of the bridge began in March 2014, with the bridge opening for use in August 2015.

The My Loi Bridge Investment Corporation was created to be the designated as a special purpose vehicle (SPV) that would take up the responsibility of singing, designing, constructing, financing, operating and maintaining the road. The corporation consisted of the Phat Dat Real Estate Development Corp. and the 620 Long An Concrete Joint Stock Company (LCC). Besides mobilizing capital from private investors, investment for the project was provided by the Joint Stock Commercial Bank for Investment and Development of Vietnam (BIDV).

Addition information on the project are summarized as follows:

- PPP type: BOT
- Location: Tien Giang province
- Length of bridge: 2.691 km (4 lanes)
- Project cost: VND 1,337 billion (USD 66.55 million)
- Construction period: 24 months (2014-2015)
- Operational period: 30 years (2016-2045)
- Investors: Phat Dat Real Estate Development Corp. (75.15 percent of equity) and 620 Long An Concrete Joint Stock Company (24.85 percent of equity)

Figure 7.1 shows the structure of the partnership, with particular reference to the public ministry and the private firms involved in the implementation of the project.

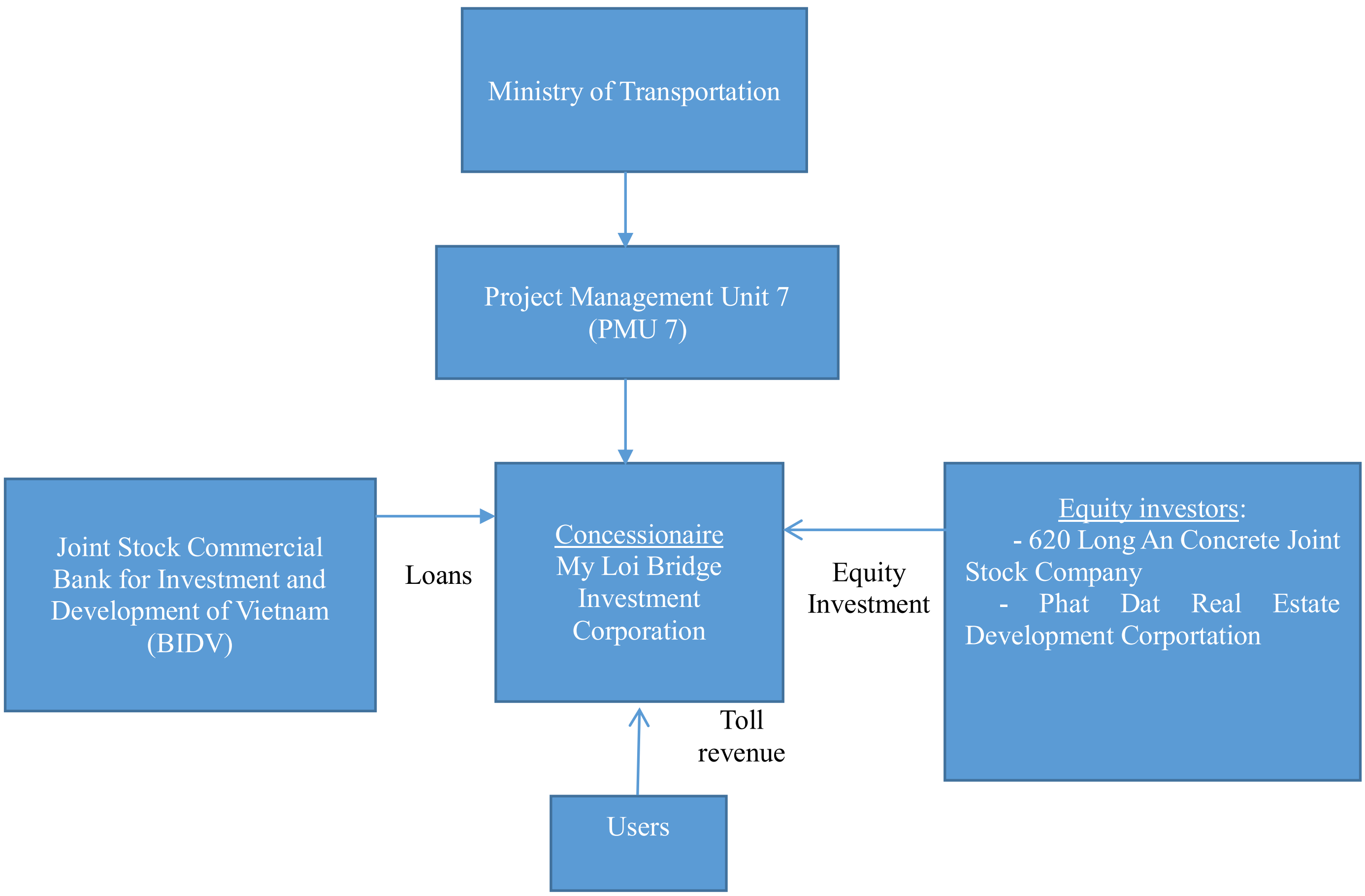

Figure 7.1: Stakeholders involved in the My Loi Bridge
(Adapted from My Loi Bridge BOT contract, 2013)

7.3. Value for Money assessment

7.3.1. Basic assumptions for the VFM assessment

* *Raw cost in PSC*

In order to compute the raw cost of the PSC, an itemization of the costs (such as the design, construction cost, administration costs, and land acquisition costs) were extracted from the feasible study on the My Loi project. Other costs (such as the operation cost and the maintenance cost) that are not currently available were estimated from the standardized cost estimates of the Vietnamese government. In particular, the estimation of the PSC's management and the maintenance costs was based on Circular 10/2010/TT-BGTVT issued by the Ministry of Transport in October 2010. The provisions of this circular guide the "regulations on the management and maintenance of roads indicate a particular ratio for each item in the maintenance cost". As an example, according to the Circular, the maintenance cost of the project includes the periodic maintenance costs, and the special maintenance cost and upgrading costs. The yearly cost of maintaining the road is estimated in a manner that depends on a proportion of the construction cost. According to the estimate, the yearly cost of maintenance should be 0.5% of the construction costs. The special maintenance cost is projected to be 5% of the construction cost; it is conducted every 4 years. Additionally, the upgrade cost projected to equal 42% of construction cost. The upgrade cost is incurred once in 12 years.

Table 7.1: Cost distribution ratios for the maintenance costs

Maintenance cost	**Ratio**	**Time**
Periodic maintenance cost/ construction cost	0.5%	Once a year
Specific maintenance cost/ construction cost	5%	Once in four years
Upgrade cost/ construction cost	42%	Once in twelve years

(Source: Circular No.10/2010/TT-BGTVT of Ministry of Transport in October 2010)

**Government financing under the PSC*

Hypothetically, it is possible for the government to fund the My Loi Bridge project through the issuance of government bonds. In such a case, the total financing cost would have been computed in respect of the interest rate of a long-term Vietnamese national bond. According to the Vietnamese State Treasury[18] (2014), the interest rate of a ten-year government bond is 6.19%. Thus, the same rate is used to compute the financing cost of the PSC in the report. It is assumed that the 6.19% interest rate does not change during the concession period.

Revenue under the PSC

The estimation of the revenue under the PSC is based on user fees, which are dependent on yearly traffic volumes and the toll fee. Due to the lack of information on the extent of revenue leakage, the traffic demand of the PSC is assumed to be identical with the PPP's. The determination of the toll fee depends on Circular regulation No. 159/2013/TT-BTC issued by the Vietnamese Ministry of Finance. The provisions of this circular guide the, "collection, payment, and the management of roads use tolls for payback of road construction investment capital".

Setting the discount rates

Discount rates play an important role in quantitative VFM assessments. In order to calculate the net present cost of the project, assuming it were implemented under the traditional procurement method, the interest rate of long-term government bonds would be used to discount the projected cash flow of the project. In addition to this, the WACC is considered to be the discount rate for the cash flow of the project if it is implemented

[18] http://vietstock.vn/2014/10/lai-suat-trai-phieu-chinh-phu-ky-han-5-nam-giam-con-48nam-785-369691.htm

under a PPP. The impact of inflation rates on each of the components in the PSC and SBP are also considered when computing the nominal present value of PSC and SBP. Throughout this research, actual domestic inflation from 2014 to 2015 in the IMF report (IMF, 2016) is used. A forecasted 6% inflation rate is based on the forecast of the Vietnamese State Bank (2016) for the period 2016-2034.

7.3.2. Determination of the PSC and the SBP

7.3.2.1. Determination of the SBP

In order to build a cash flow model of the SBP, the following selected key items were extracted from the My Loi Bridge contract:

(a) The total estimated investment capital for construction of the project is VND 1,337 billion. Out of this amount, the government provides VND 125.96 billion.

(b) The BOT finance structure: the debt and equity ratio of the project is 85% and 15%, respectively. The debt mobilized from banks is VND 811.46 billion in the first year and VND 399.67 billion in the second year. The repayment period begins in the third year of operation, with a repayment period of 22 years, at an interest rate of 11 %.

(c) Expected interest of equity is 11.05%.

(d) The corporate tax rate is 20%.

(e) The concession term is 32 years.

(f) The estimation of the real discount rate for the cash flow of the SBP is based on the WACC. The following rates are used: 11 percent for borrowing cost, 11.5 percent for cost of equity, and ratios of equity/debt of 15 percent to 85 percent. With forecasted inflation of 6%, the nominal WACC becomes15.73%.

(g) The daily traffic demand for the first year is forecasted to be:

- 1,395 vehicles with a capacity of up to 12 seats
- 725 vehicles with a capacity of 12-30 seats
- 438 vehicles with a capacity greater than 30 seats, including medium size trucks;
- 13 vehicles with a heavy truck rating;
- 3 vehicles of special operation.

(h) The number of vehicles is estimated to increase by 32 % in 2015 and 2016. The initial toll for a PCU is set at VND 35,000 in 2015. This toll fee is expected to increase by 18% every three years.

Table 7.2: Net present value of the SBP, at a 16.26% nominal discount rate

Unit: billion VND

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Year	Capital expenditure	Operation cost		Financing cost	Return on investment	Subsidy	Revenue	SBP		
		Management expense	Maintenance cost					Real	Nominal	NPV
2014										
2015										
2016										
2017										
2018										
2019										
2020										
2021										
2022										
2023										

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2037										
2038										
2039										
2040										
2041										
2042										
2043										
2044										
2045										
Total										

(Source: My Loi Bridge BOT contract, 2013)

7.3.2.2. The determination of the PSC

Table 7.3: PSC Calculation of the My Loi project, at a 12.56 % nominal discount rate[19]

Unit: billion VND

This section has been deleted as it contains sensitive information

Year	Raw PSC			Financing cost	Transferred risk		PSC		
	Capital cost	Operation	Revenue		Overrun cost	Traffic	Real price	Nominal price	NPV
2014									
2015									
2016									
2017									
2018									
2019									
2020									
2021									
2022									
2023									
2024									
2025									
2026									
2027									
2028									
2029									
2030									
2031									
2032									
2033									
2034									
2035									
2036									
2037									

[19] 12.56% = (1+6.19%)*(1+6%)-1

2038									
2039									
2040									
2041									
2042									
2043									
2044									
2045									
Total									

7.3.3. Value for Money analysis

7.3.3.1. Calculation of the quantitative VFM

Table 7.4: Comparison of the costs of the project under a PPP and the traditional delivery

*Unit: billion VND**

Items	**PSC (I)**	**SBP (II)**
Outflow (A)	3,201.60	9,136.45
Inflow (B)	1,234.94	6,819.17
Net present of cash flow (A) – (B)	1,966.66	2,317.28
VFM (PSC-SBP)	**-350.62**	

*VND = USD 0.00005

Table 7.4 shows that the whole cost of the project implemented under conventional delivery is cheaper than PPP model. Under the PPP model, the total life cycle cost of the project is expected to be VND 2,317 billion (USD 115 million). In contrast, under the traditional government procurement, the total life cost of the project is projected to be VND 1,966 billion (USD 98.3 million). This leads to a negative VFM, precisely VND -350.62 billion (-USD 17.3 million). Thus, it is not financially beneficial to use the PPP model to finance the My Loi Bridge project.

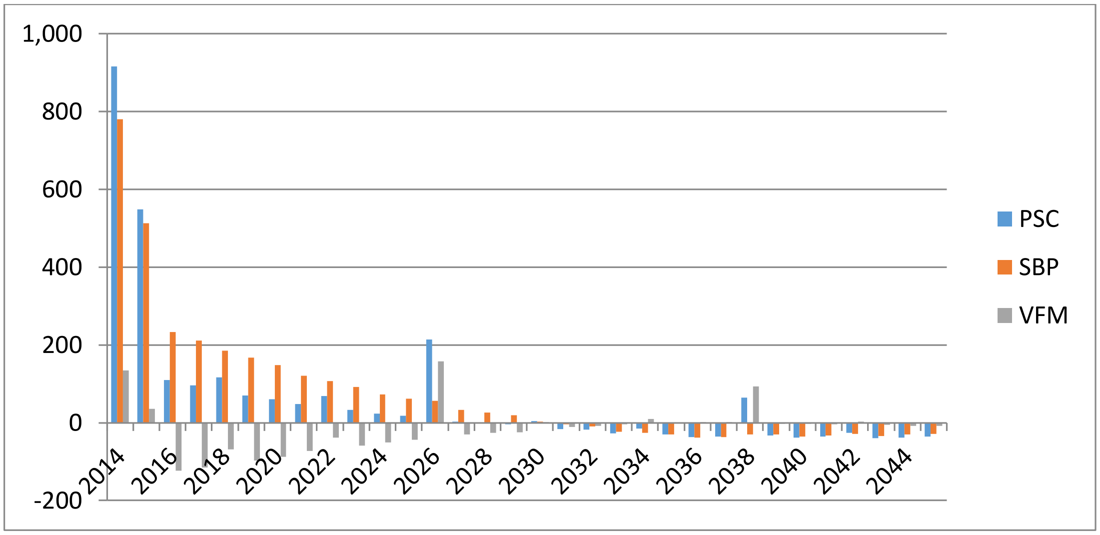

Figure 7.2: Cash flow of the project under PPP and conventional models

Figure 7.2 shows the projected the cash flow of the My Loi Bridge project under PPP and the public sector procurement models. The results show that, the PPP approach leads to larger cost savings during the construction stage, unlike the traditional model. Nevertheless, the traditional model in whole achieves higher value-for-money during the operation stage.

7.3.3.2. The Sensitivity analysis

Next, we evaluate the effect of the cost components (such as PSC capital cost, PSC operation cost and PSC revenue).Using a simple sensitivity, the effect of the changes in these cost components are examined. The result of the simulation is presented in figure below.

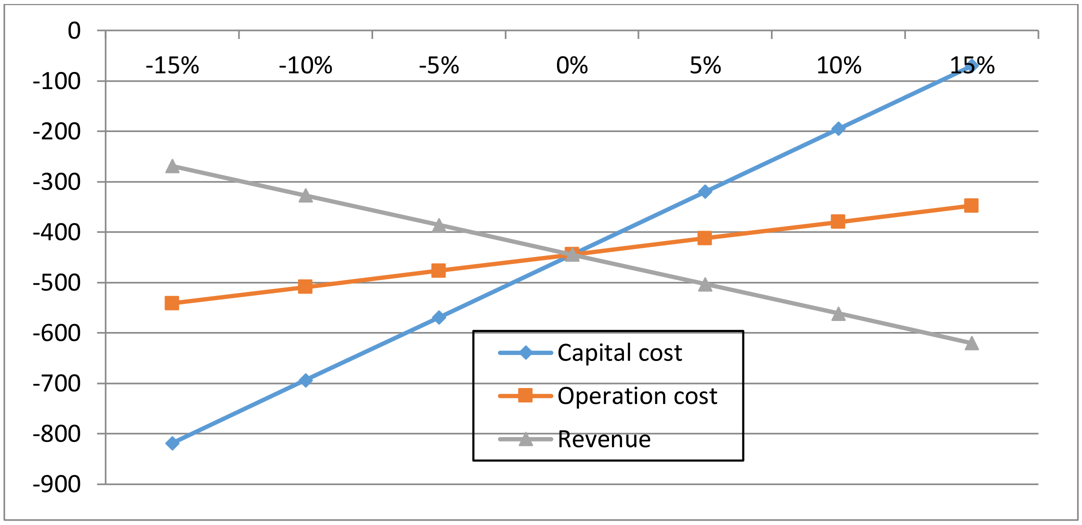

Figure 7.3: Sensitivity analysis of input variables to VFM

Figure 7.3 shows the respective impacts of the input variables on the results of VFM. In the base case, the value of VFM is approximately VND -350.62 billion, an indication that the PPP might not be the better of the two options. If the PSC's capital cost or PSC's operation cost is reduced by 15 percent, the value of VFM increases to nearly VND -50 billion and VND -350 billion, respectively. It is still less than zero all the same. This implies that the conventional procurement approach is better than the PPP model, as far as the implementation of this project is concerned. Furthermore, the VFM is negatively sensitive to changes in the PSC's revenue, and positively sensitive to movements in the PSC's capital cost and PSC's operation costs. This is because an increase in the PSC's revenue reduces the net present value of PSC. While an increase in the PSC's cost items leads to an increase in the net present value of the PSC.

Table 7.5: Sensitivity of the VFM to input variables

Input variables	The change in VFM due to the one percent in increase of input variables		
	Change	**Unit change (billion VND)**	**Reasons**
PSC capital cost	Increase	24.49	An increase in PSC's capital cost leads to a rise in the PSC. Thus VFM increases
PSC operation cost	Increase	6.01	An increase in the PSC management costs make the value of PSC to rise. Thus the VFM increases.
PSC revenue	Decrease	9.72	The increase of PSC revenue makes the value of PSC fall, thus VFM decreases

Table 7.5 describes the movements of the VFM as result of a one percent increase in the input factors (i.e., the PSC's capital cost, PSC's operation cost, PSC's revenue). Among these variables, the PSC capital cost accounts for the largest change in the VFM. For instance, a 1 percent increase in the PSC's capital cost makes the VFM to increase to VND 24.49 billion. Meanwhile, changes in the PSC's operation cost had the least impact on VFM. As an example, a 1 percent increase in the PSC's operation cost makes the VFM to increase to VND 6.01 billion.

7.3.3.3. Monte Carlo Simulations

Table 7.6: Probability distribution of input variables

Variables	Unit	Distribution	Value			
			Minimum	Maximum	Mean	Standard deviation
Construction cost overrun	%	Log-logistic			14.7	54.6
Traffic demand risk	%	Exponential			-36.6	45.6
Interest rate of government bond	%	Pareto			8.08	2.7
Inflation	%	Time series				

As mentioned in chapter 3, the uncertain input variables in the simulation model are: the risks of construction cost overrun, traffic demand risk, values associated with the rate of inflation and the interest rate of government bond. These are all assumed to follow a well-defined probability distribution. As stated in chapter 5, the interest rate of a ten-year government bond is assumed to follow a Pareto distribution, with a mean of 8.08% and a standard deviation of 2.7%. In addition, the determination of the forecasted inflation rate is derived from a time series function that is based on historical data, from 1994 to 2015. The forecasted inflation between 2016 and 2047 are estimated to follow the trend in the followings chart:

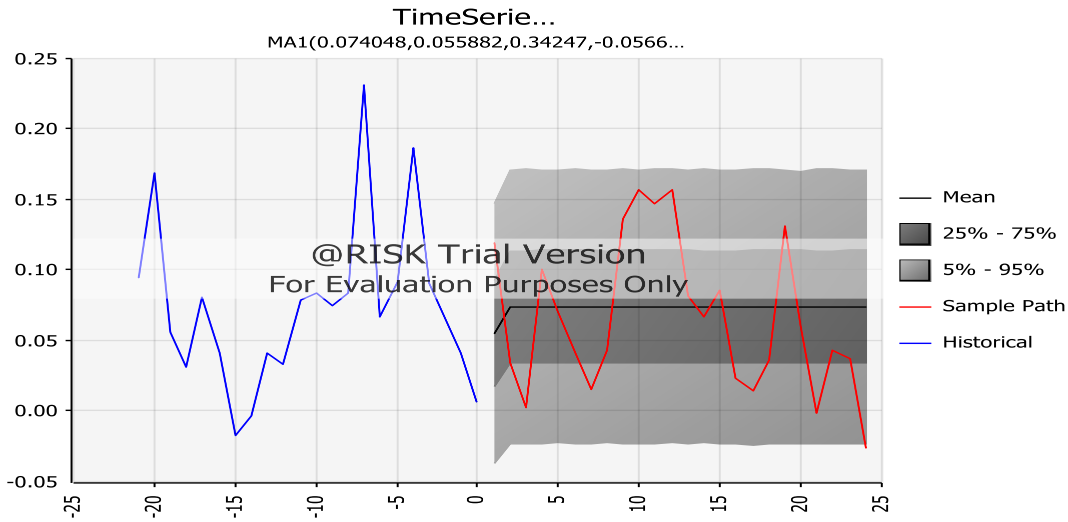

Figure 7.4: Time series of inflation between 1994 and 2047

Outcome simulation

After running 10,000 trials, results of the simulation indicate that the mean value of VFM is VND -164.5 billion (-USD 8.25 billion), with a minimum value of VND -1,179 billion (-USD 0.58 billion), and a maximum value of VND 13,034 billion (see Figure 7.5). Furthermore, there is a 93.7 percent chance that the value of VFM is between VND -805 billion (-USD 0.04 billion) and VND 578 billion (USD 0.3 billion).

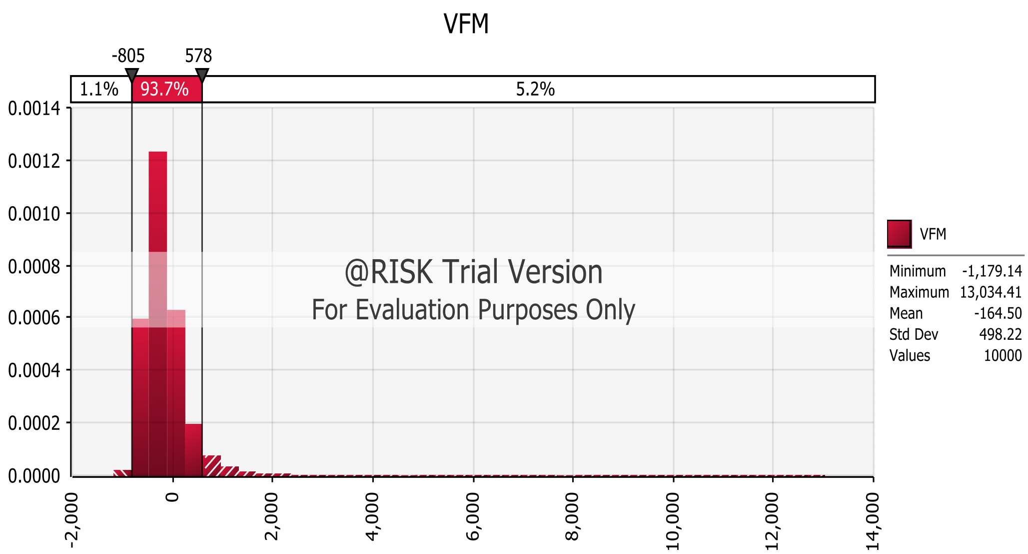

Figure 7.5: Distribution for the project's value for money

Next, we use Figure 7.6 to show accumulative probability of positive VFM

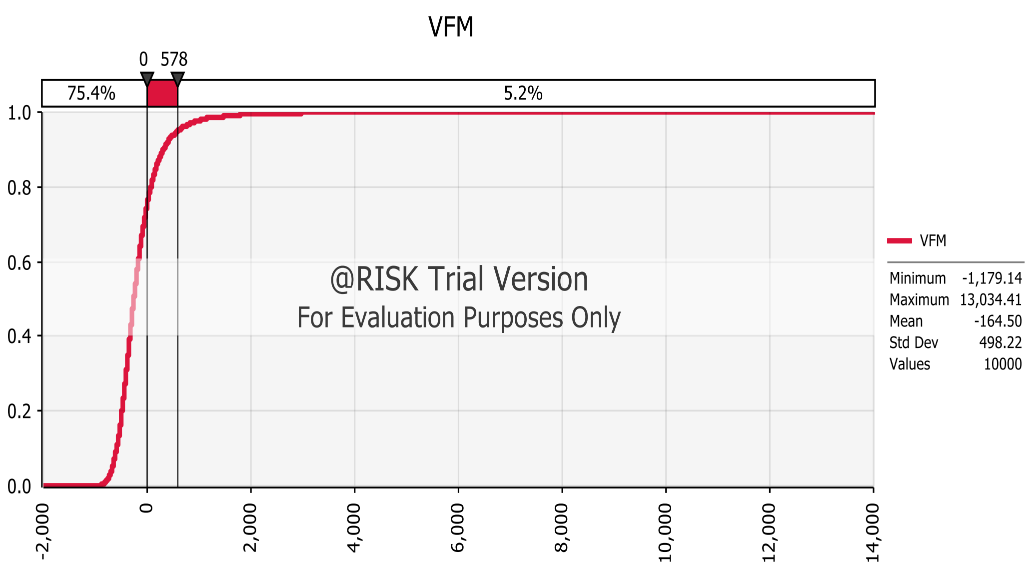

Figure 7.6: Cumulative probability of positive VFM

As can be seen in Figure 7.6, at 24.6% confidence level, the VFM is expected to be positive. In other words, there is a 24.6 percent chance that application of a PPP model to finance the project would produce a better value for the government. Thus, it can be said that the government's decision to encourage private participation in the My Loi project is not financially justified.

Figure 7.7 summarizes the distributions generated in respect of the VFM.

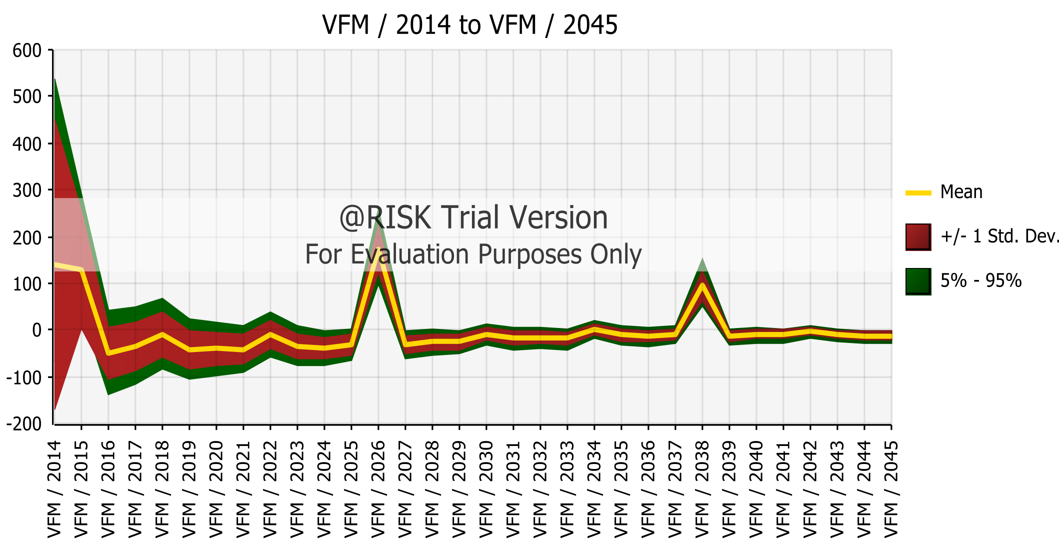

Figure 7.7: Summary trend of VFM between 2014 and 2045

Figure 7.7 shows forecasted changes in value in the VFM of the My Loi project during the 2014 - 2045 period. The x-axis represents time – the concession term of the project (from 2014 to 2045). The y-axis represents the net present value of the VFM. It is possible to see that a positive VFM is realized in the first few years. However, in the subsequence years, the cash flow of the VFM becomes negative. In other words, a PPP model only saves larger cost in the construction phase of the project. In all however, the public sector does better financially than the private sector during the operational phase.

Sensitivity analysis

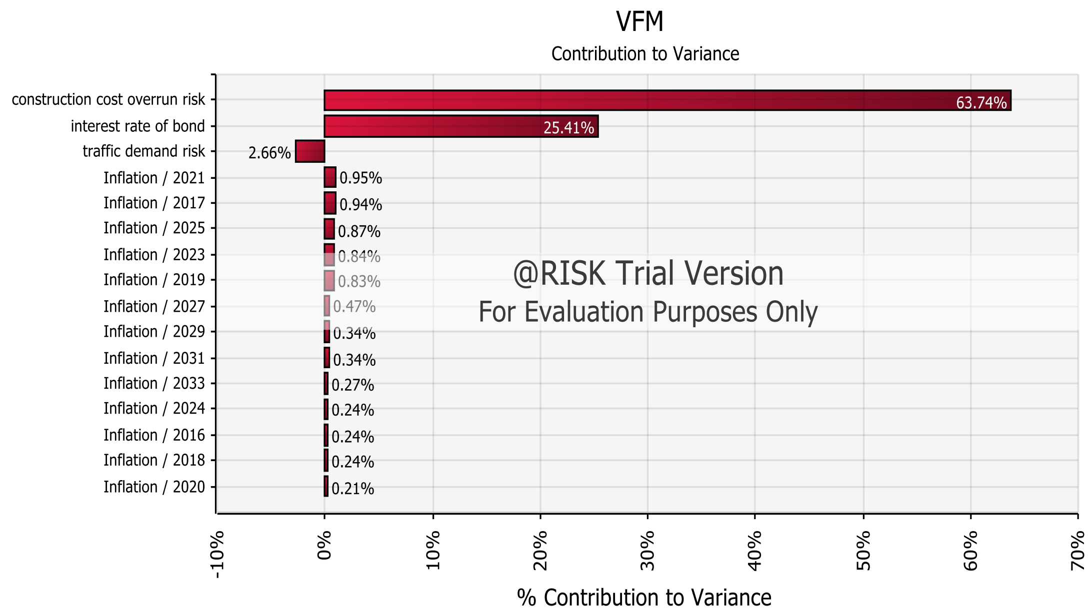

Figure 7.8: Sensitivity tornado graph for the project's value for money

Figure 7.8 shows the sensitivity tornado graph of the VFM. The x-axis represents the variations in the outcome value, while the y-axis represents the input variables. The longer the bar, the greater sensitivity of the VFM is to the corresponding input variables. It can be seen that the VFM is most sensitive to risks of construction cost overrun. On the other hand, the VFM is least sensitive to inflation, particularly in the year 2020. In detail, the errors in the estimation of the construction costs is forecasted to lead to 79.9 percent change in the simulated VFM. On the other hand, inflation in the year 2021 only leads to a 0.11 percent movement in the VFM.

Figure 7.9 shows the scatter graph of the VFM and the risks of construction cost overrun.

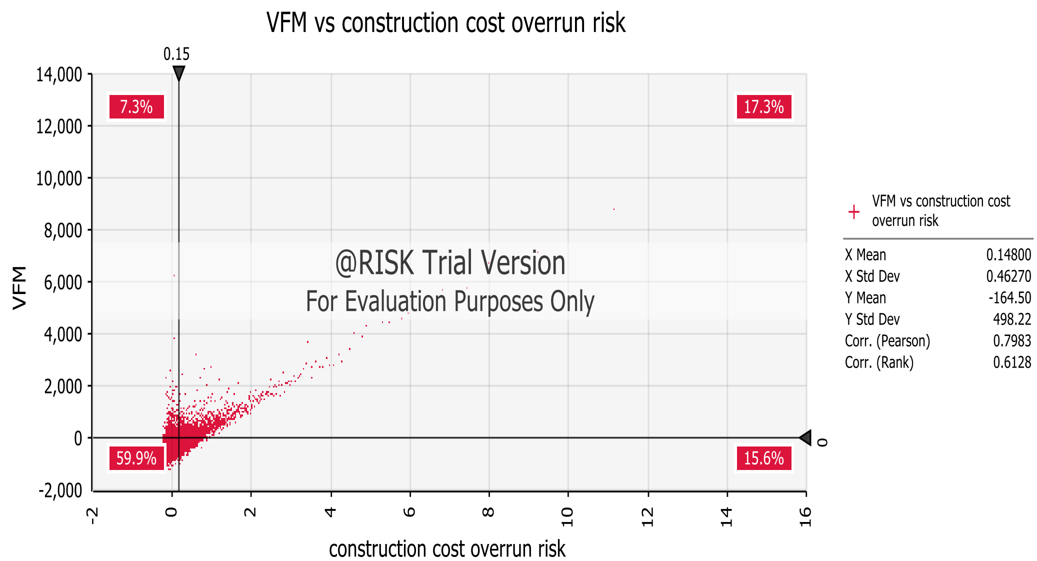

Figure 7.9: Scatter graph of the VFM and the risk of construction cost overrun

In Figure 7.9, the x-axis illustrates the level of inaccuracy in the estimation of the construction cost, while the y-axis represents the value of the VFM. As the information in the graph indicates, if the ratio of the construction cost overrun is larger than 0.15, with the probability of 17.3%, the VFM will be greater than zero. This means that, if the risk ratio is larger than 0.15, there is a 17.3% chance that a PPP model could be more appropriate than traditional public sector procurement. In contrast, if the risk ratio is less than 0.15, the probability falls to 7.3%.

Next, we explore the relationship between traffic demand risk and simulated value of the VFM of the My Loi Bridge project. These are further illustrated in figure 7.10.

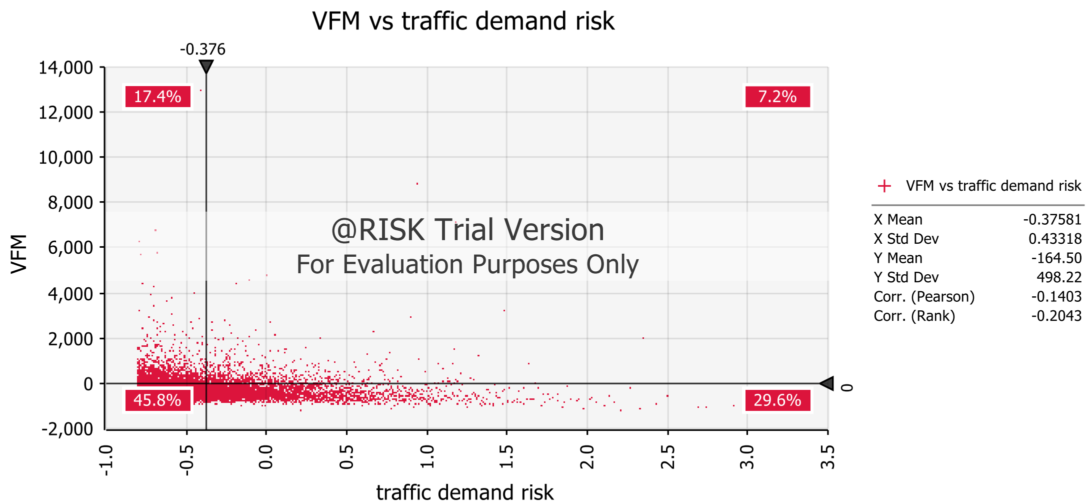

Figure 7.10: Scatter graph of VFM versus traffic demand risk

As shown in figure 7.10, when the risk ratio exceeds -0.376, the probability of the VFM being more than 0 is falls to 7.2%. This means that, there is a 7.2% chance that a PPP model could work better than a traditional government delivery if the traffic demand risk-ratio is larger than -0.376. This probability however increases to 17.4% if the traffic demand risk is less than -0.376. These are further shown in Figure 7.10.

7.4. Conclusion

The following conclusion can be arrived at, based on the VFM analysis and the complementary sensitivity analysis and the Monte Carlo Simulations. These conclusions are summarized as follows:

- The results of the MCSimulation show that the value of the VFM is VND -164.5 billion (-USD 8.25 billion). The probability that this value being positive was found to be 25 percent, suggesting that PPP delivery is not the better option in terms of financial viability, unlike the use of direct government investment.

- The advanced sensitivity analysis shows that that the input that has the largest impact on the results was the risks of construction cost miscalculations. A simple sensitivity analysis also shows that the PSC's capital cost has a significant impact on the VFM.

  In summary, one can conclude that the decision to opt for the private financing was not the best decision as far as the My Loi Bridge is concerned.

Chapter 8: Value for Money analysis of general PPP projects

8.1. Introduction

The aim of this chapter is to apply Bootstrap method to evaluate the general applicability of the PPP model for the development of road projects in Vietnam. Besides, this chapter will use the Structural Equation Modeling to explore non-monetary factors that impact the viability of road PPP projects in Vietnam.

8.2. Quantitative analysis of general PPP projects

As presented in Chapters 5, 6 and 7, the method of Monte Carlo Simulation (MCS) was used to facilitate the computation of the confidence level associated with a positive VFM. However, since the MCS alone could not be used to estimate the probability of VFM for general PPP projects if the sample size is considerably small (only three projects in this case), the Bootstrap method would be used to compute the mean value and the associated confidence interval of VFM of general projects. Theoretically, the quantitative VFM is the difference between the Public Sector Comparator (PSC) and Shadow-bidding price (SBP). Thus, in order to estimate the value of VFM in general, the data on the PSC and SBP of all three case studies will be resampled, using the bootstrapping technique.

There are three main steps involved in the generalization of the quantification of VFM in the context of the Bootstrap method. These include: (1) resampling the original data on the values of the PSC from the three case studies, (2) resampling the initial data of the SBP from the three case studies, and (3) computing the mean values of the quantitative VFM and the confidence interval, based on the new samples of the PSC and PPP.

The procedure guiding the application of the Bootstrap method in the resampling process is illustrated by the following graph.

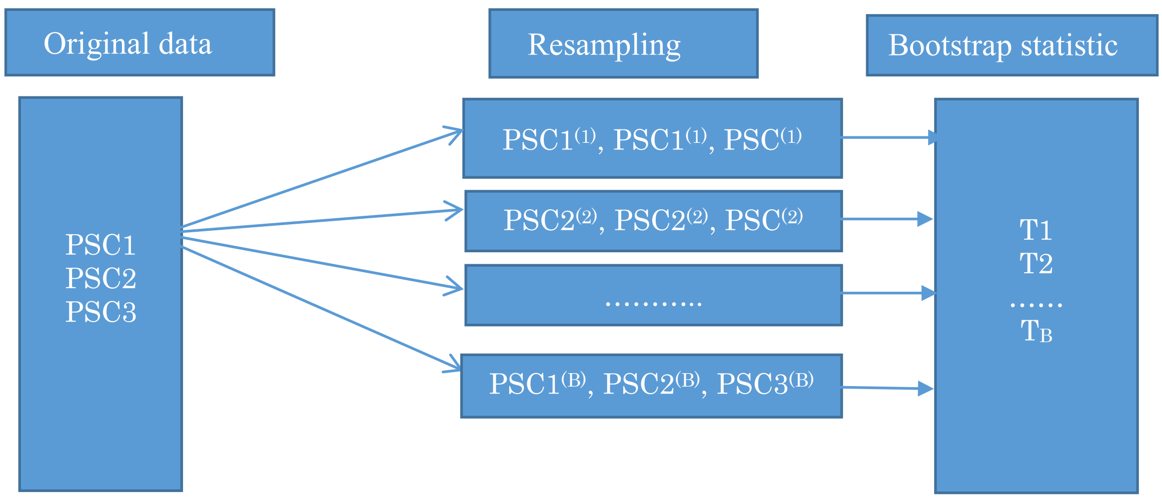

Figure 8. 1: Graphical application of Bootstrap for the value of PSC

As Figure 8.1 shows, the original data on the PSC extracted from the three case studies (PSC1, PSC2, PSC3) is regarded as the original sample. A Bootstrap sample is then generated with replacements from the original sample. Based on the Bootstrap sample, statistics (for example mean or standard deviation) are then calculated. In particular, based on the results of the PSC associated with the three case studies (Phu My project, Trung Luong-My Thuan project, and My Loi project), we have the following values of PSC as PSC1 = VND 1,645 billion; PSC2 = VND 20,205 billion; and PSC3 = VND 1,967 billion. These values are taken to be the original sample. By resampling with a replacement 1,000 times from the initial sample, we have a mean value of the PSC that equals VND 7,867 billion (USD 39.3 million), with a standard deviation of VND 4,900 billion (USD 245 million)

Likewise, Figure 8.2 describes the graphical application of the Bootstrap technique in relation to the values of the SBP.

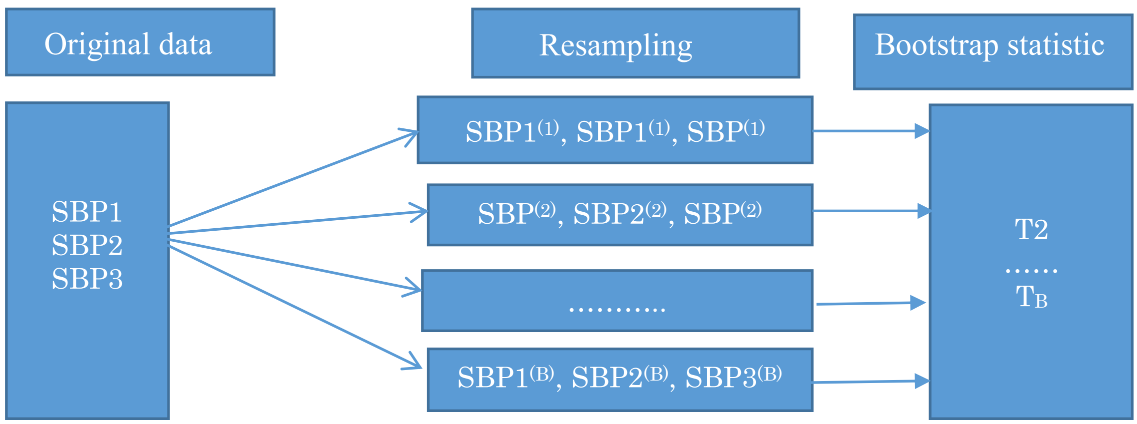

Figure 8. 2: Graphical application of Bootstrap for value of the SBP

As can be seen in Figure 8.2, the original SBP associated with the three case studies (SBP1, SBP2, SBP3) are taken to be the original samples. In particular, given the results of SBP values from the three case studies of three projects, the following values are arrived at: the values of SBP are comprised of SBP1 = VND 2,818 billion; SBP2 = VND 12,971 billion; and SBP3 = VND 2,317 billion. Through a resampling process that involved 1000 replacements from the original sample, the resulting mean and standard deviation of SBP value are VND 6,082 billion (USD 30.4 million) and VND 2,820 billion (USD 141 million), respectively.

Next, we use the Figure 8.3 to show the histogram of the resampled VFM.

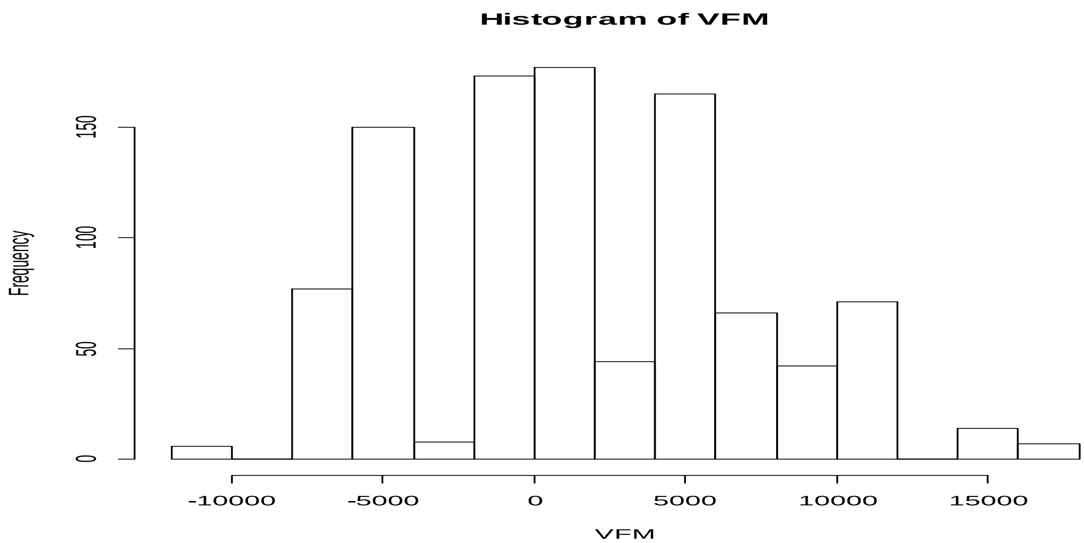

Figure 8. 3: Histogram of 1,000 bootstrap replications of VFM

Figure 8.3 is a histogram of the general quantitative VFM that resulted from the difference between the resampled values of the PSC and the SBP after a 1,000 bootstrap replications. The x-axis represents the value of the quantitative VFM, while the y-axis represents the corresponding frequency of the value-for-money. The mean VFM in general is VND 1,807 billion (USD 90.35 million), with a standard deviation of VND 5,791 billion (USD 289.5 million).

Table 8. 1: Bootstrap confidence interval

Confidence interval	**Range of the VFM** ***(billion VND*)***
95%	-7,700 to 11,469
90%	-5,032 to 819.2
85%	-4,319 to 7,950
80%	-4,208 to 7,816
75%	-1,647 to 5,389
70%	-1,513 to 5,255
65%	-904 to 4,673
60%	-555 to 2,005
55%	1,763 to 1,898

Note: * 1 VND= 0.00005 US$

The information in Table 8.1 shows that the bootstrap confidence interval indicates that, at 95 percent confidence interval, the values of VFM is between -VND 7,700 billion and VND 11,469 billion. Also, at 85 percent confidence interval, the values of the quantitative VFM is between –VND 4,319 billion and VND 7,950 billion. Furthermore, the confidence level at which the quantitative VFM takes a positive value, at the minimum, is 55 percent. According to the theory of quantitative value-for-money assessment, this reflects that there is a 55 percent chance that PPP model may be a better option than direct government financing, in relation to road projects in general in Vietnam. Consequently, the Vietnamese government's decision to use the PPP approach for the development of the road sector seems to be a relatively well warranted.

8.3. Qualitative analysis of general PPP projects

8.3.1. Determination of the evaluation criteria

8.3.1.1. Evaluation Criteria

In order to conduct the qualitative assessment of PPP projects in general, 34 factors were adopted from Thomas et al. (2010). These are further summrized in Table 8.4. According to Cheung and Chan (2011), “there is no strong justification to reinvent work that has previously been discovered by other researchers” (Cheung & Chan, 2011, p. 60). Cheung (2009) also argues that utilizing the same instrument would allow future research to be compared with the earlier one in terms of the same factors that apply to PPPs in different countries.

Table 8.2: Evaluation criteria for the viability of PPP

Code	Evaluation factors
Financial performance &Economic environment	
F1	Project is more cost effective than traditional forms of project delivery
F2	Project can be substantially self-funded or on a non-recourse basis
F3	Project value is sufficiently large to avoid procurement disproportionate procurement costs
F4	Project is of financial interest to the private sector
F5	Project can attract foreign capital
F6	Project is bankable and profitability to attract investors and lenders
F7	Economic environment is stable and favorable
F8	Existence of a sound governmental economic policy
F9	Competition from other projects is limited
F10	There is a long-term demand of the products/service in the community
F11	Level of toll/tariff is acceptable
Technical sophistication	
F12	Project size is technically managed by a single consortium
F13	Possibility of innovative solutions
F14	Availability of government experience in packaging similar PPP projects
F15	Available of experienced, strong and reliable private consortium
F16	Service quality can be easily defined and objectively measured
F17	Contract is flexible enough for frequent changes in output specification
Social system	
F18	The community is understanding and supportive
F19	Project can create more job opportunities
F20	Project is environmentally sustainable
Political and legal environment	
F21	Project is not political sensitive
F22	Political environment is stable
F23	There is political support for the project
F24	The project is compatible with current statutory and institutional arrangements
F25	There is a favorable legal framework
Managerial capacity	
F26	Fairness of new conditions to employees
F27	Possibility of significant redundancy
F28	Supportiveness and commitment of staff to the project
F29	Existence of a resolution for any civil service staff redundancy
F30	Flexibility do decide appropriate risk allocation
F31	Support from the Government is available
F32	Authority can be shared between public and private sector
F33	Possibility of an effective control mechanism over the private consortium
F34	Matching governments strategic and long-term objectives

(Source: Thomas et al., 2010)

8.3.1.2. Factors in the hypothesized structural equation model

The structural equation model (SEM) used throughout this research was designed for five independent variables and one independent variable. The details of these variables are summarized as follows.

(1) The independent variable captures the extent of financial performance and the economic environment were computed from the observations associated with the entries in F1 through to F11.

(2) The independent variable that captures the level of technical sophistication was computed from the observations associated with the entries in F12 through to F17.

(3) The independent variable representing the social system was measured by observations associated with variables F18 to F20.

(4) The independent variable representing the political and legal environment was measured from observations associated with variables F21 to F25.

(5) The independent variable that captures the other issues was computed from the observations associated with variables F26 to F34.

(6) The dependent variables that capture the nature of PPP projects' viability were estimated through a survey on the how satisfied the respondents are with the feasibility of PPP projects in the construction stage (V1) and in operation stage (V2).

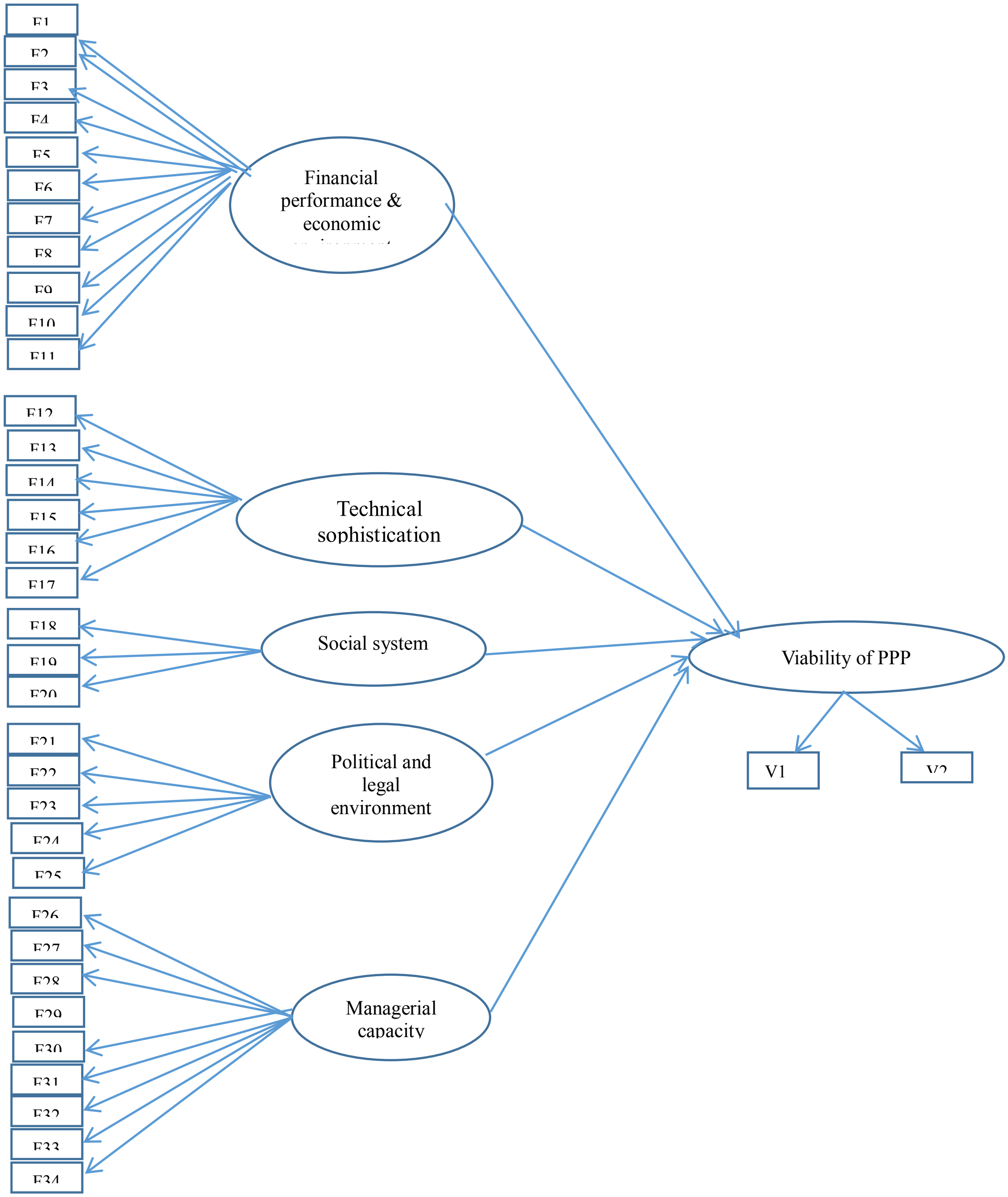

Figure 8. 5: The Structural equation model

A questionnaire survey was used to find out the views on the feasibility of implementing road PPP projects in Vietnam. The questionnaire includes three sections (see Appendix 12). Section 1 refers to questions 1 to 8, under which the respondents are required to provide demographic information:

(a) Name of respondent,

(b) Gender of respondent,

(c) Education background,

(d) Age,

(e) Respondent's position in the organization,

(f) Respondent's organization,

(i) Years of work experience in the transportation field,

(g) The number of PPP projects respondents took part in.

Section 2 consists of the 34 questions that relate to the respondents' view on the important criteria for the viability of PPP in the Vietnamese road sector. The questions are evaluated on a scale of 1 to 5, where "1" means "not important", "2" means "a little important", "3" means "neutral", "4" means "important", "5" means "very important"). Section 3 includes with two questions that ask the respondents about the level of their satisfaction with the feasibility of PPP road projects during the construction and operation phases.

8.3.2. Characteristics of the respondents

Since the aim of the qualitative assessment is to investigate individual views on the factors that are most important for improving the viability of BOT/PPP projects, the main focus was on BOT/PPP stakeholders, those who are directly involved in the implementation of BOT/PPP projects. These included government officers, financers, engineers, insurers, and civil engineering contractors. The survey was carried out in March and April 2016. A total of 300 questionnaires were distributed. A cover letter, as well as a questionnaire, was mailed to each participant. The cover letter explained the aim of the research and survey. A total of 210 questionnaires were returned, approximately 70 percent of the distributed questionnaires. However, nine out of the 210 questionnaires were returned uncompleted. This meant that only 201 questionnaires were useful. With the removal of the 9 uncompleted questionnaires, the percentage of the useful questionnaires becomes 66.7.

The background information on the BOT/PPP stakeholders includes their age, gender, education, years of work experience, place of work, sector and the number of BOT/PPP projects they have participated, which is described in Appendix 10.

Visibly, the information in Appendix 10 shows that, there were 124 and 77 male and female participants, respectively. Regarding their education levels, 72.1% of the respondents have a bachelor's degree, while 22.9% have a master's degree. This indicates that most of the respondents had a relatively high level of education. Additionally, the results of the respondents' ages shows that 21.4% of the respondents were between the ages of 18 and 30, 55.2% were between 31 and 45, and 23.4% were between 46 and 55. Accordingly, most of the respondents were between the ages of 18 and 55, accounted for about 76.4% of the entire respondents.

With respect to the sector in which they work in, the respondents from the public sector were 53 in number, representing 26.4 percent of the respondents. On the other hand, the respondents from the private sector were 148 in number; about 73.6 percent of the respondents. This implies that the majority of the respondents work in the private sector. Once again, the years of working experience in BOT/PPP shows that the number of participants with 6 to10 years of work experience was the largest group, about 25.4 percent of the entire respondents. Those with 11 to 15 years of working experience, at 23.9 percent, is the second largest group in terms of working experience. Those with less than 5 years of working experience account for 20.9%. There were also 37 respondents who have more than 21 years of working experience. The smallest group consists of the respondents who have between 16 and 20 year of working experience, about 11% of the respondents.

In terms of the number of BOT/PPP projects they have participated in, majority of the respondents (about 26.4% of the respondents) indicated that they have worked in two BOT/PPP projects. Only 14 respondents (about 7% of the respondents) indicated that they have worked in five BOT/PPP projects in the past. It can also be seen that 46 of the respondents have experienced working in only one BOT/PPP project. Meanwhile, 38 participants have worked in 3 BOT/PPP projects it the past. In sum, all the respondents have working experience in BOT/PPP projects. It is therefore reasonable to assume that

that the opinions expressed in the survey are from experts in the field.

8.3.3. Data analysis

8.3.3.1. Descriptive analysis

The result of the survey on the views of BOT/PPP stakeholders on the factors that enhance the feasibility of BOT/PPP are synthesized and ranked in the figure that follows.

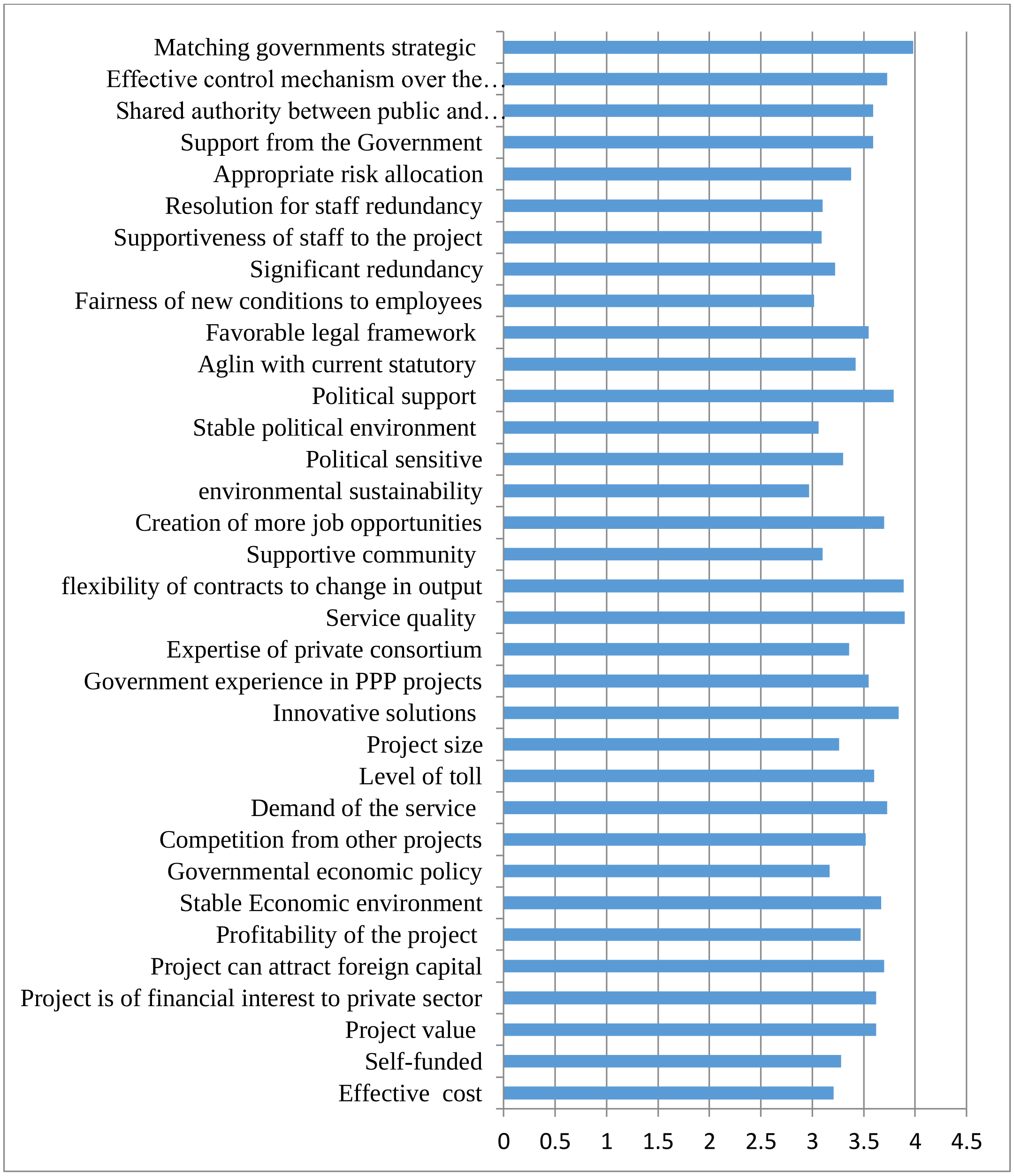

Figure 8.5: Synthesis of the evaluation factors

Figure 8.5 show the mean scores of the factors generated from the views of the respondents. Five top important factors can be identified. These include: "matching long-term objectives", "service quality", the "flexibility of the contracts to changes in output", "innovative solutions", and "political support". It is therefore reasonable to conclude that viable PPP must put these factors into consideration. Indeed, it is not surprising that one of the leading issues that host governments must address during the implementation of PPP happens to be the service quality. Traditionally, PPP projects require a larger amount of investments. This makes an explicit consideration of the level of service quality that the PPP project delivers an important criteria for justifying the use of an expensive PPP approach. Also, the "flexibility of contracts to changes in output" is third ranked factor in terms of importance. In a usual setting, during the first year of the operation stage, the revenue of PPP projects that comes from toll fees may be not enough to cover for the expenses. To manage PPP projects effectively, some level of flexibility should be included in the contract to address uncertain revenues. The fourth highest ranked factor is innovative solutions. This result is in line with the findings in Takim et al. (2011), which also reveal that innovative solutions are one of the top six important considerations for achieving the best value in PPP projects in Malaysia. According to Spiering (2006), innovation is a method for saving cost in things like construction or operation; and it is always considered as one of the benefits of PPP scheme. This suggests that, PPP is expected to be a source of innovative solutions in infrastructure service delivery.

The fifth critical factor is political support. Jacobson and Choi (2008) argue that political support is necessary for any public project. Also, Osei et al. (2015) argue that the support from political leaders is needed to encourage more private investors in PPP projects. Likewise, the University Transportation Center of Alabama (2010) argue that one of the factors critical for their PPP's success or failure was the level of political support available for the PPP projects. Essentially, it is very difficult to procure successful PPP projects if these have no support from the policy makers, or worse still, if the general public is opposed to use of the PPP model for the implementation of the project. Thus, in deciding the appropriateness of PPP, a close attention should be paid on the public opinion, and the possibility of gaining political support.

We can also see that the seven factors that have the lowest mean scores are "governmental economic policy", "supportive community", "environmental sustainability", "stable political environment", "fairness of new conditions to employees", "significant redundancy", "supportiveness of staff to the project", and the "resolution for staff redundancy" related issues.

8.3.3.2. Reliability tests

Table 8.3: Reliability statistics of the Cronbach's alpha

	Total valid cases	**Cronbach's alpha**	**Number of items**
Overall	201	0.91	34
Financial performance & economic environment	201	0.794	10
Technical sophistication	201	0.675	5
Social system	201	0.72	2
Political and legal environment	201	0.715	4
Managerial capacity	201	0.87	9

To test the internal consistency of the scales, the Cronbach's alpha is carried out. Table

8.3 shows the reliability statistics of the Cronbach's alpha. It can be seen that the overall Cronbach's alpha is 0.91 (>0.6) at sig. = 0.000. This suggests that the respondents have a high level of consensus on the evaluation factors. However, the Corrected Item-Total Correlation coefficients of factor F11, F12, F19, and F23 is less than 0.3. It means that these factors do not have good correlation with the overall scale. Hence, these factors were removed in order to achieve a higher rate of reliability.

8.3.3.3. Explanatory factor analysis

In order to carry out a factor analysis, the sample size needs to be taken into consideration. In this regard, there are various recommended approaches. The sample to variable ratio is one of the most popular recommendations. According to Hair et al. (2010), the sample to variable ratio should be 5:1. It means that there should be at least five participants per a variable in a survey. Accordingly, the required sample size should be at least 180 for an explanatory factor analysis that is based on 36 variables. In the research, 201 samples were used. This number meets the recommended sample size in terms of sample-variable ratio.

In order to examine whether the collected data is fits enough for a factor analysis, the KMO test and the Bartlett's Test of sphericity were carried out. The results reveal that the Bartlett's Test of sphericity is 2080.152 with a significance level of 0.000. The result also shows that the KMO is 0.854. These are further displayed in Table 8.4.

Table 8.4: Result of the KMO and Bartlett's Test of Sphericity

	Bartlett's Test of Sphericity		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	Approximate Chi-Square	Degree of freedom	Significance
0.854	2080.152		0.000

Given the suggestion in Hair et al. (2010), any KMO value between 0.8 and 0.9 is considered good. Besides, the significance level of the Bartlett's Test of sphericity, at 0.000 (<0.05) confirms that the survey data is very suitable for a factor analysis, and that the relationship among the elements is good enough.

Next step is to identify the number of factors to be kept for analysis. This can be indicated in Figure 8.6.

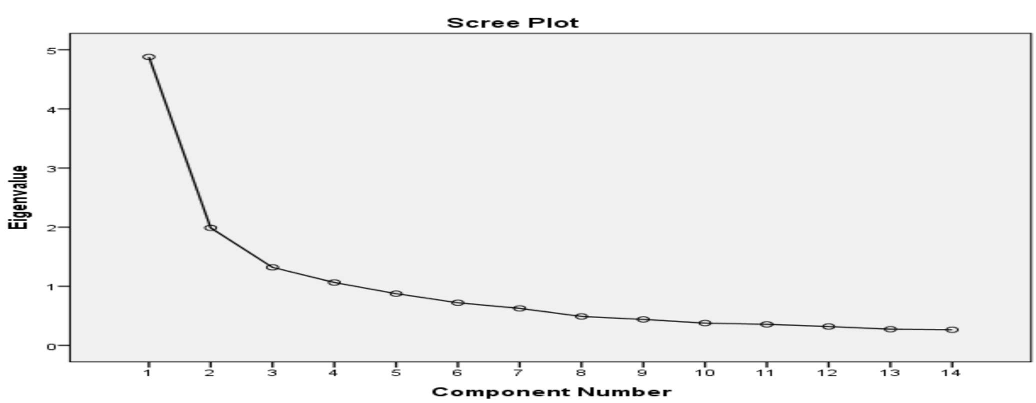

Figure 8.6: Screen test for factor analysis

As shown in Figure 8.6, three components are drawn because they all have an eigenvalue larger than 1. Accordingly, the total amount of variance extracted by the three components is shown in Table 8.5.

Table 8.5: Total variance

Component	Initial eigenvalues			Rotation sums of squared loadings
	Total	% of variance	Cumulative (%)	Total
1	6.587	32.933	32.933	6.352
2	3.231	16.155	49.088	3.373
3	1.801	9.003	58.091	2.796

As shown in Table 8.5, a cumulative percentage of variance of 58.09 percent indicates that the three components explain 58.09 percent of the total variance.

After choosing the number of components to be retained, we should examine the factor rotation. These are further shown in Table 8.6.

Table 8.6: Rotated component matrix

Factors	Components		
	1	2	3
F27	.868		
F26	.862		
F29	.853		
F22	.813		
F28	.806		
F8	.743		
F20	.722		
F18	.657		
F9	.612		
F1	.610		
F4		.771	
F5		.757	
F3		.679	
F6		.676	
F7		.661	
F10		.581	
F17			.791
F16			.785
F25			.717
F24			.709
Cronbach's alpha	**.916**	**.783**	**.767**

After two times of the factor rotations, it was possible to identify 10 factors that have a factor loading that is less than 0.5. These are therefore eliminated, so they are eliminated out from the model. The eliminated factors include: F15: Expertise of the private consortium, F13: innovative solutions, F21: political sensitivity, F14: availability of government experience, F2: self-funded, F33: effective control mechanism, F31-: support from the government, F30: appropriate risk allocation, F32: shared authority and F34: matching long-term objectives.

Based on the rotated component matrix in Table 8.6, it is possible to arrive at the following three dimensions. First, under group 1 combines, we have 10 factors. The factors under group 1 includes: the fairness of new conditions to employees, the resolution for staff redundancy, significant redundancy, supportiveness of staff to the project, stable political environment, governmental economic policy, environmental sustainability, limited competition from other projects, supportive community, and effective cost. These factors under group 1 are correlated to managerial capacity. Together, they account for 32.93% of the total variance. Additionally, the fairness of new conditions to employees, resolution for staff redundancy, significant redundancy, and supportiveness of staff to the project seem to be the most important sub-factors under component 1, with loading values that correspond to 0.868, 0.862, 0.853, 0.813 and 0.806, respectively). This means that the management of PPP projects needs to put the interests of employees into consideration.

In addition, the evaluation of PPP's feasibility should take the prevailing "governmental economic policy" into consideration. A suitable government policy will help ensure that the private sector is able to do business in the country. It may help to reduce the project costs.

Next, the result indicates that group 2 consists of six factors. These include: whether the project is of financial interest to private sector, the ability to attract foreign capital, sufficient project value, profitability of projects, stable economic environment, and long-term demand of service. These are associated with financial performance and economic environment, which represents 16.15% of the total variance. In addition, financial interest to private sector and the ability to attract of foreign capital are the two most critical sub-factors under component 2, with their loadings equaling 0.771; and 0.757, respectively.

Group 3 consists of four factors. These include service quality, flexible contract for change in output, favorable legal framework and the project's alignment with current statutory provisions. These are all related to the degree of technical sophistication and the legal environment, which account for 8.14% of the total variance. As noted in Hardcastle (2005), technical problems are one of the most important factors in considering the feasibility of a project. Besides technical factors, respondents perceive legal factors as important. In addition, the consistency with institutional arrangements could help ensure that the working environments of PPP are transparent and conducive.

In summary, each factor's loading is larger than 0.6. This means that convergent validity is good. Likewise, the Cronbach's alpha for each group is larger than 0.7, which implies that factor analysis is reliable.

8.3.3.4. Development of Structural Equation Modeling

Structural equation model analysis

Three factor groups from the explanatory factor analysis were used in the structural equation modeling (SEM) in order to investigate the effects of the factors on the viability of PPP projects. To facilitate the discovery of the best-fit model for examining the relationships between evaluation factors and PPP's viability, the Statistical Package for the Social Sciences software (SPSS) 20 and Amos 22 was used. In addition, in order to evaluate the fitness of the models, some model fit indices were used. These include (1) the minimum fit function chi-square ($\chi 2$) ratio degree of freedom test, (2) the root mean square error of approximation (RMSEA) (Steiger, 1990), (3) the comparative fit index (CFI) (Joreskog & Sorbon, 1989), (4) Tucker-Lewis Index (TLI) (Tucker &Lewis, 1973), and (5) the standardized root mean square residual (SRMR) (Hu & Bentler, 1999).

Initial model

The initial SEM model is illustrated in Figure 8.12. It comprises of three independent variables and one dependent variable. The independent variables includes: (1) managerial capacity, (2) financial performance and economic environment, and (3) technical sophistication and legal environment. The dependent variable is the viability of PPP projects. A total of 22 observed variables are utilized to develop the four constructs.

First, we check the goodness-of-fit index in the initial model, using chi-square, CFI, NFI, and RMSEA. In this initial model, the chi-square value of 651.991 with 203 degrees of freedom is statistically significant at 0.000 (less than 0.05 significant level). This suggests that the model is unfit or inadequate. However, it has been argued that a Chi-Square test is usually very sensitive to increases in the number of indicators (Hair et al., 2010). According to Byrne (2010), the $\chi 2$ ratio/degrees (CMIN/DF) can be considered as one of the options for dealing with such issues. Particularly, the CMIN/DF in the initial model of the research has a value of 3.21, at a marginal level of 0.5 suggested in Hooper et al. (2008).

As shown in table 8.7, the value of CFI is 0.793, which is lower compared to the accepted level, 0.9, as suggested in Hu and Bentler (1999). Likewise, the value of NFI equals 0.728, which does not achieve the recommended level of 0.9 suggested in Hu and Bentler (1999). Also, the goodness-of-fit index RMSEA has a value of 0.106, which is larger than the recommended level, a value between 0.5 and 0.8, as recommended in Browne and Cudeck, (1993). In all, with a TLI value of 0.764 (<0.9), the result of model fit indices implies that the model poorly fits the data.

Table 8.8 illustrates the regression coefficients of the structural equation model. The result shows that the relationship between managerial package and the PPP viability was not statistically significant (the p-value of managerial capacity is larger than 0.05). In other words, managerial capacity had little to no impact on the feasibility of PPP.

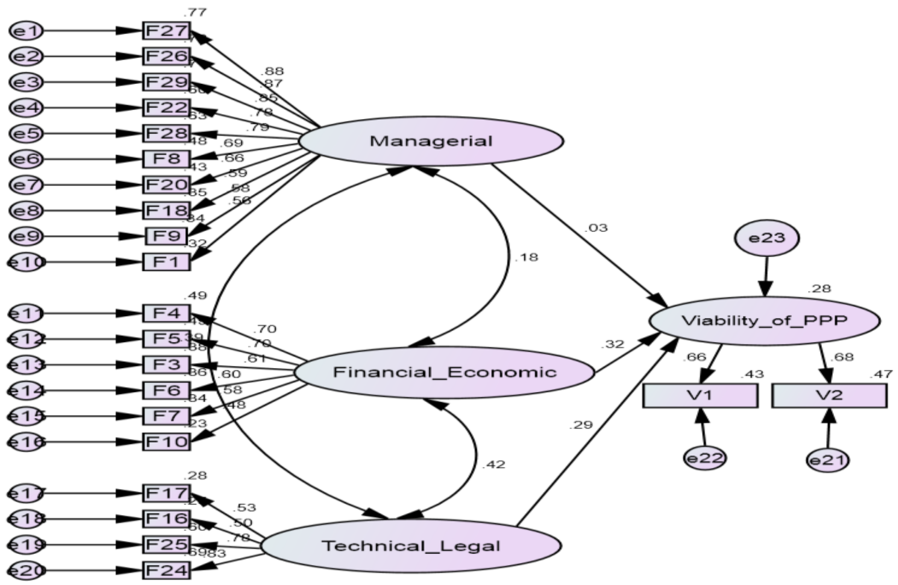

Figure 8.7: Standardized path estimates for initial structural equation model

Note: Managerial =managerial capacity; Economic financial = Financial performance &economic environment; Technical legal = technical sophistication & legal environment.
F27= "Possibility of significant redundancy"
F26 = "Fairness of new conditions to employees"
F29 = "Existence of a resolution for any civil service staff redundancy"
F28 = "Supportiveness and commitment of staff to the project"
F8 = "Existence of a sound governmental economic policy"
F20= "Project is environmentally sustainable"
F18= "The community is understanding and supportive"
F9 = "Competition from other projects is limited"
F1 = "Project is more cost effective than traditional forms of project delivery"
F4 = "Project is of financial interest to private sector"
F5 = "Project can attract foreign capital"
F3 = "Project value is sufficiently large to avoid procurement disproportionate procurement costs"
F6= "Project is bankable and profitability of the project is sufficient to attract investors and lenders"
F7 = "Economic environment is stable and favorable"
F10= "There is a long-term demand of the products/service in the community"
F17= "Contract is flexible enough for frequent change in output specification"
F16= "Service quality can be easily defined and objectively measured"
F25= "There is a favorable legal framework"
F24= "The project is compatible with current statutory and institutional arrangements"

Table 8.7: Fit indices for the alternative structural equation model

Indices	*Good model fit*	*Accepted model fit*	*References*	*Initial model*	*Final model*
CMIN/DF	Value <2	<5	Hooper, D et., al (2008)	3.21	1.74
Significance	>0.1	>0.05	Hair et al. 2010	0.00	0.00
RMSEA	Values <0.05	<0.08	Browne &Cudeck, (1993)	0.10	0.06
CFI	Values >0.95	>0.90	Hu&Bentler (1999)	0.79	0.95
NFI	Values >0.95	>0.90	Hu&Bentler (1999)	0.72	0.89
TLI	Values >0.95	>0.90	J.J.Hox & T.M. Bechger (1998)	0.76	0.93

Table 8.8: Alternative structural equation models

Model	**Relations**	**Estimate**	**P**	**Significant**
Initial model	H5: Managerial → viability of PPP	0.03	0.716	*No*
	H1: Financial and economic → viability of PPP	0.32	0.005	Yes
	H2: Technical and legal → viability of PPP	0.29	0.020	Yes
Final model	H1: Financial and economic → viability of PPP	0.34	0.003	Yes
	H2: Technical and legal → viability of PPP	0.31	0.008	Yes

Table 8.9: Covariance between the latent factors in the alternative models

Model	**Correlation path**	**Estimate**	**Standard errors**	**P**
Initial model	Managerial ⟷ Technical and legal	0.11	0.05	0.03
	Managerial ⟷ Financial and economic	0.17	0.04	***
	Technical and legal ⟷ Financial and economic	0.13	0.03	***
Final model	Technical and legal ⟷ Financial and economic	0.14	0.03	***

Note: *** means as P-value < 0.01

Final model

In order to improve the fitness of the model, managerial capacity was removed from the initial model. The fit indicators in the new model are much better than those in the initial model (as presented in Table 8.7). More specifically, the value of the CMIN/DF under the new mode is 1.796, which is very good compared to the previous model. Likewise, a CFI value of 0.932 was achieved, which is also acceptable when compared with the desired level of 0.9 to 0.95 (Hu & Bentler, 1999).

Next, the goodness-of-fit index TLI value of 0.91 was found to be acceptable. In addition, the value of the RMSEA is 0.064, which seems good enough. This shows that our model fits well. Under the new model, factor F10 has a factor loading of 0.48. According to the Hair et al. (2010), one should remove any factor loading less than 0.5. Therefore, factor F10 was moved from the model.

Figure 8.8 describes the path diagram of the final model, after the deletion of managerial capacity and factor F10 from the initial model. Again from Table 8.7, the fit indices in the modified model improved to achieve the desired threshold of a fit model. In particular, the CMIN/DF value decreases from 3.21 to 1.74. The RMSE value also dropped from 0.106 to 0.06, while the CFI increased from 0.79 to 0.95. The TLI value also increased from 0.76 to 0.93. It is therefore reasonable to conclude that the alternative model is a better fit than the initial model.

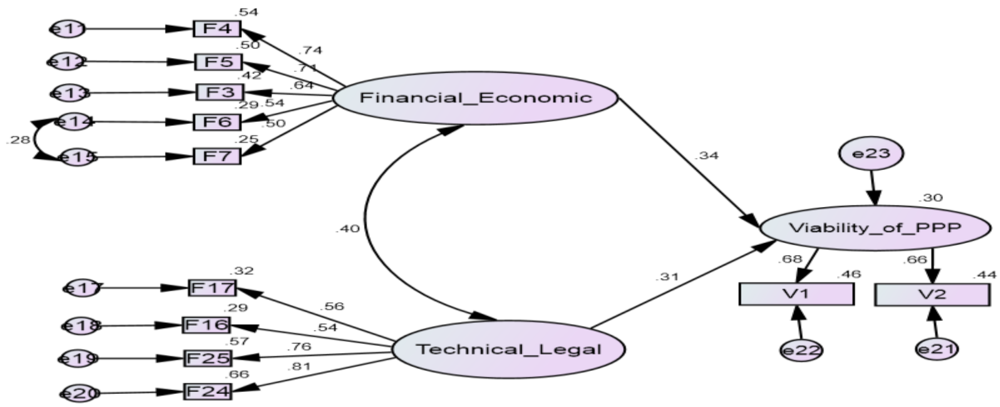

Figure 8.8: Standardized path estimates for final structural equation model

Note: Economic financial = Financial performance &economic environment; Technical legal = technical sophistication & legal environment.

F4 = "Project is of financial interest to private sector"
F5 = "Project can attract foreign capital"
F3 = "Project value is sufficiently large to avoid procurement disproportionate procurement costs"
F6= "Project is bankable and profitability of the project is sufficient to attract investors and lenders"
F7 = "Economic environment is stable and favorable"
F10= "There is a long-term demand of the products/service in the community"
F17= "Contract is flexible enough for frequent change in output specification"
F16= "Service quality can be easily defined and objectively measured"
F25= "There is a favorable legal framework"
F24= "The project is compatible with current statutory and institutional arrangements"

Testing the reliability and validity of final SEM model

In order to measure the validity and reliability of the SEM model, several indicators are suggested in the literature (Fornell & Larcker, 1981; Hair et al., 2010; and Wong, 2013). Following the existing studies, the Composite Reliability (CR) and Average Variance Extracted (AVE) are used in this study to test the reliability of the SEM model. As shown in Table 8.10, all three Composite Reliability figures were larger than the 0.6 suggested in Bagozzi et al. (1991). This is an indication of high internal consistency among the three latent variables. On the other hand, the AVE of each latent variable seems to be smaller than the threshold of 0.5 suggested in Hair et al. (2010). As an example, the AVE of financial performance and economic environment, the AVE of technical sophistication and legal environment, and the AVE of viability are 0.40, 0.46, and 0.45, respectively. However, according to Fornell and Larcker (1981), if the AVE is smaller than 0.5, but composite reliability is larger than 0.6, the construct's convergent validity is still good. Therefore, it can be concluded that the final SEM model has an acceptable level of reliability and validity.

Table 8.10: Construct validity of final SEM model

Factor	Factor loading	Squared multiple correlation	AVE	CR
Financial performance & economic environment			*0.40*	*0.77*
F4	0.74	0.54		
F5	0.71	0.50		
F3	0.64	0.42		
F6	0.54	0.29		
F7	0.50	0.25		
Technical sophistication & legal environment			*0.46*	*0.77*
F17	0.56	0.32		
F16	0.54	0.29		
F25	0.76	0.57		
F24	0.81	0.66		
Viability of PPP			*0.45*	*0.62*
V1	0.68	0.46		
V2	0.66	0.44		

Analysis of Path diagram in the final SEM model

The results of the path analysis indicate that financial performance and economic environment, and technical sophistication and legal environment significantly affect the viability of PPP projects at a p-value less than 0.05. As an example, regression coefficient between financial performance and economic environment and the viability of PPP have a p-value of 0.003. Also, the regression coefficient of technical sophistication and legal environment on the viability of PPP has a p-value of 0.008 (as shown in Table 8.8). The two latent factors account for 30 percent of the total variance of the viability of PPP. It also means that hypothesis 1 and hypothesis 2 and 3 can be accepted, while hypothesis 4 and 5 are rejected. In other words, financial performance and economic environment, and technical sophistication and legal environment are influential factors.

The direct effect of financial performance and economic environment on the viability of PPP is indicated by the regression coefficient of 0.34, while the direct effect of technical sophistication and legal environment on the feasibility of PPP is indicated by the regression coefficient 0.31. Additionally, correlation coefficient between financial performance and economic environment, and technical sophistication and legal environment is 0.4 (as shown in Table 8.11 and Figure 8.9).

As argued in Hair et al. (2010), the size of a direct effect is a function of direct effects that make it up, while the total effect is a sum of indirect and direct relationships between constructs. In this case, the indirect effect of financial performance and economic environment on the viability of PPP via technical sophistication and legal environment can be computed as follows: 0.40*0.31 = 0.12. This leads to a total effect of 0.46. Likewise, the indirect effect of technical sophistication and legal environment on the viability of PPP through financial performance and economic environment is measured as follows: 0.40*0.34 = 0.14. Accordingly, the total direct effect becomes 0.45.

The viability of PPP is therefore estimated, using the following equation:

$\hat{y}$ *viability* = 0.34*(Financial performance & economic environment) +0.31*(Technical sophistication & legal environment).

Accordingly, the total effect of financial performance and economic environment on the viability of PPP is the sum of the direct and indirect paths, which is computed by the following function:

$\hat{y}$ viability 1 = direct + indirect = 0.34 + 0.40*0.31 = 0.46

Likewise, the total effect of technical sophistication and legal environment on the viability of PPP is calculated by the following:

$\hat{y}$ viability 2 = direct + indirect = 0.31 + 0.40*0.34 = 0.44

Next, Table 8.11 summarizes the correlation between the latent factors in final model.

Table 8.11: Correlation between the latent factors in final model

	Estimated

Correlation Path			Direct effect	Indirect effect	Total effect
Economic and Financial	→	Viability of PPP	0.34	0.12	0.46
Technical and Legal	→	Viability of PPP	0.31	0.13	0.44

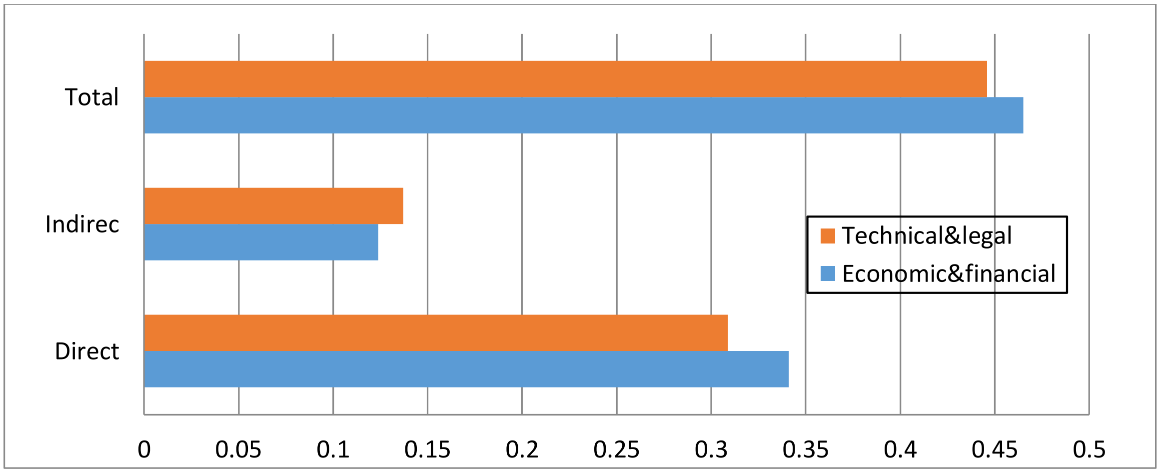

Figure 8.9: Correlation between factors and viability of PPP

As indicated on Figure 8.8, the larger the coefficient of the factors, the more these factors will affect the viability of PPP. As can be seen in the chart, the direct effect of financial performance and economic environment factors on the viability of PPP is larger than the direct effect of technical sophistication and legal environment. On the other hand, the indirect effect of financial performance and economic environment factors on the viability of PPP is bigger than the indirect effect of technical sophistication and legal environment on the viability of PPP. As a result, financial performance and economic environment seem to have a greater impact on the viability of PPP.

One possible explanation regarding the importance of the two factor groups for the viability of Vietnamese PPP projects can be attributed to the context of PPP projects in Vietnam. First, the use of modern technology to construct and operate road PPP projects is still severely limited. Some contractors still use traditional technology, which are sometimes adversely affected by the project's scale and level of sophistication. Li et al. (2005) advocates that technical aspects are normally one of the most significant considerations in the study of a project's viability. Hence, it is necessary to review all technical issues involved in PPP.

On the other hand, in spite of Vietnam's more than two-decade experience in the use of the PPP approach, the regulatory provisions guiding PPP scheme are still unclear and inconsistent. Such of the ambiguities have caused certain difficulties for private sectors in the past. Therefore, besides technical feasibilities, legal factors are of equal importance in to the PPP's viability. An improved legal framework may significantly boost the feasibility of PPP projects implementation. A consistent institutional arrangement could help create a healthier environment for PPP, increase transparency, and mitigate corruption. Secondly, there are several PPP projects that have relatively small capital, with their revenue coming mainly from toll fees, which sometimes is unreliable and unable to cover expenses. In such case, the private firms are faced with the problem of insufficient income.

Multiple group analysis

A multiple group analysis was applied to evaluate the correlations among the constructs across groups regarding gender, sector, experience and the number of projects they have been involved in in the past. First, we checked if the coefficients in the unconstrained model are equal among groups. Secondly, we estimated the constrained model where the fixed parameters were constrained to be equal among the groups. Last, we conducted the Chi-square difference test. Statistically, if chi-square difference test is not significant; it means that there is no difference between the unconstrained and constrained models. In contrast, if chi-square difference test happens to be statistically significant, it would suggest that there is a difference between the two models.

***Analysis of the gender groups**

Table 8.12: Comparison of the chi-square between unconstrained and constrained models in gender group

Overall model	Chi-square	Degree of freedom	P-value
Unconstrained	128.311	80	
Fully constrained	131.283	90	
Difference	2.972	10	**0.98**

Table 8.12 shows the chi-square comparisons of the unconstrained and constrained models for male and female groups. The result reveals that the chi-square difference is 2.972, with a degree of freedom that equals 10 and a p-value of 0.98 (>0.05). This shows that the chi-square of the unconstrained model is equal to the chi-square of the constrained model. In other words, there is no statistical difference between the views of female and male respondents on the factors that affect the viability of PPP.

***Analysis of the sector groups**

Table 8.13: Comparison of the chi-square between unconstrained and constrained models in sector group

Overall model	Chi-square	Degree of freedom	P-value
Unconstrained	119.666	80	
Fully constrained	143.678	90	
Difference	24.012	10	**0.0075**

Table 8.13 illustrates the chi-square comparisons of the unconstrained and constrained models between the public sector and the private sector. The result shows that the chi-square of the unconstrained model is 119.666 with 80 degrees of freedom, while the chi-square of the constrained model is 143.678 with 90 degrees of freedom. As a result, the chi-square difference of 24.012 with 10 degrees of freedom and a p-value of 0.0075 (<0.05) indicates that the chi-square of the unconstrained model is different from the chi-square of the constrained model. This demonstrates that there is a significant difference between opinions of the public and private sector on the factors that affect the viability of PPP. The multiple groups in the unconstrained model are used in the path analysis. In addition, a review of the goodness-of-fit of the unconstrained model is summarized in as follows.

Table 8.14: Fit indices for the unconstrained structural equation model

Indices	**Value**
CMIN/DF	1.496
CFI	0.93
GFI	0.904
TLI	0.904
RMSE	0.05

As can be seen in Table 8.14, CMIN/DF = 1.496 < 2, the CFI = 0.93 >0.9, and the GFI = 0.904>0.90; TLI = 0.904 >0.90 and RMSE = 0.05 reveals that the model fit the data collected.

Next, we use Table 8.15 to show a comparison of the view of the public sector and private sectors.

Table 8.15: Comparison of public and private views

	Public sector		Private sector	
	Financial performance & economic environment	Technical sophistication & legal environment	Financial performance &economic environment	Technical sophistication & legal environment
Direct effect	0.13	0.69	0.40	0.20
Indirect effect	0.22	0.05	0.07	0.10
Total effect	0.38	0.74	0.47	0.30

Regarding the public sector, the direct effect of financial performance and economic environment on value for money is 0.13, with a total effect of 0.38. On the other hand, for the public sector, the direct effect of technical sophistication and legal environment is 0.69, with a total effect of 0.74. For the private sector, the direct effect of financial performance and economic environment on the viability of PPP projects is 0.4, with a total effect of 0.47, while the value of the indirect effect of technical sophistication & legal environment equals 0.20, with total effect of 0.30. This implies that for the public sector, technical sophistication and legal environment are more important than financial performance and economic environment in relation to the enhancement of the viability of PPP. In contrast, for the private sectors, financial performance and economic environment are more important than technical sophistication and legal environment in relation to the viability of PPP. Thus, it can be concluded that the working sector of the respondents did significantly influence the relationships in the SEM model.

Analysis of groups with different project experience

Table 8.16: Comparison of the chi-square between unconstrained and constrained across groups with different project experience

Overall model	Chi-square	Degree of freedom	P-value
Unconstrained	113.586	80	
Fully constrained	125.878	90	
Difference	12.29	10	**0.26**

Table 8.16 illustrates the chi-square difference test of the unconstrained and constrained model among the group of respondents who have less than 3 PPP projects experiences and those that have more 3 PPP project experiences. The chi-square of the unconstrained model is 113.586 with 80 degrees of freedom, while the chi-square of the constrained model is 125.878 with 90 degrees of freedom. Therefore, the chi-square difference of the two models becomes 12.292 with 10 degrees of freedom. With a p-value greater than 0.05 (0.26), we can conclude that the chi-square of the unconstrained model corresponds to the chi-square of the constrained model. In the other words, there is no statistical difference between the perspectives of the groups with less PPP experiences and those with more than 3 PPP experiences.

Analysis of groups with different years of experience

Table 8.17: Comparison of the chi-square between unconstrained and constrained model across groups with different years of experience.

Overall model	Chi-square	Degree of freedom	P-value
Unconstrained	116.893	80	
Fully constrained	134.854	90	
Difference	17.96	10	**0.05**

Table 8.17 illustrates the chi-square difference test of the unconstrained and constrained models between the group having fewer than 15 years of experience (less experienced) and the group having more than 15 years of experience (more experienced). The result of the table indicates that the chi-square of the unconstrained model is 116.893 with 80 degrees of freedom, while the chi-square of the fully constrained model is 134.854 with 90 degrees of freedom. As a result, it can be seen that the chi-square difference of 17.961 with 10 degrees of freedom and a p-value of 0.05 indicates that the chi-square of the unconstrained model is different from the chi-square of the constrained model. This reveals that there is a significant difference between the perceptions of less experienced and more experienced groups. This also means the multiple groups in the unconstrained model can be used. Moreover, the goodness-of-fit of the unconstrained model regarding the CMIN/DF = 1.461 < 2, the CFI = 0.937 >0.9, the GFI = 0.905>0.90, the TLI = 0.913 >0.90 and the RMSE = 0.048 suggests that the model fit is at the accepted level.

Next, we use Table 8.18 to illustrate a comparison of the view of the less experienced and more experienced groups.

Table 8.18: Comparison of the views of less experienced and more experienced groups

	Less experience group		Much experience group	
	Financial performance & economic environment	Technical sophistication & legal environment	Financial performance & economic environment	Technical sophistication & legal environment
Direct effect	0.34	0.24	0.36	0.76
Indirect effect	0.09	0.14	0.27	0.13
Total effect	0.43	0.38	0.63	0.89

Table 8.18 shows a comparison of the effect analysis between less experienced and more experienced groups. This result shows that for the less experienced group, the direct effect of financial performance and economic environment on viability of PPP is larger than the direct effect of the technical sophistication and legal environment. Meanwhile, in the opinions of the more experienced group, the direct effect of technical sophistication and legal environment on the viability of PPP road projects is greater in comparison with the implications of their views on the direct effect of financial performance and economic environment. For the less experienced group, the indirect effect of financial performance and economic environmental factors on the viability of PPP projects is 0.09; with a total effect that equals 0.43. On the other hand, the indirect effect of technical sophistication and the legal environment equals 0.14; with an overall effect that equals 0.38. For the more experienced group, the indirect effect of financial performance and economic environment factors on the viability of PPP is 0.27; with a total effect that equals 0.63. On the other

hand, based on their views, the indirect effect of technical sophistication and legal environment equals 0.13; with a total effect that equals 0.89.

8.4. Conclusion

The key conclusions that one can draw from the ongoing analysis in this chapter are summarized as follows.

First, we found out that there is a 55 percent chance that the PPP option is more suitable than government direct investment in the implementation of roads projects.

Secondly, in terms of the qualitative assessment, in order to increase the viability of PPP projects, the stakeholders need to pay close attention on financial performance and the economic environment, as well as the degree of technical sophistication and the legal environment. Accordingly, particular attention needs to be paid to the financial interest to private sector, the profitability of the projects, the governmental economic policy and the long-term demand for the service; basically anything that is associated with financial performance and the economic environment. Regarding technical sophistication and the legal environment, priority should be given to service quality, the flexibility of the contracts to changes in output, the alignment with current statutory provisions and the provision of a favorable legal framework.

Chapter 9: Implications and conclusions

9.1. Introduction

This chapter consists of four sections. It begins with a review of main findings in the research. It then outlines the implications of the research for the Vietnamese government in the development of road transport infrastructure. Subsequently, the chapter shifts its focuses to the contributions of the research in the context of the literature, and the additional insights that VFM assessment of PPP provides. Finally, some limitations and suggestions for future researches are also provided.

9.2. Overview of the research findings

9.2.1. Major findings of quantitative VFM assessment

<u>Determining the procurement option for the cases under consideration</u>

Value-for-money is becoming one of the most effective decision-support mechanisms for PPP. It is increasingly being used in many countries. A VFM assessment allows policymakers to accurately compare the whole cost of a project done via PPP model with that via traditional public procurement. Below is an account of the findings emerged from the VFM analyses conducted in this study.

First, an analysis of the Phu My Bridge shows that it is more financially reasonable to return the project to the public sector, as the Vietnamese government did. The result of the research also shows that the probability of a negative VFM indicator for this particular project is 97.2 percent. This number implies that PPP scheme is unlikely to be better option than a wholly state funded model, as far as the Phu My project is concerned. In other words, the government's earlier decision to employ PPP for the project was not the best option.

Secondly, through the VFM assessment, one can say that the decision to use PPP model for the Trung Luong-My Thuan expressway is financially justified. Our findings show that the probability of a positive VFM for the project is 99.9 percent. In other words, there is a 99.9 percent chance that PPP model would be more efficient than government direct procurement. As a matter of fact, to minimize the chances of failure, the government has provided some subsidy for the project. Even if the government decides to withdraw the subsidy, the analytical result indicates that the probability of a positive VFM is still high enough, approximately 60 percent, which makes PPP to be a better option.

Third, the result of the VFM analysis of the My Loi Bridge shows that the probability of positive VFM for this project is 0.24. It means that there is a 24 percent chance that a PPP scheme would out-perform government direct investment in this project. At this rate, it seems unreasonable to opt for the PPP model. Additionally, an advanced sensitivity analysis shows that the input that has the largest positive impact on VFM is the risk of construction cost overrun. Also, a simple sensitivity analysis reveals that the most significant input impact on the VFM is the PSC's capital cost.

Finally, to the best of our knowledge, this research is one of the few studies that are based on the modified VFM methodology introduced by Tsukada (2015). Our research found that there is no significant difference between the modified and the conventional VFM. Regarding Trung Luong – My Thuan Expressway and Phu My Bridge, the results from a traditional and modified approach are similar. However, in the case of the My Loi project, the result of the modified method is different from that resulted from the traditional VFM approach.

Selecting a better procurement option for road projects

According to the master plan for the development in road transportation infrastructure in Vietnam until 2020 and the orientation towards the year 2030, PPP is high priority, an important alternative method to traditional public procurement. Between 2001 and 2016, Vietnam witnessed a substantial increase in the number of PPP projects. However, according to Deloitte (2015), such increases in PPP projects do not necessarily reflect the suitability of the PPP approach. In fact, the over-excitement over PPP development has caused failures in some PPP projects. Such failures have in turn brought some questions in the suitability of PPP in general. By using the VFM methodology and the Bootstrap techniques, our research has estimated that there is a 55 percent probability of having a VFM greater than zero. That is to say that, there is a 55 percent chance that PPP model could do better than government direct investment in Vietnamese road projects. Thus, the decision to opt for the PPP model in the road sector in Vietnam is justifiable.

9.2.2. Major findings of qualitative VFM assessment

In order to investigate the factors that enhance the viability of PPP projects, a survey of PPP stakeholders was carried out in Vietnam. A total of 300 responses were collected, however, only 201 were usable. The summary of demographic information confirms that most respondents are from the private sector and are also well experienced in the implementation of road PPP projects. On the other hand, through the survey, our research found that, to improve the viability of PPPs in Vietnamese road sector, public policymakers as well as the investing public need to take financial performance and economic environment; technical sophistication and legal environment into consideration. The former reflects the importance of financial interests to the private sector, the need for profitable projects, the need for a sound economic policy, the importance of attracting foreign investors, and the need to consider long-term demand for the service. Meanwhile the technical sophistication and legal environment consist of service quality, the flexibility of the contracts to changes in output, the provision of a favorable legal framework, and the need to get things aligned with current statutory.

Multiple group analysis was applied to evaluate the correlation of the views expressed by various groups (in terms of gender, sector, and experience in projects). The result shows that there is no significant difference in the perspectives expressed in the respective groups (gender and years of experience) on the factors that improve the viability of PPP projects. Meanwhile, some differences were found in opinions those respondents that work in public and private sectors. As an example, for the respondents in the public sector, technical sophistication and the legal environment have more impact on the viability of PPP than financial performance and economic environment. On the other hand, for the private sector, financial performance and economic environment have stronger influence on viability than technical sophistication and legal environment. Also, we found that, for the less experienced group, the effect of financial performance and the economic environment appears to be more important than the effect of technical sophistication and legal environment. The views of the more experienced group are entirely the other way round.

9.3. Research implications

Theoretically, the evaluation of PPP decision-making should be done in a two-stage process that includes the evaluation of the decision to invest or not, and an evaluation of the best procurement option. However, in Vietnam, this process mostly focuses on the first stage. As a result, the second stage, VFM assessment, is absent. It has been shown that this omission can lead to wrong decision-making. This is a main basis for the need for the VFM analysis in Vietnam.

More specially, this research used the VFM analysis for the evaluation of the suitability of PPP for three case studies. Accordingly, the Phu My project was identified as a good example of an unsuitable PPP. The results associated with the case shows that PPP is not always the best solution; it does not always reduce state budget constraints. In any case, a PPP project tends to cut down costs if the private firm is able to use new technologies and innovations. This leads to the following conclusions. If the decision to pursue PPP delivery is solely based on the need to reduce budget deficit, a selection of the PPP will not necessarily provide a solution to this problem.

9.4. Contributions of the research

This research has applied the VFM assessment specifically for the purpose of evaluating the viability of road PPP projects in Vietnam both qualitatively and quantitatively. This study has used a modified VFM analysis to examine the decisions to use PPP model in Vietnamese road projects. It has also evaluated the effects of uncertain input variables, such as the risks of construction cost overrun, erroneous traffic demand forecasts, inflation, and the interest rate of government bonds on VFM and decision-making in PPP. Apart from that, the impacts of non-monetary factors on viability of PPP projects were also examined in this research.

The first key strength of the current study is that it has used a comprehensive VFM methodology, a revised VFM that is capable of comparing the whole cost of a project under PPP scheme and under the traditional public procurement. The modified VFM has incorporated the financing cost of the PSC and the return on investment under the SBP to guarantee a more accurate estimation of the VFM. To best of our knowledge, this dissertation is one of the very few studies that have used the modified quantitative VFM analysis. Therefore the research might be considered as an important evidence for clarifying and confirm the suitability of the methodology. The revised VFM methodology is expected to be applied in many countries in generally and in Vietnam in particular.

The second important contribution of this dissertation is that this is one of the few studies that have measured the effect of qualitative factors on the viability of PPP. Using a survey of PPP stakeholders, the research has helped reveal the factors that improve the viability of PPP. Also, most studies in the field have focused only on the importance of factors to the PPP's viability, while ignorance of quantifying effects of these factors. As a result, the Structural Equation Modeling was used to compute the effect of the factors on viability of PPP, in a manner that can be used for decision-making and PPP appraisals.

The third important contribution of the dissertation is the fact that very few studies have looked at the possibility of applying VFM in the context of Vietnamese PPP program. In a usual case, a PPP project plan is approved after a VFM test and feasibility is carried out. However, in the context of PPP programs in Vietnam, VFM assessment of PPP schemes is not carried out. Thus, this research is expected to play a significant role in the application and use of the VFM as a decision-support tool in Vietnam.

Additionally, according to Lubis and Majid (2013), "for most ASEAN countries, it is still not sufficiently clear how VFM is incorporated in the assessment framework" (Lubis and Majid, 2013, p. 929). The introduction of a comprehensive value for money assessment in this research is expected to become a reference for countries in ASEAN on VFM analysis in PPP. More importantly, this research has attempted to provide a detailed and practical application of VFM assessment, using three real-life cases in the Vietnamese road sector. By doing so, it has demonstrated that PPP scheme may or may not always be the best option, as exemplified in the cases examined in this study. Circumstances under which the PPP option becomes justifiable were also indicated in the simulation analysis.

9.5. Limitation of the research and recommendation for future research

Despite the aforementioned contribution to PPP theory and practice, some limitations deserve to be mentioned here. These could be used as the bases for future research. As an example, due to data limitations, this study has focused on two risk factors: (the risk of construction cost overrun and the miscalculation of traffic demand). In practice however, several risk factors can affect the implementation of PPP projects. It would therefore be interesting to examine other potential risk factors such as the risks of late completion (and other risk factors) in future studies and VFM analysis.

The scope of the study was also limited by the fact that estimation of the risks of construction cost overrun are based on the actual and the forecast data of the 15 road projects completed from 2003 to 2015 in Vietnam. Likewise, the estimation of the risks related to the estimation of the traffic volume was based on real and projected data in 7 PPP road projects that implemented from 2010 to 2015 in Vietnam. The sample size is not sufficient to determine the best distribution when conducting Monte Carlo Simulations. In order to respond to this problem, the research has used the Bootstrap method. However, this approach mostly used when there is insufficient or missing data (Wibowo et al., 2012). As a result, the estimation of the risk of construction cost overrun as well as traffic-demand risk would become more reliable if a larger size of data is used.

The third limitation is how the traffic-volume component of the PSC in each case of the studies was assumed to be identical with the PPP approach. Due to the paucity of revenue leakage associated with the public sector, this assumption may be wrong in some cases. To confirm this, we highly recommend additional analyses that are based on actual PSC traffic-demand estimates, and other evidences that could support the projected income stream of each procurement option.

In addition, this study has focused mainly on the VFM assessment of PPP projects in the road sector (mostly Expressways and Bridges). Without a consideration of railways, airports and water transport projects, the views on the use of PPP in the transport sector cannot be complete. It would be therefore interesting to extend the VFM assessment of PPP projects in these sectors as well. This could help facilitate detailed comparative analyses and better decision-making in relation to PPP and transport infrastructure programs in Vietnam.

The study also suffers from the fact that social benefits were not explicitly considered in the quantitative VFM. Social benefits are usually associated with the factors like travel time savings and environment impact. These are not easy to estimate quantitatively. Nevertheless, if the whole life cycle cost of a project includes social benefits as well as social costs, a methodology that is capable of handling such information would be looked into in the future research.

Additionally, in this research, the bootstrap method was used to determine the probability distribution for VFM in PPP in general. The aim was to provide a good approximation of VFM in PPP in general. Based on that figure, it was possible for this study to estimate the confidence intervals within which PPP delivery becomes a best option and viable. It should be acknowledged that the application of the bootstrap method to estimate the probability of PPP being suitable in road projects, in general, is not always the best approach on an individual basis. This is because every project has own characteristic, size and cash flow. In the future, when the amassed data is sufficient, a more accurate estimation of the probability of VFM may give rise to new revelations.

Furthermore, the three projects examined in this study have faced a lot of oppositions and criticisms. In any case, there seems to be no consensus on what the best option is. Without looking at the subjective opinions of the stakeholders, this study has focused on a quantitative assessment, which has in turn allowed us to estimate the values associated with each option. Nevertheless, it may be necessary to conduct a new study on the qualitative issues that have helped make the cases unpopular among some groups. In this regard, in future studies, a Multi-Criteria Decision Analysis (MCDA) may help reveal some of the contentions and issues.

Finally, the used SEM was used to investigate the factors that influence the viability of the PPP approach in road projects in Vietnam. However, with a sample size of 201, it is would be wrong to conclude that a larger sample size would not help to address some the analytical limitations associated with limited sample sizes. As an example, due to time and resource limitations, only 54 respondents from public sector took part in the survey, which makes multiple group analysis less reliable.

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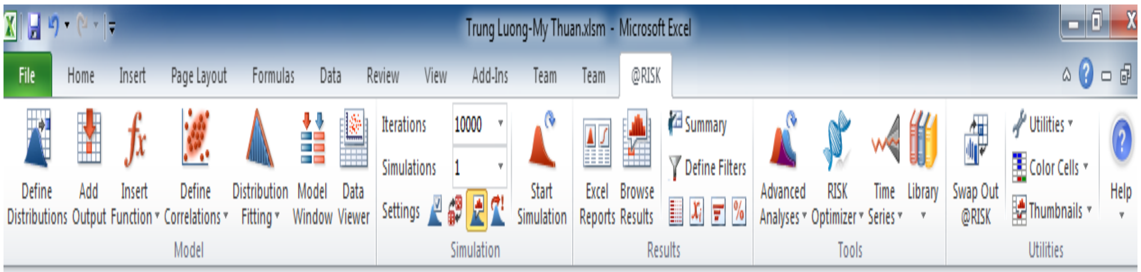
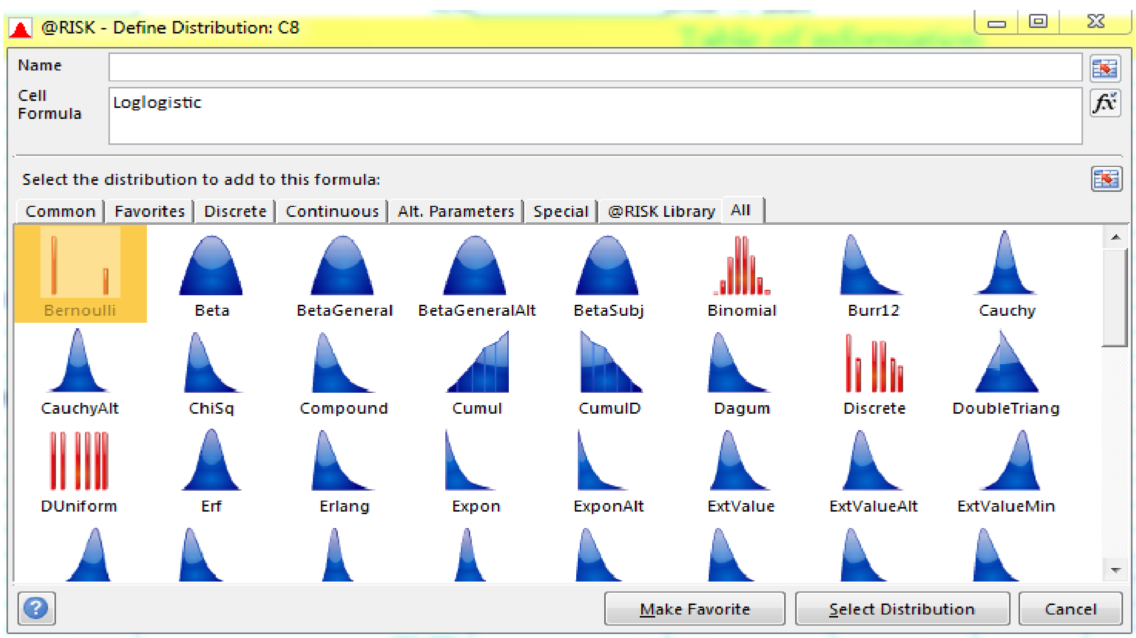
APPENDICES

Appendix 1: Characteristics of Palisade's @RISK software version 7.5

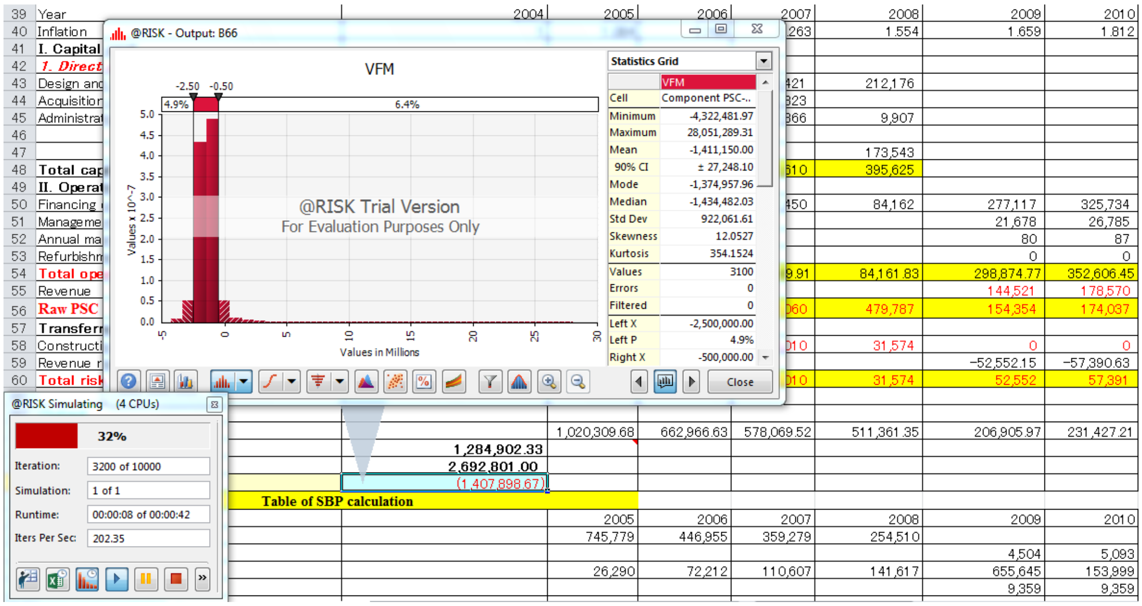
Appendix 1.1: Features of Palisade's @RISK software version 7.5



Appendix 1.2. Coninues distribution function within @RISK version 7.5



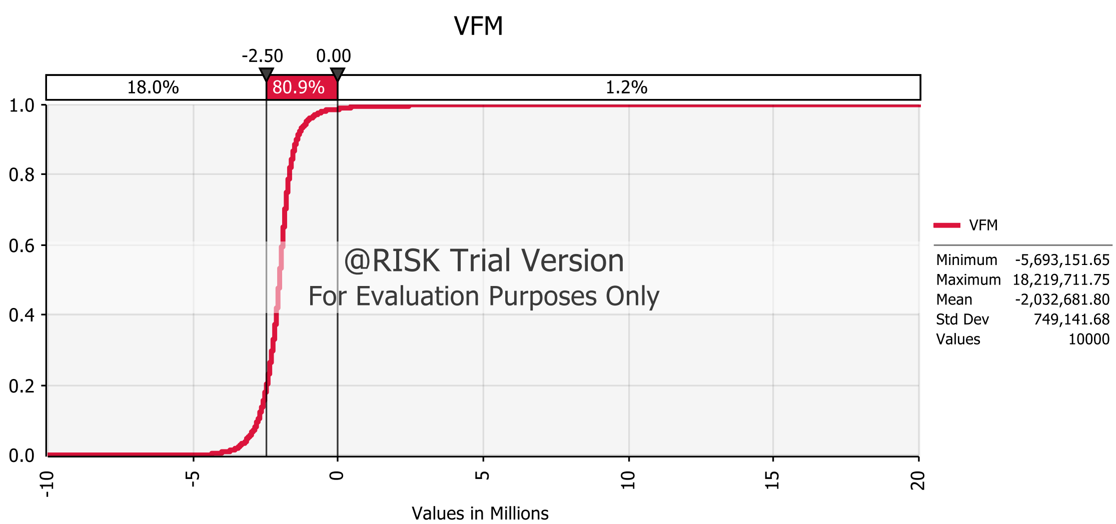
Appendix 1.3. Simulation with 10,000 iterations for outcome



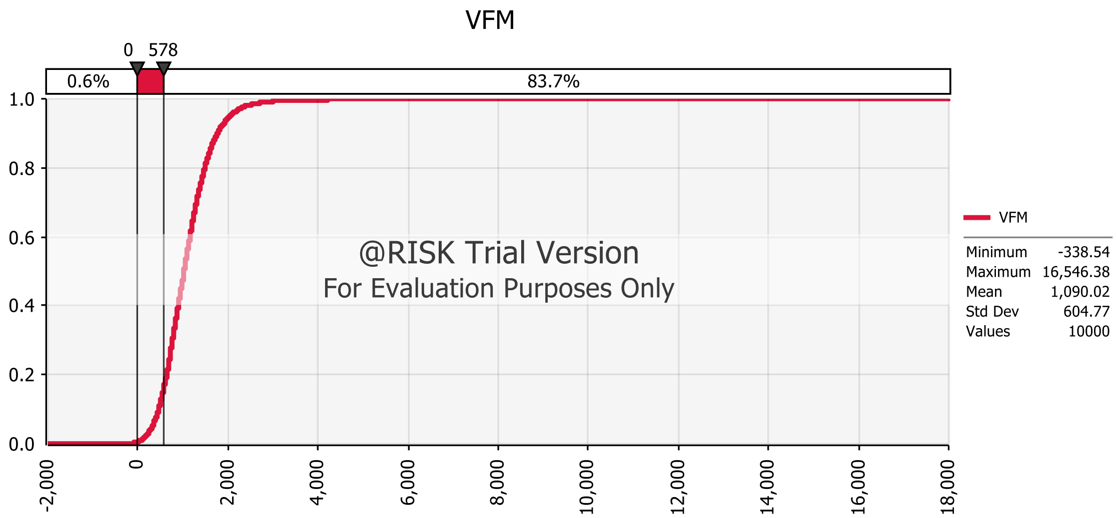
Appendix 2: Cumulative probability of VFM

(the traditional accounting approach)

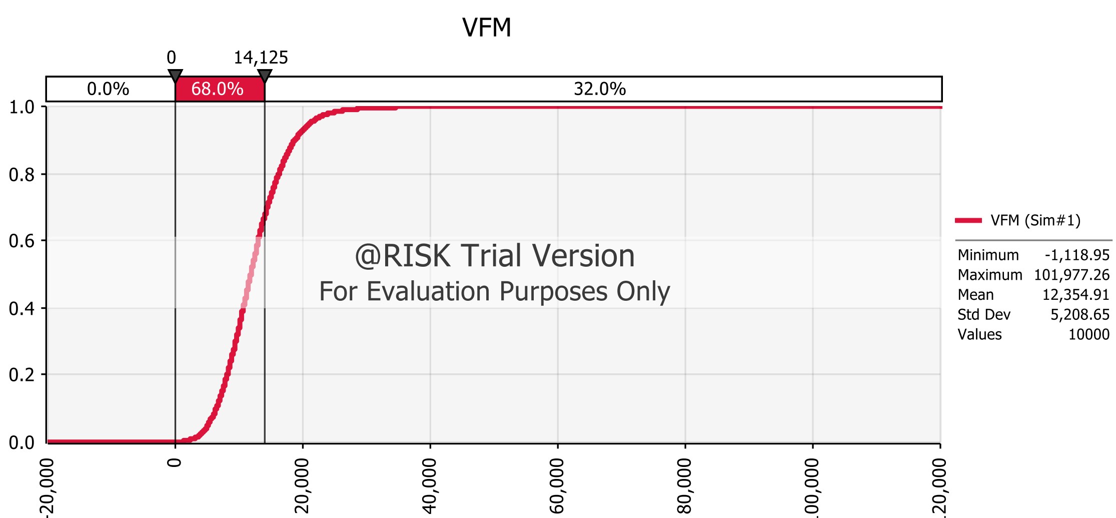
Appendix 2.1 Case study of Phu My Bridge



Appendix 2.2 Case study of My Loi Bridge



Appendix 2.3 Case study of Trung Luong-My Thuan



Appendix 3: Actual inflation rate in Vietnam during the period 1994-2015

Year	Inflation rate	Year	Inflation rate
1994	9.48%	2005	8.39%
1995	16.93%	2006	7.50%
1996	5.59%	2007	8.35%
1997	3.10%	2008	23.12%
1998	8.11%	2009	6.72%
1999	4.11%	2010	9.21%
2000	-1.77%	2011	18.68%
2001	-0.31%	2012	9.10%
2002	4.08%	2013	6.60%
2003	3.30%	2014	4.10%
2004	7.90%	2015	0.63%

(World economic outlook database, 2016)

Appendix 4: Toll based on the Circular 90/2004/TT-BTC dated 07 September 2004 of the Ministry of Finance

Vehicles	One way ticket (VND/ticket/trip)	Monthly ticket (VND/ticket/trip)	Quarterly ticket (VND/ticket/trip)
Car (<12 seats), Truck (<2 tons), mass transit bus	10,000	300,000	800,000
Car (12-30 seats), Truck (2-4 tons)	15,000	450,000	1,200,000
Car (>30 seats), Truck (4-10 tons)	22,000	660,000	1,800,000
Truck (10-18 tons, and 20ft container	40,000	1,200,000	3,200,000
Truck (>18 tons)	80,000	2,400,000	6,500,000

Appendix 5: Forecasted and actual traffic demand of BOT road projects in Vietnam since 2003

Project	Length (km)	Year of approval	Open (year)	Forecasted PCU/day	Actual PCU/day	Traffic volume inaccuracy
Cau Gie-Ninh Binh Expressway	50	2006	2012	144,317	40,000	-0.72
Noi bai-Lao Cai Expressway	245	2009	2014	49,077	14,092	-0.71
Ho Chi Minh-Trung Luong Expressway	61.9	2004	2010	69302	50000	-0.48
Binh bridge	0.245	2000	2005	7,071	1,731	-0.76
Yen Lenh bridge	2	2003	2005	3,600	3,048	-0.15
Ben Thuy bridge	25.8	2003	2006	9,153	8,737	-0.05
Sai Gon 2 bridge	0.987	2009	2013	25,322	40,000	0.58

(Source: Vietnam Expressway Corporation, 2015; Civil Engineering Construction Corporation No 4, 2015; Audit State Office of Vietnam, 2015; VNexpress, 2010)

Appendix 6: Forecasted and actual construction cost in road projects of Vietnam since 2003

Project	Year	Length (km)	Forecasted construction cost	Actual construction cost	Construction overrun ratio
QE1A-Thach Khe road	2008	19.86	524,332	684,450	0.30538
Xuan Hoi-Vung Ang road	2009	36.4	984,244	1,121,495	0.13945
Nghi Son-Cau Giat Highway	2013	40	1,774,317	1,807,544	0.01873
Yen Lenh Bridge	2004	2	303,776	315,695	0.03924
National Highway 29 (Bac Kan-Tuyen Quang)	2013	147	1,262,477	1,319,030	0.0448
Provincial road 48 (West Nghe an Km 53+900- Quy Hop)	2006	16.3	118,258	113,452	-0.04064
National Highway (Vinh city bypass)	2013	23	325,165	300,964	-0.07443
National Highway 1A (South Cau Cam)	2005	34	319,393	316,273	-0.00977
National Highway 1A (South Ben Thuy-Ha Tinh)	2012	34	1,421,368	1,345,103	-0.05366
Provincial road 7 (West Nghe an Km 53+900- Quy Hop)	2004	107.7	501,749	454,647	-0.09388

Provincial road 48 (Kim Son-Thong Thu)	2005	51	465,647	465,400	-0.02362
Node G (intersection between railway and highway)	2014	12	256,800	201,243	-0.216343
HCM-Trung Luong Expressway	2004	61.9	6,555,000	9,880,000	0.5072464
Thang Long Highway (Lang-Hoa Lac)	2005	30	5,379,000	7,500,000	0.3943112
Cau Gie-Ninh Binh Expressway	2006	54	3,733,000	8,974,000	1.4039646

(Source: Civil Engineering Construction Corporation No 4, 2015; Department of Transportation, 2015; Directorate for roads of Vietnam 2015; Vu, 2015)

Appendix 7: Forecasted number of vehicle of Phu My project

(1,000 vehicles/year)

Year	**Car (<12 seats)**	**Car (12-30 seats)**	**Car (>30 seats)**	**Truck (10-18 tons)**	**Truck (>18 tons)**
2009	920	440	1160	830	210
2010	1040	490	1310	940	240
2011	1180	560	1480	1070	270
2012	1350	630	1680	1210	300
2013	1510	720	1900	1370	340
2014	1710	810	2160	1550	390
2015	1940	920	2450	1760	440
2016	2235	1064	2820	2029	507
2017	2537	1208	3201	2303	576
2018	2879	1371	3633	2614	654
2019	3268	1556	4124	2967	742
2020	3709	1766	4681	3368	842
2021	3999	1905	5047	3631	908
2022	3999	1905	5047	3631	908
2023	3999	1905	5047	3631	908
2024	3999	1905	5047	3631	908
2025	3999	1905	5047	3631	908
2026	3999	1905	5047	3631	908
2027	3999	1905	5047	3631	908

2028	3999	1905	5047	3631	908
2029	3999	1905	5047	3631	908
2030	3999	1905	5047	3631	908
2031	3999	1905	5047	3631	908
2032	3999	1905	5047	3631	908
2033	3999	1905	5047	3631	908
2034	3999	1905	5047	3631	908

(Feasibility studies report of Phu My project, 2005)

Appendix 8: Forecasted number of vehicles of Trung Luong-My Thuan project

Appendix 8.1: The section of Trung Luong-Cao Lay (vehicles/day)

Year	Car (<12 seats)	Car (12-30 seats)	Car (>30 seats)	Truck (10-18 tons)	Truck (>18 tons)
2019	9212	2320	2313	302	197
2020	9950	2506	2498	326	212
2021	10748	2707	2698	352	229
2022	11609	2924	2914	380	248
2023	12539	3158	3148	411	268
2024	13544	3411	3400	444	289
2025	14629	3684	3673	479	312
2026	15801	3979	3967	518	337
2027	17067	4298	4285	559	364
2028	17067	4298	4285	559	364
2029	17067	4298	4285	559	364
2030	17067	4298	4285	559	364
2031	17067	4298	4285	559	364
2032	17067	4298	4285	559	364
2033	17067	4298	4285	559	364
2034	17067	4298	4285	559	364
2035	17067	4298	4285	559	364
2036	17067	4298	4285	559	364
2037	17067	4298	4285	559	364
2038	17067	4298	4285	559	364
2039	17067	4298	4285	559	364
2040	17067	4298	4285	559	364
2041	17067	4298	4285	559	364

2042	17067	4298	4285	559	364
2043	17067	4298	4285	559	364
2044	17067	4298	4285	559	364
2045	17067	4298	4285	559	364
2046	17067	4298	4285	559	364
2047	17067	4298	4285	559	364
2048	17067	4298	4285	559	364

Appendix 8.2: The section of Cai Lay-Cai Be (vehicles/day)

Year	**Car (<12 seats)**	**Car (12-30 seats)**	**Car (>30 seats)**	**Truck (10-18 tons)**	**Truck (>18 tons)**
2019	9268	2334	2327	304	198
2020	9847	2480	2472	323	210
2021	10463	2635	2627	343	223
2022	11118	2800	2791	364	237
2023	11813	2975	2966	387	252
2024	12552	3161	3151	411	268
2025	13337	3359	3348	437	285
2026	14171	3569	3558	464	302
2027	15057	3792	3780	493	321
2028	15999	4029	4017	524	341
2029	17000	4281	4268	557	363
2030	17000	4281	4268	557	363
2031	17000	4281	4268	557	363
2032	17000	4281	4268	557	363
2033	17000	4281	4268	557	363
2034	17000	4281	4268	557	363
2035	17000	4281	4268	557	363
2036	17000	4281	4268	557	363
2037	17000	4281	4268	557	363
2038	17000	4281	4268	557	363
2039	17000	4281	4268	557	363
2040	17000	4281	4268	557	363
2041	17000	4281	4268	557	363
2042	17000	4281	4268	557	363
2043	17000	4281	4268	557	363
2044	17000	4281	4268	557	363
2045	17000	4281	4268	557	363

2046	17000	4281	4268	557	363
2047	17000	4281	4268	557	363
2048	17000	4281	4268	557	363

Appendix 8.3: The section of Cai Be-My Thuan (vehicles/day)

Year	**Car (<12 seats)**	**Car (12-30 seats)**	**Car (>30 seats)**	**Truck (10-18 tons)**	**Truck (>18 tons)**
2019	8804	2217	2210	288	188
2020	9355	2356	2349	306	200
2021	9940	2503	2495	326	212
2022	10562	2660	2652	346	225
2023	11222	2826	2817	368	239
2024	11924	3003	2994	391	254
2025	12670	3191	3181	415	270
2026	13462	3390	3380	441	287
2027	14304	3602	3591	469	305
2028	15199	3828	3816	498	324
2029	16150	4067	4054	529	345
2030	16150	4067	4054	529	345
2031	16150	4067	4054	529	345
2032	16150	4067	4054	529	345
2033	16150	4067	4054	529	345
2034	16150	4067	4054	529	345
2035	16150	4067	4054	529	345
2036	16150	4067	4054	529	345
2037	16150	4067	4054	529	345
2038	16150	4067	4054	529	345
2039	16150	4067	4054	529	345
2040	16150	4067	4054	529	345
2041	16150	4067	4054	529	345
2042	16150	4067	4054	529	345
2043	16150	4067	4054	529	345
2044	16150	4067	4054	529	345
2045	16150	4067	4054	529	345
2046	16150	4067	4054	529	345
2047	16150	4067	4054	529	345
2048	16150	4067	4054	529	345

(Feasibility studies report of Trung Luong-My Thuan project, 2014)

Appendix 9: Forecasted number of vehicles of My Loi project

(vehicles/day)

Year	Car (<12 seats)	Car (12-30 seats)	Car (>30 seats)	Truck (10-18 tons)	Truck (>18 tons)
2015	1395	725	438	13	3
2016	1855	963	582	17	5
2017	1997	1033	624	18	5
2018	2150	1108	669	19	5
2019	2315	1189	718	20	5
2020	2494	1275	771	23	6
2021	2671	1363	824	24	7
2022	2862	1456	881	25	8
2023	3066	1556	942	27	9
2024	3285	1663	1006	29	10
2025	3518	1778	1075	31	11
2026	3750	1892	1144	33	12
2027	3997	2014	1217	35	13
2028	4260	2144	1295	37	14
2029	4540	2282	1379	40	15
2030	4840	2427	1467	43	16
2031	5132	2570	1554	45	16
2032	5441	2722	1646	48	16
2033	5770	2883	1743	51	16
2034	6119	3053	1846	54	16
2035	6489	3235	1956	57	16
2036	6489	3235	1956	57	16
2037	6489	3235	1956	57	16
2038	6489	3235	1956	57	16
2039	6489	3235	1956	57	16
2040	6489	3235	1956	57	16
2041	6489	3235	1956	57	16
2042	6489	3235	1956	57	16
2043	6489	3235	1956	57	16
2044	6489	3235	1956	57	16
2045	6489	3235	1956	57	16

(My Loi Bridge BOT contract, 2013)

Appendix 10: Summary of background of respondents

Characteristic	Number of respondents (n=201)	Percent (%)
Gender		
Male	124	61.7%
Female	77	38.3%
Age		
18-30	43	21.4%
31-45	111	55.2%
46-55	47	23.4%
Education		
Under college	3	1.5%
College	7	3.5%
Bachelor	145	72.1%
Master	49	22.9%
Sector		
Public	53	26.4%
Private	148	73.6%
Number of BOT projects		
1	46	22.9%
2	53	26.4%
3	38	18.9%
4	24	11.9%
5	14	7%
Above 5	26	12.9%
Years of work experience		
Less than 5	42	20.9%
6-10	51	25.4%
11-15	48	23.9%
16-20	23	11.4%
21 above	37	18.4%

Appendix 11: Statistic Results of final structural equation model

Appendix 11.1: Regression weights

			Estimate	S.E.	C.R.	P	Label
Viability_of_PPP	<---	Financial _Economic	.238	.081	2.928	.003	
Viability_of_PPP	<---	Technical_legal	.317	.119	2.665	.008	
F4	<---	Financial _Economic	1.000				
F5	<---	Financial _Economic	.934	.114	8.162	***	
F3	<---	Financial _Economic	.914	.120	7.627	***	
F6	<---	Financial _Economic	.795	.123	6.459	***	
F7	<---	Financial _Economic	.662	.110	6.045	***	
F17	<---	Technical_legal	1.000				
F16	<---	Technical_legal	1.040	.178	5.833	***	
F25	<---	Technical_legal	1.346	.190	7.095	***	
F24	<---	Technical_legal	1.631	.226	7.201	***	
V2	<---	Viability_of_PPP	1.000				
V1	<---	Viability_of_PPP	1.272	.282	4.512	***	

Appendix 11.2: Standardized Regression Weights:

			Estimate
Viability_of_PPP	<---	Financial _Economic	.341
Viability_of_PPP	<---	Technical_legal	.309
F4	<---	Financial _Economic	.737
F5	<---	Financial _Economic	.710
F3	<---	Financial _Economic	.644
F6	<---	Financial _Economic	.536
F7	<---	Financial _Economic	.500
F17	<---	Technical_legal	.562
F16	<---	Technical_legal	.542
F25	<---	Technical_legal	.756
F24	<---	Technical_legal	.811
V2	<---	Viability_of_PPP	.664
V1	<---	Viability_of_PPP	.678

Appendix 11.3 Intercepts

	Estimate	S.E.	C.R.	P	Label
F4	3.617	.068	52.960	***	
F5	3.697	.066	55.789	***	
F3	3.622	.071	50.686	***	
F6	3.473	.075	46.511	***	
F7	3.667	.067	55.000	***	
F17	3.891	.061	63.778	***	

	Estimate	S.E.	C.R.	P	Label
F16	3.900	.066	59.285	***	
F25	3.552	.061	58.211	***	
F24	3.423	.069	49.651	***	
V2	3.856	.053	72.784	***	
V1	3.662	.066	55.499	***	

Appendix 11.4: Covariances

			Estimate	S.E.	C.R.	P	Label
Technical_legal	<-->	Financial _Economic	.139	.037	3.731	***	
e14	<-->	e15	.204	.061	3.330	***	

Appendix 11.5: Correlations

			Estimate
Technical_legal	<-->	Financial _Economic	.402
e14	<-->	e15	.280

Appendix 11.6: Variances

	Estimate	S.E.	C.R.	P	Label
Financial _Economic	.507	.096	5.302	***	
Technical_legal	.235	.060	3.904	***	
e23	.174	.053	3.254	.001	
e11	.425	.064	6.665	***	
e12	.435	.061	7.145	***	
e13	.597	.074	8.035	***	
e14	.794	.090	8.844	***	
e15	.666	.074	9.028	***	
e17	.509	.057	8.901	***	
e18	.611	.068	9.013	***	
e19	.319	.049	6.514	***	
e20	.325	.062	5.219	***	
e21	.314	.061	5.166	***	
e22	.471	.096	4.880	***	

Appendix 11.7: Squared Multiple Correlations

	Estimate
Viability_of_PPP	.296
V1	.459
V2	.440
F24	.658
F25	.571
F16	.294
F17	.316
F7	.250
F6	.288
F3	.415
F5	.504
F4	.544

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	37	69.862	40	.002	1.747
Saturated model	77	.000	0		
Independence model	22	618.000	55	.000	11.236

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.887	.845	.948	.927	.947
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.727	.645	.689
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	29.862	10.468	57.109
Saturated model	.000	.000	.000
Independence model	563.000	486.744	646.704

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.349	.149	.052	.286
Saturated model	.000	.000	.000	.000
Independence model	3.090	2.815	2.434	3.234

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.061	.036	.084	.210
Independence model	.226	.210	.242	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	143.862	148.585		
Saturated model	154.000	163.830		
Independence model	662.000	664.809		

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	.719	.622	.856	.743
Saturated model	.770	.770	.770	.819
Independence model	3.310	2.929	3.729	3.324

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	160	183
Independence model	24	27

Appendix 12: Research questionnaire

Research Questionnaire

Dear Sir/Madam,

My name is Dinh Thi Thuy Hang. I am a student of Ph.D program at Ritsumeikan Asia Pacific University in Japan. I am conducting my doctoral dissertation on the topic: "A study on value for money to evaluate Public private partnership projects in road sector in Vietnam".

The main objective of the research is to evaluate the suitability and viability of BOT/PPP projects in road sector in Vietnam. In addition, this research aims to investigate factors influencing the viability of BOT/PPP in Vietnam.

Therefore, we would highly appreciate you if you participate in our survey to answer the questionnaire. Your information on the answer is utilized for the research purpose only. Your personal information will be kept confident and not be shared with anyone.

If you have any question, please contact:

Ms. Dinh Thi Thuy Hang
Tel: (+81) 80-6471-6068
Email: thitdi14@apu.ac.jp

Thank you very much for you time and your cooperation

Section A:

1. Gender: a. Male b. Female

2. Age: a. age 18 to 30 b. age 31 to 45 c. age 46 to 65

3. Education background:

a. High school b. College b. Bachelor degree b. Master c. Ph.D

4. Position: a. Employee b. Manager

5. Organization:

a. Government agency b. Research institutions (University)

c. Financial organization d. Civil engineering company (contractor, sub-contractor)

e. Insurance company f. Private company

6. How many years have you had experience in working?

a. Less than 5 years b. 6-10 years c. 11-15 years d. 16-20 years e. 21 years above

7. Have you worked involving BOT/PPP road projects?

1. Yes 2. No

8. How many PPP/BOT road projects have you taken part in?

a. None b. 1 project c. 2 projects d. 3 projects e. 4 projects f. 5 g. 5 above

Section B:

Please give your opinion to the extent the importance of criteria to the viability of PPP projects in road sector in Vietnam. Please circle (○) for the best answer.

No	Factor	(1) Not important	(2) A little important	(3) Neutral	(4) Important	(5) Very important
	Financial performance &Economic environment					
1	Project is more cost effective than traditional forms of project delivery	1	2	3	4	5
2	Project can be substantially self-funded or on a non-recourse basis	1	2	3	4	5
3	Project value is sufficiently large to avoid procurement disproportionate procurement	1	2	3	4	5

	costs					
4	Project is of financial interest to private sector	1	2	3	4	5
5	Project can attract foreign capital	1	2	3	4	5
6	Project is bankable and profitability of the project is sufficient to attract investors and lenders	1	2	3	4	5
7	Economic environment is stable and favorable	1	2	3	4	5
8	Existence of a sound governmental economic policy	1	2	3	4	5
9	Competition from other projects is limited	1	2	3	4	5
10	There is a long-term demand of the products/service in the community	1	2	3	4	5
11	Level of toll/tariff is acceptable	1	2	3	4	5
	Technical sophistication	1	2	3	4	5
12	Project size is technically managerial by a single consortium	1	2	3	4	5
13	Possibility of innovative solutions	1	2	3	4	5
14	Availability of government experience in packaging similar PPP projects	1	2	3	4	5
15	Available of experienced, strong and reliable private consortium	1	2	3	4	5
16	Service quality can be easily defined and objectively measured	1	2	3	4	5
17	Contract is flexible enough for frequent change in output specification	1	2	3	4	5
	Social factors					
18	The community is understanding and supportive	1	2	3	4	5
19	Project can create more job opportunities	1	2	3	4	5
20	Project is environmentally sustainable	1	2	3	4	5
	Political and legal environment	1	2	3	4	5
21	Project is not political sensitive	1	2	3	4	5
22	Political environment is stable	1	2	3	4	5
23	There is political support for the project	1	2	3	4	5
24	The project is compatible with current statutory and institutional arrangements	1	2	3	4	5
25	There is a favorable legal framework	1	2	3	4	5
	Managerial capacity					
26	Fairness of new conditions to employees	1	2	3	4	5
27	Possibility of significant redundancy	1	2	3	4	5
28	Supportiveness and commitment of staff to the project	1	2	3	4	5
29	Existence of a resolution for any civil service staff redundancy	1	2	3	4	5
30	Flexibility do decide appropriate risk allocation	1	2	3	4	5
31	Support from the Government is available	1	2	3	4	5

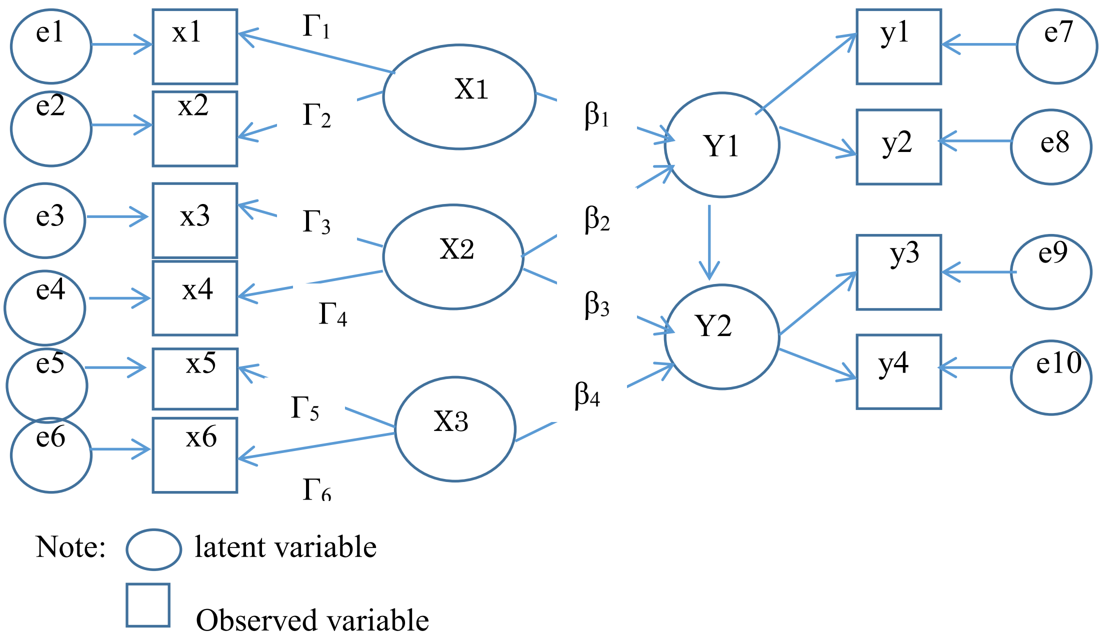
32	Authority can be shared between public and private sector	1	2	3	4	5
33	Possibility of an effective control mechanism over the private consortium	1	2	3	4	5
34	Matching governments strategic and long-term objectives	1	2	3	4	5

Section C:

1. How do you evaluate the viability of Public-Private partnership road projects in the construction stage?
   1. Not good 2. A little good 3. Neutral 4. Good 5. Very good
2. How do you evaluate the viability of Public-Private partnership road projects in the operation stage?
   1. Not good 2. A little good 3. Neutral 4. Good 5. Very good

Appendix 13: Estimation of model parameters

Supposed SEM model



The SEM model in above figure can be written as:

$$Y = \beta Y + \Gamma X + \zeta$$

where, β is the matrix of coefficients that links dependent variables to each other

Γ is the matrix of coefficients that links dependent to independent variables

ζ is disturbance

Y is vector of dependent variables

X is vector of independent variables

Φ= cov (x) = matrix of covariance among X

ψ= cov (ζ) = matrix of covariance among errors

Estimation of coefficients

It is supposed that there is a survey of 10 respondents to investigate their perspective on importance of economic environment (F1) and government support (F2) to viability of PPP (F3). In order to support answer, we use 5-point Likert scale (1= "not important", 2= "a little important", 3= "neutral", 4= "important", 5= "very important"). This following table describes data, where each row represents one respondent's score on each factor, while column represents the variables.

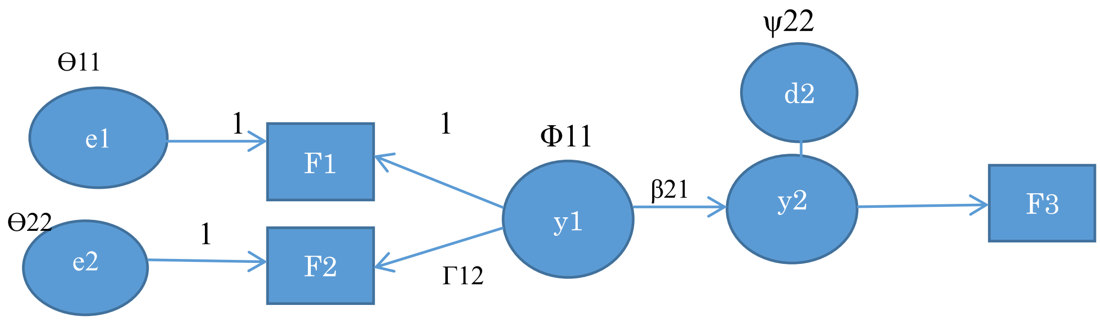
Respondent	Factor F1	Factor F2	Factor F3
1	1	2	1
2	4	4	4
3	5	5	3
4	3	4	2
5	2	3	4
6	4	2	3
7	4	3	2
8	3	4	2
9	1	2	4
10	3	2	2
Mean	3.0	3.1	2.7
Variance	1.06	1.09	1.12

Note: F1, F2 are independent variables. F3: dependent variable

Sample variance

	F1	F2	F3
F1	**1.06** (S_{11})	0.8 (S_{12})	0.1 (S_{13})
F2	0.8 (S_{21})	**1.09** (S_{22})	0.13 (S_{23})
F3	0.1 (S_{31})	0.13 (S_{32})	**1.12** (S_{33})

Next, we have a hypothesized model as following:



Note: F1, F2: observed exogenous variables and F3: observed endogenous.
y1: latent exogenous and y2: latent endogenous.
d2: disturbance
e1, e2: error
β21: regression coefficient of y2 on y1
Γ12: regression coefficient of y1 on F2
Θ11, Θ22, Φ1, ψ22: variance errors and disturbance
F3 is supposed to be free of measurement error.

Assumed that source of uncorrelated measurement error follows normal distribution:

$$\begin{pmatrix} y1 \\ e1 \\ e2 \\ d2 \end{pmatrix} \rightarrow N \left(\begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \begin{pmatrix} \Phi_1 & 0 & 0 & 0 \\ 0 & \Theta_{11} & 0 & 0 \\ 0 & 0 & \Theta_{22} & 0 \\ 0 & 0 & 0 & \psi_{22} \end{pmatrix} \right)$$

The purpose of estimation is to solve the system $\Sigma(\Omega)=\Sigma$, where

$$\Sigma = \begin{pmatrix} б_{11} & б_{12} & б_{13} \\ б_{21} & б_{22} & б_{23} \\ б_{31} & б_{32} & б_{33} \end{pmatrix}$$

There are three observed variables (F1, F2 and F3) in the model, so number of distinct elements in Σ will be 6 (= (n)*(n+1)/2 = 3*(3+1)/2)). And $\Omega = (\Theta_{11}, \Theta_{22}, \Phi_{11}, \psi_{22}, \beta_{21}, \Gamma_{21})$.

In order to estimate $\Omega = (\Theta_{11}, \Theta_{22}, \Phi_{11}, \psi_{22}, \beta_{21}, \Gamma_{21})$, we should solve the system $\sum \hat{\Omega} = S$

(sample variance). We have a number of equations:

$$\begin{cases} \sigma_{11} = 1*\Theta_{11} + 1*\Phi_{11} \\ \sigma_{21} = \Gamma_{21} * \Phi_{11} * 1 \\ \sigma_{22} = 1*\Theta_{22} + \Gamma_{21} * \sigma_{21} = 1*\Theta_{22} + \Gamma^2_{21} * \Phi_{11} \\ \sigma_{31} = 1*\Phi_{11}*\beta_{21} \\ \sigma_{32} = \beta_{21}*\Gamma_{21}*\Phi_{11} \\ \sigma_{33} = \psi_{22} + \beta_{21}*\sigma_{31} = \psi_{22} + \beta^2_{21}*\Phi_{11} \end{cases} \Longrightarrow \begin{cases} \Phi_{11} = \sigma_{31}*\sigma_{21}/\sigma_{32} \\ \beta_{21} = \sigma_{31}/\Phi_{11} \\ \Gamma_{21} = \sigma_{21}/\Phi_{11} \\ \Theta_{11} = \sigma_{11} - \Phi_{11} \\ \Theta_{22} = \sigma_{22} - \Gamma^2_{21} * \Phi_{11} \\ \psi_{22} = \sigma_{33} - \beta^2_{21}*\Phi_{11} \end{cases}$$

Estimating Σ from a sample covariance matrix:

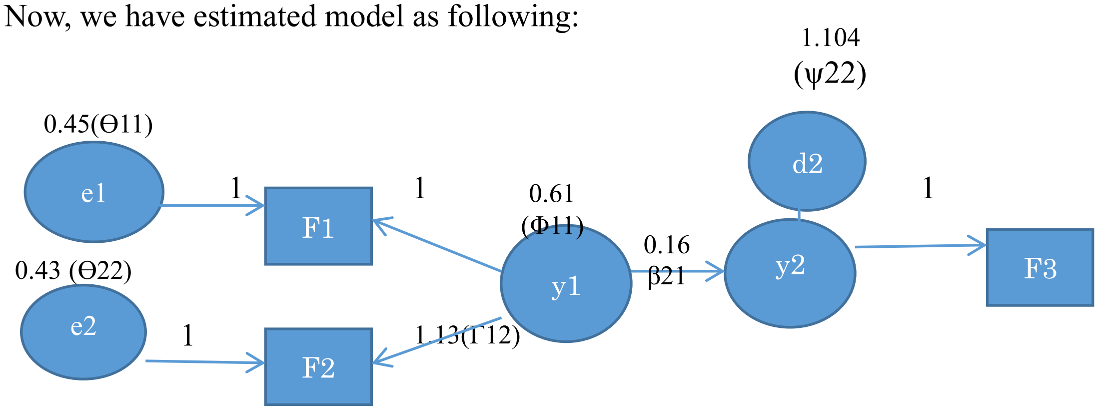
$$\begin{pmatrix} S_{11} & S_{12} & S_{13} \\ S_{21} & S_{22} & S_{23} \\ S_{31} & S_{32} & S_{33} \end{pmatrix} = \begin{pmatrix} 1.06 & 0.8 & 0.1 \\ 0.8 & 1.09 & 0.13 \\ 0.1 & 0.13 & 1.12 \end{pmatrix}$$

Dealing with a number of equations, we have value of parameters, as following:

$$\begin{cases} \Phi_{11} = S_{31}*S_{21}/S_{32} = 0.1*0.8/0.13 = 0.61 \\ \beta_{21} = S_{31}/\Phi_{11} = 0.1/0.61 = 0.16 \\ \Gamma_{21} = S_{21}/\Phi_{11} = 0.8/0.61 = 1.31 \\ \Theta_{11} = S_{11} - \Phi_{11} = 1.06 - 0.61 = 0.45 \\ \Theta_{22} = S_{22} - \Gamma^2_{21} * \Phi_{11} = 1.09 - 1.31^2 * 0.61 = 0.043 \end{cases}$$

$$\psi_{22} = S_{33} - \beta^2_{21}*\Phi_{11} = 1.12 - 0.16^2 * 0.61 = 1.104$$

Now, we have estimated model as following:



Clearly, regression coefficient ($\beta 21$) of y2 on y1 in above model is 0.16. In addition, regression coefficient (Γ_{12}) of F2 on y1 is 1.13. However, this result is unstandardized regression coefficient. The final goal of estimation is standardized regression coefficient. The standardized coefficient is estimated as following formula:

$$\beta = \sqrt{1 - \frac{Variance\ residual}{Variance\ total}}$$

$$\Gamma_{12} = \sqrt{1 - \frac{\Phi 11}{б12}} = \sqrt{1 - \frac{0.61}{0.8}} = 0.48$$