School of Civil and Mechanical Engineering

Urban Rail Transit Public-Private Partnerships with Land Value Capture

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Declaration

To the best of my knowledge and belief, this thesis contains no material previously published by any other person except where due acknowledgement has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

Human Ethics The research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007) – updated March 2014. The proposed research study received human research ethics approval from the Curtin University Human Research Ethics Committee (EC00262), Approval Number # HRE2019-0447

Signature: …….

Date: …….

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Author's Relevant Publications

This PhD thesis by hybrid form consists of four (4) first-author peer-reviewed publications and one (1) first-author under-review submission. The copyright permission statement for each publication is given in Appendix I. Signed statements of the contribution of co-authors are given in Appendix J.

Peer-Reviewed Journal Publication

1. **Li, X.,** and Love, P. E. D. (2019). Employing land value capture in urban rail transit public-private partnerships: Retrospective analysis of Delhi's Airport Metro Express. *Research in Transportation Business and Management*, 32, 100431.
2. **Li, X.,** and Love, P. E. D. (2020). State-of-the-art review of urban rail transit public-private partnerships. *Journal of Infrastructure Systems*, 10.1061/(ASCE)IS.1943-1555X.0000552.
3. **Li, X.,** and Love, P. E. D. (2022). Procuring urban rail transit infrastructure by integrating land value capture and public-private partnerships: Learning from the cities of Delhi and Hong Kong. *Cities,* 122, 103545.
4. **Li, X.,** Love, P. E. D., Luo, H., and Fang, W. (2022). A systemic model for implementing land value capture to support urban rail transit infrastructure projects. *Transportation Research Part A: Policy and Practice,* 156, 90-122.

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Abstract

Urban Rail Transit systems (URTs) can reduce pollution, increase accessibility, decrease road congestion, and improve a city's economic and social well-being. Despite the benefits of URTs, governments often find them expensive to construct, operate and maintain, placing a financial burden on taxpayers. Faced with fiscal constraints (e.g., debt, budget or deficit limits), governments have found it increasingly difficult to deliver and sustain taxpayers with quality rail infrastructure and services. Accordingly, many governments have opted to engage Private Participation in Infrastructure (PPI) to tackle their fiscal restrictions and procure their URTs using the Public-Private Partnership (PPP) approach or variants thereof.

While PPPs have been the procurement method of choice, a great deal of scepticism surrounds their inability to provide value for money. Reinforcing this scepticism has been the failure of PPPs to provide adequate operating revenues, which has resulted in the public sector having to subsidise shortfalls. Naturally, the public sector has considered alternative forms of funding and financing that can be used in conjunction with a PPP model to support the economic viability of their URTs and networks. It has been widely suggested that Land Value Capture (LVC) can support the economic viability of PPPs. In particular, the public sector has been drawn to adopting development-based LVC to acquire revenue from increases in land values near railway stations and their surrounding commercial and residential developments.

The use of development-based LVC with PPP to support URTs has been proven successful in Hong Kong, prompting a call to expand its application to other cities across the world. However, justifying the use of development-based LVC with a form of PPP is problematic due to an absence of a framework that can be drawn upon to ensure their successful implementation. Thus, this thesis addresses the following research question: *How can URTs be successfully supported by PPP and LVC across their life-cycle?*

The research commenced by undertaking literature reviews to determine the gaps in knowledge associated with the procurement of URT PPPs, including their integration with LVC. Then, a structured-case approach was adopted, aiming to build theory,

identify relationships between concepts, and provide understanding through iterative research cycles (i.e., plan, collect data, analyse and reflect). An exploratory case study approach using the 31 documentary sources (e.g., policy documents, expert reports and peer-reviewed academic articles) is used to learn from the experiences of delivering the Delhi Airport Metro Express and Hong Kong's Mass Transit Rail. Emanating from this study was a conceptual framework (CF_1) consisting of four core dimensions (i.e., PPP agreement, LVC, life-cycle process and governance) that can influence the success and failure of a URT project delivered via a PPP and LVC. The developed CF_1, therefore, was examined and modified with 27 semi-structured interviews and 70 documentary sources based on the experience of three Chinese cities (i.e., Guiyang, Guangzhou and Wuhan) to produce CF_2, CF_3 and CF_4 to justify their feasibility and improve their representations of practice.

The research proposes a final framework that provides a generic frame of reference for implementing PPP procurement to support URTs in conjunction with the LVC strategy. The final frameworks comprise three specific aspects within context (i.e., policies of PPP and LVC, the municipal transit agencies, and land acquisition within implementation procedure) and four dimensions of projects (i.e., PPP agreement, LVC, life-cycle process and governance). Also, a systemic model is developed, which identifies the underlying interdependency that influences the successful adoption of LVC. These proposed frameworks and the model are verified through internal validation.

Based on the different cities' experiences, the conceptual and final frameworks and systemic model are provided. The underlying problems and implications for adopting development-based LVC with PPP to support URTs are discussed. Furthermore, recommendations for future research are also presented in the conclusions. Due to its close connection to practice, this research can help policymakers better understand the integration of PPPs and LVC enabling them to calibrate their policies to deliver URTs successfully.

Keywords: Land value capture; public-private partnerships; structured case study, system thinking, urban rail transit

Table of Contents

List of Figures

List of Tables

List of Abbreviations

AAI: Airports Authority of India

BIM: Building Information Modelling

BOOT: Build-Own-operate-Transfer

BOT: Build-Operation-Transfer

BTO: Build-Transfer-Operate

CAPEX: Capital Expenditure

CBD: Central Business District

CCXI: China Cheng Xin International

CF: Conceptual Framework

CICC: China International Capital Corporation

CLD: Causal Loop Diagrams

CSOE: Centrally Administrated SOE

DAME: Delhi Airport Metro Express

DAMEPL: Delhi Airport Metro Express Private Limited

DBFO: Design-Build-Finance-Operation

DBFOM: Design-Build-Finance-Operate-Maintain

DCMF: Design-Construct-Manage-Finance

DMRC: Delhi Metro Rail Corporation

DPR: Detailed Project Report

DUAC: Delhi Urban Arts Commission

EPC: Engineering-Procurement-Construction

FAR: Floor Area Ratio

GDG: Governmental Debt Guarantee

GNCTD: Government of the National Capital Territory of Delhi

GOI: Government of India

ICRA: International Credit Rating Agency

IGI Airport: Indira Gandhi International Airport

JICA: Japan International Cooperation Agency

LRRT: Light Rail Rapid Transit

LRT: Light Rail Transit

LVC: Land Value Capture

MDG: Minimum Demand Guarantee

MIG: Minimum Income Guarantee

MRG: Minimum Revenue Guarantee

MTR: Mass Transit Rail

O&M: Operations and Maintenance

OPEX: Operation Expenditure

PFI: Private Finance Initiative

PPI: Private Participation in Infrastructure

PPP: Public-Private Partnership

RGR: Regional Rail

RITES: Rail India Technical and Economic Service

ROT: Rehabilitate-Operate-Transfer

RRT: Rapid Rail Transit

RTRT: Rubber-Tired Rapid Transit

SIM: Systems Information Modelling

SIP: Share Issue Privatisation

SOE: State-Owned Enterprise

SPC: Search Path Count

SPV: Special Purpose Vehicle

TOD: Transit-oriented Development

UK: United Kingdom

URT: Urban Rail Transit

URTs: Urban Rail Transit systems

US: United States

CHAPTER 1 INTRODUCTION

1.1 Background

Urban Rail Transit systems (URTs) are critical pieces of infrastructure that support cities' economic and social development (Ramos-Santiago *et al.*, 2016; Love *et al.*, 2017). With increasing population levels, congestion, and pollution, the capacity of existing transport infrastructure networks and systems in cities worldwide is becoming strained (Newman and Kenworthy, 2015).

Despite the benefits of URTs, governments often find them expensive to construct, operate and maintain, placing a financial burden on taxpayers. The Capital Metro Agency (2014), for example, estimated that the capital expenditure (CAPEX) required to construct a 12-km Light Rail Transit (LRT) in Canberra, Australia, was AU$789 million, and its operation expenditure (OPEX) was AU$1285 million over its 30-year life. In China, for example, more than US$84 billion[1] of investment has been made available to construct and upgrade URT systems in many cities (China Association of Metros, 2020a, 2020b, 2020c).

Faced with fiscal constraints (e.g., debt, budget or deficit limits), governments have found it increasingly difficult to deliver and sustain taxpayers with quality rail infrastructure and services (Pulido *et al.*, 2018). Accordingly, many governments have opted to engage in Private Participation in Infrastructure (PPI) to tackle their fiscal restrictions and procure their URTs using the Public-Private Partnership (PPP) or variants thereof (Lesley, 1995; Roumboutsos and Saussier, 2014; Chang and Phang, 2017; Love *et al.*, 2017; Regan *et al.* 2017). There is no widely accepted definition of PPP (The World Bank, 2017). But it is believed that the definition developed by the PPP Knowledge Lab (2017) is the most comprehensive:

> "A long-term contractual agreement between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility and remuneration is linked to performance." (p.1)

[1] 1 USD = 7.02 CNY (according to the exchange rate on 6 July 2020)

Recognising the benefits of PPPs, governments have utilised them to deliver their URTs (Lesley, 1995; Siemiatycki, 2006; Phang, 2007; de Jong *et al.*, 2010; Gordon *et al.*, 2013a; Carpintero and Petersen, 2014, 2015; Fombad, 2015; Hong, 2016; Neto *et al.*, 2016; Ke *et al.*, 2017; Sturup, 2017). Since 2004, for example, seven subway lines in China have been constructed using PPPs, with several others being planned (de Jong *et al.*, 2010; Luan *et al.*, 2014). In Australia, PPPs are being used to deliver the Sydney Metro Northwest, LRTs in Sydney's Central Business District, and Canberra and have become a popular procurement strategy for State Governments (PwC, 2017a).

Despite the benefits of using PPPs for URTs, a great deal of trepidation prevails about their ability to provide value for money, primarily because they have been prone to CAPEX increases during their construction (Santos *et al.*, 2010). Moreover, when a concessionaire has adopted ridership/traffic risk during operations, there has been a proclivity for anticipated revenues to fall below those forecasted, resulting in financial losses being borne by the private sector (Santos *et al.*, 2010; Dehornoy, 2012). The leverage on ridership for a concessionaire, for example, is often limited by high levels of price elasticity, hindering their ability to raise their revenue. Notably, the price elasticity of rail is almost -1. Thus, a 1% increase in the average price of a ticket will result in a 1% decrease in ridership (Dehornoy, 2012, p. 10).

Naturally, the public sector has considered alternative forms of funding and financing that can be used in conjunction with a PPP model to support their URT systems and networks (Sharma and Newman, 2018a). Land Value Capture (LVC) has been identified as a potential finance mechanism integrated with a PPP to ensure economic success. The concept of LVC has received widespread attention, and several definitions have been proposed (Alterman, 2012; Medda, 2012; Zhao *et al.*, 2012a; Smolka, 2013; Suzuki *et al.*, 2015; Loo *et al.*, 2018). Suffice to say, Transport for London's (2017) definition of LVC was considered as the most concise one because they deem it to be "a set of mechanisms used to monetise increases in land values that arise in the catchment areas of transport projects" (p.12).

In Asian cities such as Hong Kong and Tokyo, LVC with PPPs has been successfully deployed (Chang and Phang, 2017). In Hong Kong, development-based LVC has contributed approximately 50–60% of the Mass Transit Rail (MTR) Corporation's total profit (2018). Similarly, in Tokyo, public agencies and private conglomerates have formed a partnership to create their heavy rail transit network and rely on LVC to generate between 20 and 60% of their revenue (Suzuki *et al.*, 2015). Achieving such a significant financial return resulted in an advocation to deliver Beijing's No.4 Line, Mumbai Metro and Gold Coast Light Rail using a PPP with the LVC mechanism (Murray, 2016; Chang and Phang, 2017; Sharma and Newman, 2018a).

Replicating the success of Hong Kong and Tokyo in other cities that are not as densely populated is a challenge, and examples of other cities that have effectively utilised LVC to financially support the construction and operation of their URTs are few and far between. Equally, LVC has also contributed to the failure of several cities' URT systems. In the United Kingdom (UK), for instance, the use of LVC in London's Crossrail project (now branded as the Elizabeth Line) has presented a 30% return on capital costs (Department of Infrastructure and Regional Development, 2016). In contrast, Indian cities such as Bangalore and Delhi, which have used PPPs and LVC, have been confronted with defects during their construction and revenue shortfalls, and have been subject to corruption (Pratap, 2013; Sinha, 2021).

There have only been a handful of studies that examined the experience of integrating LVC with a PPP to deliver URTs, rendering it difficult for governments to apply lessons from previous researches to their unique environments. Indeed, studies tend to be insular in their focus and specifically examine issues associated with the strategy, policies and problems related to using PPPs with LVC (Luan *et al.*, 2014; Suzuki *et al.*, 2015; Chang and Phang, 2017; Newman *et al.*, 2018; Sinha, 2021). As a result, policymakers may overlook the critical issues, interactive relationships and potential risks that emerge from implementing LVC in conjunction with PPPs to support the procurement of URTs. Therefore, there is a need for focused research that examines critical issues of PPP and LVC and their collective impact on the successful delivery of URTs. With this in mind, the research question of this study is *How can URTs be successfully supported by PPP and LVC across their life-cycle?*

1.2 Research Aim and Objectives

This research aims to develop a *generic framework*. This framework can assist policymakers in delivering their URTs when procured using a PPP and supported by LVC. Specific objectives to achieve this research aim include:

- Identify the success and failure of experience in using PPP and LVC to deliver URTs;
- Determine the critical issues that contribute to the performance of using PPP and LVC, and the interaction arising from their adoption;
- Develop a conceptual framework, which incorporates the critical issues and their interactions to support the adoption of PPP and LVC;
- Examine the applicability and validity of the conceptual framework in the real world (i.e., Chinese cities for this research); and
- Generate a generic framework underpinned by a systemic model that can successfully support policymakers' adoption of PPPs and LVC.

The output of this research is significant, not only theoretically but also practically as it contributes to the area of using PPP and LVC to deliver URTs, which has received limited attention but can potentially provide governments with an innovative financing approach for rail infrastructure.

1.3 Research Significance

Using PPPs to deliver URT is increasingly difficult due to fiscal constraints. It is thus required to finance the URT PPP project within budget and minimise its whole-life costs to ensure its success (Pulido *et al.*, 2018). Employing an LVC mechanism can support these aims. For example, in the case of URT PPPs in Gold Coast City, Australia, it is estimated that the size of the gains from LVC was around 25% of the capital cost (Murray, 2016). Similarly, fourteen URT PPPs in China, totalling a CAPEX of US$31.3 billion, might be suspended due to debt and funding issues of municipal governments (China Public-Private Partnership Centre, 2018; Sohu, 2018). If LVC can be adopted, these projects could be given the opportunity to be continued. The experience of Shenzhen serves as a case in point (Luan *et al.*, 2014). When more

financial benefits are brought from LVC, the URT PPP project is taken into consideration.

The experience of URT PPPs with LVC, however, is limited, and they tend to provide context-specific lessons that focus on analysing particular strategies, policies and problems (Luan *et al.*, 2014; Suzuki *et al.*, 2015; Chang and Phang, 2017; Newman *et al.*, 2018; Sinha, 2021). Thus, there is an absence of knowledge that provides a holistic and generic understanding of using PPP and LVC to deliver URTs and that helps worldwide policymakers apply them successfully.

This research will fill this "gap" by drawing on the empirical evidence to develop a generic framework that is underpinned by a systemic model. The generic framework comprises the critical issues contributing to the performance of using PPP and LVC and their interactive relationships and, more importantly, indicates how they can support the delivery of URTs. Moreover, the systemic model that presents the interdependency between constituents of LVC adoption can support the utilisation of the generic framework. Accordingly, this generic framework with the systemic model can be considered as a robust reference for policymakers to procure URTs with PPP and LVC successfully.

Hence, this research provides a twofold contribution. In one aspect, it provides significant insights regarding PPP and LVC for policymakers and alike to improve the financial sustainability of rail infrastructure. In another aspect, as the first study to provide a holistic understanding of URT PPPs with LVC, this research contributes to innovative knowledge on the procurement approach for rail infrastructure.

1.4 Research Methodology

This research firstly undertakes a systematic methodology to examine the literature related to URT PPPs. Based on the systemic review of URT PPPs, an in-depth review of LVC is conducted. This phase confirms that integrating PPP and LVC to deliver URTs has been increasingly advocated as an important and emergent area but has not been fully explored. The prior studies undertaken for URT PPPs with LVC have not provided a holistic understanding of these issues, which failed to be a robust reference

for academics and policymakers. Accordingly, to fill this knowledge gap, an empirical study that can provide a generic framework for delivering URTs through PPP and LVC is needed.

This empirical study employs an interpretive qualitative research approach. The research question of this study is suited to the interpretive qualitative research approach as it is effective in exploring issues that have been seldom examined previously by providing detailed and in-depth descriptions and developing theories drawn on few empirical evidence (Sofaer, 1999; Anderson, 2010). In particular, the emerging nature of this research is suited to interpretivism. The examination of URT PPPs with LVC has shown that access to objective data is limited, whereas using subjective data from documents and interviews can also reflect critical factors that can influence its success (Aveline-Dubach and Blandeau, 2019; Sinha, 2021). With this in mind, selecting interpretivism can help the researcher gather information from respondents' subjective perspectives so that a better understanding of how PPP and LVC can be used together to deliver URTs successfully can be gained.

Within the scope of interpretive qualitative research, this study uses a structured case study approach. It has been acknowledged that a structured case study approach can build theory, discover relationships between concepts, and explain, predict and/or provide understanding for complex issues such as those associated with PPPs and LVC (Carroll and Swatman, 2000; Love *et al.*, 2006). Therefore, with the employment of this approach, a series of conceptual frameworks (i.e., CF_1, CF_2, CF_3.....CF_n) can be established through the research process to examine and revise the understanding gained from research objectives. In this case, CF_n arises when data saturation has occurred, enabling theory building, representing a good picture of practice and the end of the research process (Eisenhardt, 1989; Carroll *et al.*, 1998; Carrol and Swatman, 2000; Love *et al.*, 2006).

The detailed research process of the structured case approach for this study will be presented in Chapter 3, where CF_1, CF_2, CF_3 and CF_4 are used to achieve the process of knowledge and theory building for URT PPPs with LVC. For this matter, the research process of this study firstly commences with recognising critical issues and

their correlations from the empirical evidence provided by Hong Kong and Delhi cases and reviewing the extant literature. The CF_1 is generated to understand the integration of PPP and LVC for URTs. The empirical evidence here is collected from the critical document source of these two cases, including regulations, concession agreements, annual reports of the transit agencies, and peer-reviewed academic articles.

Then, this research validates the CF_1 and transforms it to CF_2, CF_3, and CF_4 with empirical evidence collected from URT PPPs with LVC in three Chinese cities (namely Guiyang, Guangzhou and Wuhan). As a result, the feasibility and applicability of these frameworks are empirically tested. To be noted, the empirical evidence is collected from the three cities, including the critical document source, introduced above, and the semi-structured interviews. All respondents in semi-structured interviews were involved in the implementation process of URT PPPs with LVC. They comprise senior government officers, rail transit and land agency project managers, engineers, financial experts, and urban planners.

Following this, a final PPP and LVC framework for supporting URT systems and networks is developed by conducting the inter-case comparison and combining CF_1, CF_2, CF_3, and CF_4. The final framework can provide the most theoretically-appropriate and practically-effective knowledge of URT PPPs with LVC for policymakers. In conjunction with this, a systemic model of using LVC to support the procurement of URTs is developed through a causal loop diagram, aiming to help policymakers create an effective LVC strategy.

In addition, these proposed frameworks and the model are verified through internal validation, which confirms the research findings and the reliability of the research. Therefore, the proposed frameworks and models in this research are practical and can be used by policymakers to deliver URTs through PPP and LVC successfully.

1.5 Thesis Outline

This thesis comprises seven chapters: Introduction, Literature Review, Research Methodology, Initial Conceptual Framework (CF_1), The Conceptual Framework 2, 3, and 4, Discussion, and Conclusion and Recommendations. Figure 1.1 indicates the

organisation of the thesis, and a summary of each chapter (except Chapter 1) is presented subsequently.

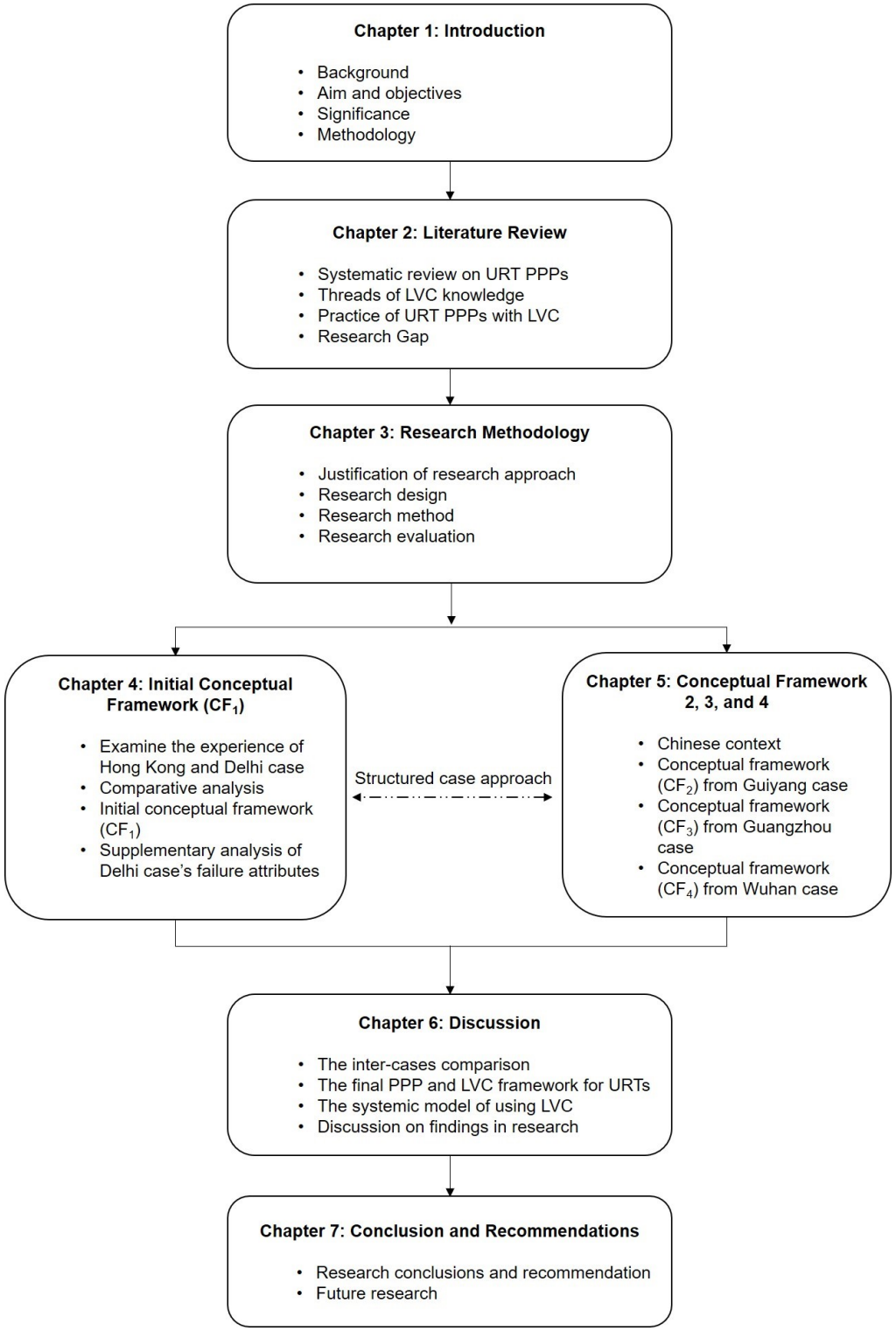


Figure 1.1 Organisation of the thesis

"Chapter 2: Literature Review" – A systematic review of the normative literature examines the current URT PPP studies, undertaking a historiographic mapping and then identifying their three knowledge themes (i.e., industry structure, governance and financial sustainability). With the knowledge of financial sustainability within URT PPPs, the in-depth review on threads of the LVC knowledge is summarised, and its adoption to support URT PPPs is presented. Moreover, it indicates that, although the use of LVC and PPP to deliver URT is recommended in the literature, its practical adoption is limited, and its success relies on an array of political, socio-economic and geographical factors. The result is the absence of research that can be used to develop a robust framework to help policymakers effectively deliver URT systems and networks with PPP and LVC. In summary, this chapter identifies a significant knowledge gap and builds a theoretical foundation for this research on URT PPPs with LVC.

"Chapter 3: Research Methodology" introduces the methodological strategy and the process of data collection required for this research. Based on the limited experience and inadequate access to objective data for the issues of URT PPPs with LVC, the interpretive qualitative approach using subjective data has been adopted as the primary research strategy of this thesis. Within the interpretive qualitative approach, the structured case study, semi-structured interviews and documentary sources are applied to achieve the identified research aim and objectives.

"Chapter 4: Initial Conceptual Framework (CF_1)" is an exploratory case study on the experience of Hong Kong and Delhi cases. It aims to examine the success and failure of URTs procurement using PPPs with LVC in Hong Kong and Delhi. This investigation draws on empirical evidence from 31 publicly-available and critical documentary sources to examine these two cases. The NVivo 12 software was used to analyse the documentary sources collected. As a result, an initial conceptual framework that integrates LVC and PPPs for URT procurement is developed. This initial conceptual framework (CF_1) identifies that the PPP agreement, LVC, life cycle process, and governance dimensions contribute to the success of the URT PPP with LVC projects. In addition, the supplementary analysis of the Delhi case presents the overly optimistic transit demand forecast and aggressive bidding can impair the

performance of URT PPPs with LVC. The conceptual framework developed provides the basis for examining the URT delivery using a PPP and LVC in the study's selected Chinese cities in Chapter 5.

"Chapter 5: The Conceptual Framework 2, 3, and 4" completes the research cycles of the structured case approach. It examines the applicability and feasibility of CF_1 with the experience of URT PPPs with LVC in three selected Chinese cities (i.e., Guiyang, Guangzhou and Wuhan) and transforms it to CF_2, CF_3, and CF_4. These case studies rely on 27 semi-structured interviews and 70 publicly-available critical documentary sources. The NVivo 12 software was used to analyse these semi-structured interviews and documentary sources. As a result, the CF_2, based on the CF_1, also requires consideration of specific aspects (i.e., PPP and LVC policies, municipal transit agencies, and land acquisition in implementation procedure) within the context and add cost decrease issue into the LVC dimension. Also, in regard to the latter, the CF_3 identifies the overly optimistic estimate that can impair the project's cost performance and propose the appropriate mitigation strategies in the dimension of governance. In comparison, CF_4 removes the overly optimistic estimate and its mitigation strategies and identifies other themes in this conceptual framework recurring in CF_2 and CF_3. Hence, this chapter empirically confirms that conceptual frameworks developed in this research can apply to the practical condition and can be a sound foundation to develop the final PPP and LVC framework for delivering URTs.

"Chapter 6: Discussion" develops the final PPP and LVC framework for delivering URTs, establishes the systemic model, and describes how the findings of this research contribute to policymaking and academic research. The inter-case comparison for all conceptual frameworks is first conducted to discuss their similarities and differences, from which the final PPP and LVC framework for URTs is developed. The final framework includes three specific aspects within the context and four dimensions of projects. To support the LVC dimension in the final framework, a systemic model is developed. The systemic model presents interdependency between the constituents of LVC within policy, planning, finance and project management using a series of causal loop diagrams. This systemic model helps policymakers create their LVC strategy to collectively work on the final framework to contribute to its success. The implications

of the primary research findings in this study for policymakers and the academic community are also presented, which can be grouped into seven themes. They are: (1) applicability of the final PPP and LVC framework; (2) transit agencies governance; (3) ineffective transit-oriented development (TOD); (4) cost decrease and risk mitigation strategies for LVC; (5) selection of bundled or unbundled contracts; (6) optimistic forecast, and; (7) negative impact of the URT on the environment.

"Chapter 7: Conclusion and Recommendations" – the final chapter of this thesis – is where key research findings are summarised. Additionally, practical and theoretical implications will be discussed. These implications include improving transparency in the decision-making process, developing a regime to reduce the political influence, and employing independent organisations to prepare technical documents. Also, recommendations for future research are outlined and re-stated in this chapter.

1.6 Research Limitations

It needs to be acknowledged that there are limitations to this research. The most significant is that this research is specific to the development-based LVC with PPP for the procurement of URTs, the reason being that development-based LVC, compared to tax or fee-based LVC, receives less opposition from taxpayers and is more applicable to worldwide jurisdictions (Suzuki *et al.,* 2015). However, tax or fee-based LVC can also support the URT PPPs (Murray, 2016). A lack of the examination of the tax or fee-based LVC in the context of URT PPPs could reduce the validity and reliability of the generic framework developed in this research. Thus, future studies can overcome this limitation by comparing the generic framework in this research with the tax or fee-based approaches to improve their validity and reliability.

The research presented in this thesis is based on five cases studies, meeting the recommendation from Eisenhardt (1989) where between four and ten cases often works well. However, more cases are advocated as they are often considered more compelling, and the overall study is regarded as being more robust (Yin, 2009). With this in mind, the findings of this research that are derived from five cases may not be robust enough. Thus, future studies can examine more cases of URT PPP with LVC to improve the robustness of the generic framework in this research.

The semi-structured interviews and documentary sources were collected as the primary empirical evidence to conduct this research. Both semi-structured interviews and documentary sources were not collected systematically due to their lack of availability, resulting in the incomplete analysis of URT PPPs with LVC issues. Nonetheless, studies that inquire into the delivery of URT with PPP/LVC in high-quality academic journals also use empirical evidence that is not collected systematically (Luan *et al.*, 2014; Chang and Phang, 2017; Aveline-Dubach and Blandeau, 2019; Sinha, 2021). Thus, it implies that multiple semi-structured interviews with sufficient critical documents can conduct reliable analysis on issues of URT PPPs with LVC.

1.7 Chapter Summary

This chapter begins by introducing the fiscal limits of URTs delivery, their sceptical adoption with PPP and the benefit of using LVC. In relation to this, this chapter identifies that there are limited studies on delivering URTs through PPP and LVC and needs to explore a way to assist policymakers in understanding and achieving the successful achievement of rail infrastructure. With the need to study how to deliver URTs with PPP and LVC successfully, the primary aim is to develop a generic framework. Five relevant objectives are derived in this chapter. Then, the significance and methodology of this research are described and introduced, respectively. This chapter also serves a role in providing an overview of the research. There are seven chapters embedded into this thesis, and the core contents are summarised above. Essentially, these chapters constitute qualitative research under the structured case study approach based on the data collection from semi-structured interviews and documentary sources. Finally, the research limitations are provided. These limitations are related to the research scope specific to development-based LVC with PPP, the number of cases in this research, and data collection from semi-structured interviews and documentary sources.

CHAPTER 2 LITERATURE REVIEW

2.1 Chapter Introduction

This Chapter firstly uses a systematic literature review to examine the current URT PPP studies and identifies three underlying knowledge themes (i.e., industry structure, governance and financial sustainability). In particular, the financial sustainability theme within the systematic review identifies that employing LVC can support URT PPPs. Based on it, an additional in-depth review including more studies is conducted to provide a more comprehensive examination of using LVC for URT PPPs. This additional in-depth review summarizes the LVC knowledge threads and presents the practice of its adoption to support URTs. Finally, the research gaps in the normative literature about the use of PPP and LVC to deliver URT systems and networks are identified.

This Chapter provides background knowledge to support the development of the conceptual framework proposed in Chapter 4. To this end, this Chapter serves as the theoretical foundation to understand current research progress, gaps and future developments for integrating PPP and LVC to deliver URTs.

Parts of this Chapter have been published in the ASCE Journal of Infrastructure Systems and Transportation Research Part A: Policy and Practice.

Li, X., and Love, P. E. D. (2020). State-of-the-art review of urban rail transit public-private partnerships. Journal of Infrastructure Systems, 10.1061/(ASCE)IS.1943-1555X.0000552.
Li, X., Love, P. E. D., Luo, H., and Fang, W. (2022). A systemic model for implementing land value capture to support urban rail transit infrastructure projects, Transportation Research Part A: Policy and Practice, 156, 90-122.

2.2 Systematic Review Framework for URT PPPs

The definition of PPP has been presented in Chapter 1. Recognising the benefits of PPPs, governments have utilised them to deliver their URT (Lesley 1995; Siemiatycki 2006; Phang 2007; de Jong *et al.* 2010; Gordon *et al.* 2013b; Carpintero and Petersen 2014, 2015; Fombad 2015; Hong 2016; Neto *et al.* 2016; Ke *et al.* 2017; Sturup 2017). A summary of URT PPPs constructed and are now in operation worldwide is presented in Table 2.1. Notably, it is expected that 44 URTs in China are to be delivered using PPPs soon (China Public-Private Partnership Centre, 2018).

While numerous studies have examined URT PPPs, a paucity of research has critically reviewed, analysed, and compared developments in this critical and emergent area of transportation procurement. Here, a systematic methodology is undertaken to review the URT PPP literature. A systematic review differs from those traditionally undertaken as it is replicable, iterative, and transparent. The systematic review thus can minimise bias and deploy a comprehensive search and analysis framework (Tranfield *et al.*, 2003). For example, the literature shows that systematic reviews have been undertaken within the milieu of the PPPs field (Roehrich *et al.*, 2014; Torchia *et al.*, 2015; Wang *et al.*, 2017). While there has been no systemic review research in the context of PPPs and URTs. Drawing on the works of Torchina *et al.* (2013) and Roehrich *et al.* (2014), a systematic review of PPPs and URTs is undertaken using a three-stage process as presented in Figure 2.1.

2.2.1 Stage I: Scoping and Defining Search Strategy

A systematic search commences with the confirmation of scope and a search strategy based on keywords from a selected citation database. For the purposes of this research, the Web of Science (WOS) was chosen as it is considered to be the single most authoritative source to determine citation impacts and due to its widespread journal coverage (Chadegani *et al.*, 2013). In line with Delmon (2010), Zhang *et al.* (2016) and the PPP Knowledge Lab (2017), the selected typologies of PPPs and their abbreviations were included in Keywords I in Table 2.2. The modes of URT and their abbreviations as addressed by The World Bank (2017) and Vuchic (2007) were also included in Keywords II in Table 2.2. The words presented in Keywords I and II were paired. For example, the terms Public-Private Partnerships Metro were used to search within the WOS database.

Table 2.1 A summary of URT PPPs projects

Country	Project	URT Type	PPP Agreement	Capital Costs (US$ Billions)	Year	Reference
Australia	Gold Coast Light Rail (Stage 1)	Light Rail	Design-Build-Finance-Operate-Maintain	0.58	2011[+]	GoldLinQ Pty Ltd. (2012)
Brazil	Metro Line 4 of the Sao Paulo Subway System	Heavy Rail	Equipment, Rolling stock and Operate	0.26	2006[+]	Brandao *et al.* (2012)
Canada	Canada Line	Light Rail	Design-Build-Finance-Operate	2	2005[+]	Siemiatycki (2007)
China	Extension of Shenzhen Line 4	Heavy Rail	Build- Develop-Operate-Transfer	0.86	2009[++]	de Jong *et al.* (2010); Luan *et al.* (2014)
China	Beijing No.4 Metro Line	Heavy Rail	Joint Venture (excluding civil work to the public sector)	2.23	2006[++]	de Jong *et al.* (2010), Chang (2013)
China	Hong Kong MTR	Heavy Rail	Joint Venture	-	2000[+]	Chang and Phang (2017)
India	Mumbai Metro Line 1	Heavy Rail	Joint Venture	0.34	2008[++]	JICA (2013)
India	Delhi Airport Metro Express	High Speed Rail Transit	Build-Operate-Transfer (excluding civil work to the public sector)	0.77	2008[+]	JICA (2013)
India	Hyderabad Metro	Heavy Rail	Design-Build-Finance-Operate-Transfer	2.3	2012[++]	Hyderabad Metro Rail Limited (2014)
Italy	Milan Metro Line 4	Heavy Rail	Joint Venture	2.11	2011[+]	Cohen and Boast (2016)

Japan	Hachioji Line	Light Rail	Joint Venture	-	2015[++]	Wunderlich and Mayer (2017)
Malaysia	Star LRT (Ampang Line)	Light Rail	Build-Own-Operate	1.3	1993[++]	Kiggundu (2009), Bray and Sayeg (2013)
Malaysia	Putra LRT (Kelana Jaya Line)	Light Rail	Build- Operate-Transfer	1.8	1994[++]	Kiggundu (2009), Bray and Sayeg (2013)
Malaysia	KL Monorail	Monorail	Build- Operate-Transfer	0.5	2003[++]	Kiggundu (2009), Bray and Sayeg (2013)
Philippines	Metrostar Express (MRT-3)	Light Rail	Build-Lease-Transfer	0.7	1997[++]	Bray and Sayeg (2013)
Portugal	Tagus South Line	Light Rail	Design-Build-Operate-Maintain	0.25	2002[+]	Cruz *et al.* (2015)
Singapore	Singapore Mass Rapid Transit	Heavy Rail	Joint Venture	-	2000[+]	Chang and Phang (2017)
South Africa	Gautrain	Regional Rail	Build- Operate-Transfer	2.17	2006[+]	Fombad (2015)
South Korea	Seoul Line 9	Heavy Rail	Build- Transfer-Operate	5.7	2004[++]	Hong (2016)
Spain	Expansion of the Subway to Madrid-Barajas International Airport	Heavy Rail	Construction –Maintenance	0.07	2006[+]	Solino and Vassallo (2009)
Spain	Las Tablas Line	Light Rail	Build- Operate-Transfer	0.28	2006[+]	Carpintero and Petersen (2014)
Spain	Pozuelo Boadilla Line*	Light Rail	Build- Operate-Transfer	0.61	2006[+]	Carpintero and Petersen (2014)

Spain	Trambessos Line	Light Rail	Build- Operate-Transfer	0.28	2000[+]	Carpintero and Petersen (2014)
Spain	Parla Line	Light Rail	Build- Operate-Transfer	0.14	2005[+]	Carpintero and Petersen (2014)
Spain	Trambaix Line	Light Rail	Build- Operate-Transfer	0.25	2000[+]	Carpintero and Petersen (2014)
Thailand	Bangkok Transit System	Heavy Rail	Build- Transfer-Operate	1.9	1999[+++]	Bray and Sayeg (2013)
United Kingdom	London Underground	Heavy Rail	Maintenance and Renew	19	2003[+]	Butcher (2012)
United States	JFK International Airport Airtrain	Light Rail	Design-Build-Operate-Maintain	1.9	1998[+]	Gosling and Freeman (2012)

+ Year of Award

+ + Year of construction commenced

+++ Year of operation commenced

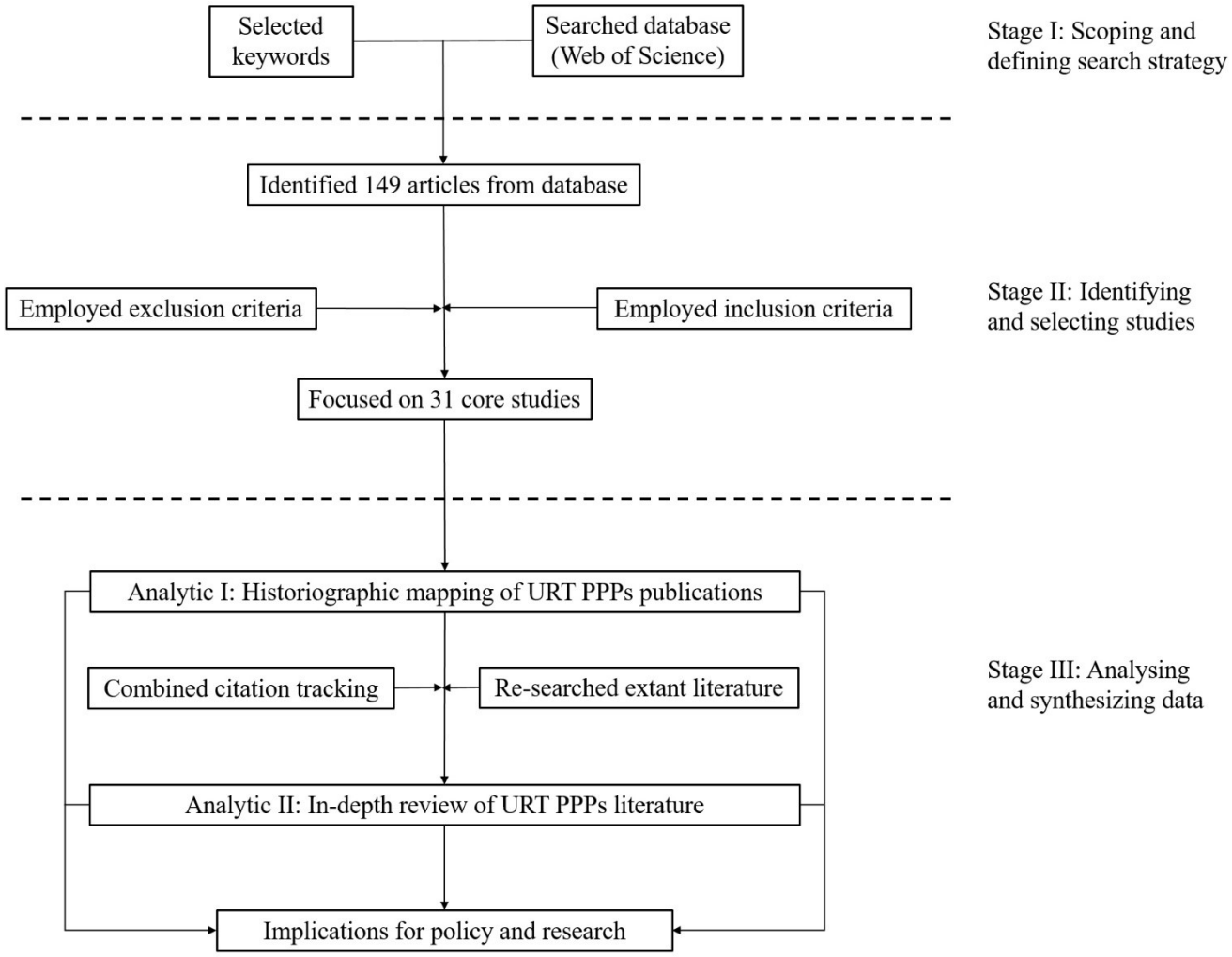


Figure 2.1 Systematic review process

Table 2.2 List of selected keywords

Categories	**Keywords**
I - Typologies of public-private partnerships	Public-private partnership (PPP)
	Design-build-finance-operate-maintain (DBFOM)
	Design-build-finance-operation (DBFO)
	Design-construct-manage-finance (DCMF)
	Build-operation-transfer (BOT)
	Build-own-operate-transfer (BOOT)
	Build-transfer-operate (BTO)
	Operations and maintenance (O&M)
	Lease
	Afterimage
	Concession
	Franchise
	Management contract
	Rehabilitate-operate-transfer (ROT)
	Joint venture
	Private finance initiative (PFI)
II—Modes of urban rail transit	Urban rail transit (Urban rail/URT)
	Tramways (Tram)
	Streetcar
	Rapid rail transit (Rapid rail/RRT)
	Rubber-tired rapid transit (RTRT)
	Heavy rail
	Subway/Underground/Tube/Metro (MTR)
	Monorail
	Light rail transit (LRT)
	Light rail rapid transit (LRRT)
	Regional rail (RGR)

2.2.2 Stage II: Identifying and Selecting Studies

A total of 149 studies were identified from the WOS database from 1990 to 2017. This period of analysis was selected as modern forms or variants of PPPs began to emerge as a result of the Private Finance Initiative (PFI) introduced in the United Kingdom (UK) in 1992 (Li *et al.*, 2005a). However, only 31 articles have focused explicitly on PPPs and URT, listed in Appendix A. In addition, the following were considered when selecting articles to be examined: (1) a primary focus on URT PPPs; (2) high-level quality scholarly journals (e.g., Q1 and Q2 in Scimago Journal Rank (SJR); and (3) those of a conceptual, quantitative or qualitative nature. Editorials, non-English journals, non-full text papers, and other unrelated papers were excluded from the research.

2.2.3 Stage III: Analysing and Synthesising Data

The analysis and synthesis of the data extracted from the identified papers were conducted in two phases. In phase 1 - Analysis I, a scientometric analysis of the URT PPPs publications was undertaken. Using Algorithmic Historiography, an understanding of the development of knowledge and significant PPP and URT works were identified. In essence, algorithmic historiography identifies the critical works associated with the development of a field and facilitates the understanding of paradigms for a given topic (Garfield *et al.*, 2003). In phase 2 -Analysis II, an in-depth review of the identified URT PPPs publications was undertaken to determine gaps in knowledge within the extant literature and identify common and emergent themes. The analysis is presented by summarising, comparing, and synthesising the characteristics and connections between the identified themes.

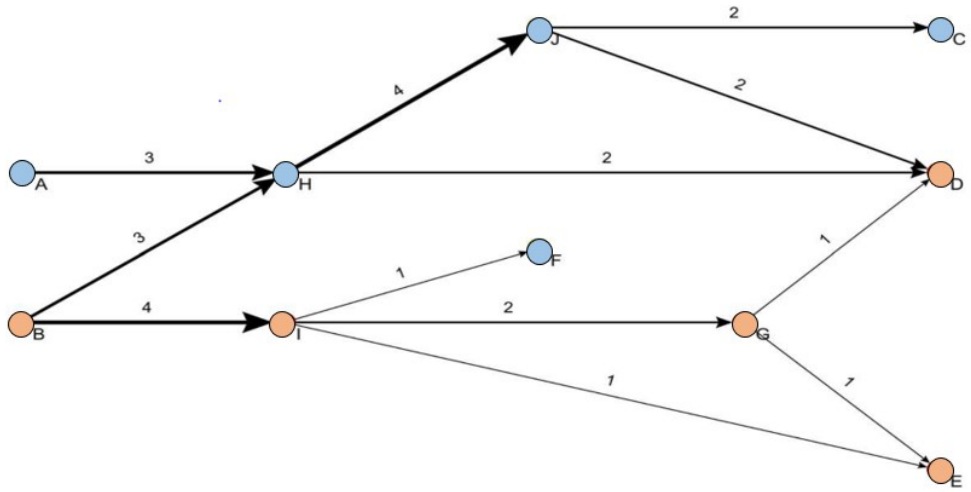
2.3 Analysis I: Historiographic Mapping of URT PPPs Publications

A chronological citation network, using HistCite ^{TM} software (Garfield, 2009), is indicated by an Algorithmic Historiography provides a graphical and genealogic presentation of links between papers and thus enables the underlying developments

within a scientific field to be determined (Lucio-Arias and Leydesdorff, 2008). In a chronological citation network, knowledge flows between cited documents and their links act as conduits of knowledge used to disseminate ideas. Among these links, the main path is the most important sequence of conduits used to disseminate knowledge from the selected research articles (Liu and Lu, 2012). Through the main paths in the chronological citation network, key intellectual developments within a field of study can be located when it is self-contained (i.e., not borrowing from other fields for its key intellectual developments) (Carley *et al.*, 1993).

According to Hummon and Dereian (1989), the main path can be identified using two steps: (1) calculate each link in a chronological citation network to indicate its significance; and (2) employ a search algorithm to construct the main path. In this research, the Search Path Count (SPC) method proposed by Batagelj *et al.* (2014) is initially used to calculate the value of the links between URT PPPs publications. Liu and Lu (2012) used a simple citation network, illustrated in Figure 2.2, to demonstrate how the SPC for each link in a citation network is calculated. The SPC for each link is defined as the total number of times that the link is traversed from the cited node but cites no other nodes to the node that cites other nodes but is not cited. In Figure 2.2, A and B are cited nodes, but they cite no additional nodes. Also, C, D, E, and F are nodes that cite other nodes, but they are not cited. Thus, link J-C has an SPC value of 2 as paths A–H–J–C and B–H–J–C pass through it, and B-I and H-J have the largest SPC value.

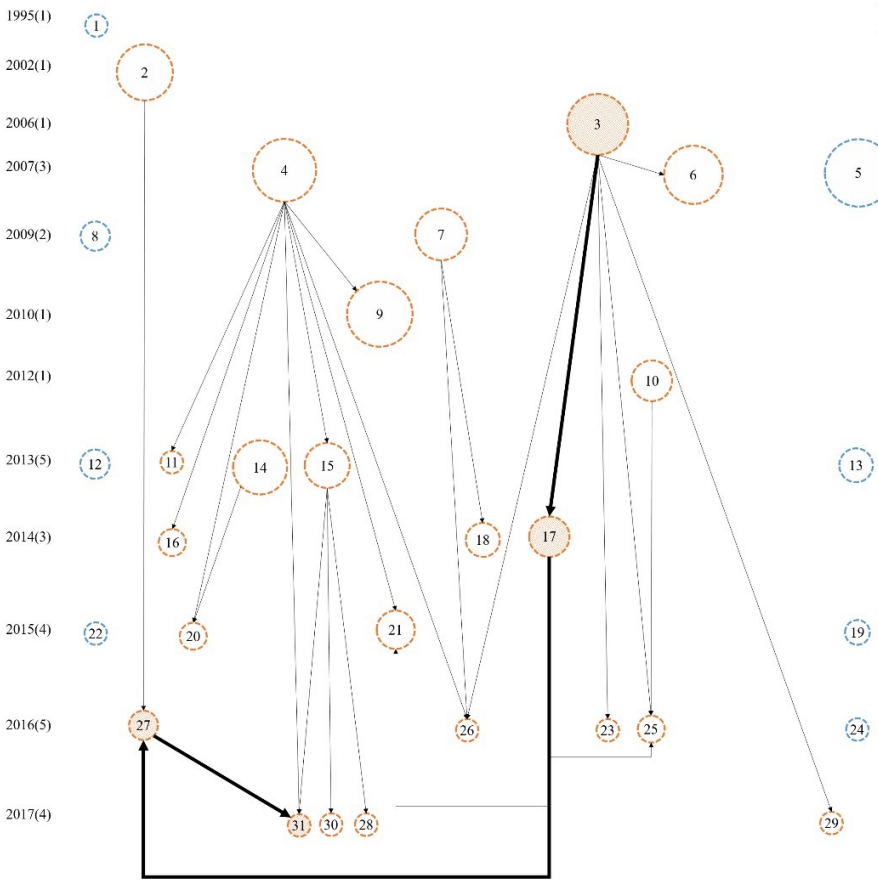
The approach proposed by Batagelj and Mrvar (2004) was employed to determine the main path. This approach examines all articles that do not cite each other, and then the researcher can select the link with the highest SPC value arising from them. Next, the researcher can choose the link with the highest SPC from the starting point as the next one. This determination of the main path is a continuous process where the linking ends with an article containing no further references.



Adapted from Liu and Lu (2012)

Figure 2.2 Illustration of a simple citation network

In Figure 2.3, the node's size reflects the number of papers cited by other studies contained within the WOS database. A highly cited paper denotes a large node. Blue nodes represent those that have not been cited by the 31 core papers, which have been identified in Appendix A. Red nodes indicate those cited by at least one of the core papers listed. Lines indicate that papers are connected by their citation. Thus, the combination of nodes and lines form the basis of the chronological citation network. In Figure 2.3, the main path in this research is the link "3-17-27-31. It can be further seen in Figure 2.3 that Node 5 is the largest and was the most cited paper within the WOS database for papers examining only PPPs, but surprisingly has not been cited by the other 30 papers. The paper Node 5 was authored by Hodge and Coghill (2007), which examined the accountability associated with URT service franchises. Accountability is a core principle of governance and thus central to the operationalisation of PPPs designated objectives (Fombad, 2013). It would appear that accountability is an area that has been overlooked in the URT PPP research that has been undertaken.



Number	Author[a] /Year/Journal	Location[b]	LCS[c]	GCS[d]	LCR[e]
1	Lesley L, 1995, PUBLIC MONEY MANAGE, V15, P61	U.K.	0	0	0
2	Shaoul J, 2002, PUBLIC MONEY MANAGE, V22, P53	U.K.	1	23	0
3	Siemiatycki M, 2006, J PLAN EDUC RES, V26, P137	Canada	6	30	0
4	Phang SY, 2007, TRANSPORT POLICY, V14, P214	Singapore	9	37	0
5	Hodge GA, 2007, GOVERNANCE, V20, P675	Australia	0	43	0
6	Siemiatycki M, 2007, J AM PLANN ASSOC, V73, P388	Canada	0	28	1
7	Solino AS, 2009, J MANAGE ENG, V25, P21	Spain	2	19	0
8	Kiggundu A, 2009, TRANSPORTATION, V36, P275	Uganda	0	3	0
9	de Jong M, 2010, J TRANSP GEOGR, V18, P301	Netherlands	0	42	1
10	Brandao LE, 2012, J INFRASTRUCT SYST, V18, P218	Brazil	1	8	0
11	Bray D, 2013, RES TRANSP ECON, V39, P191	Australia	0	0	1
12	Gordon C, 2013, RES TRANSP ECON, V39, P239	Australia	0	3	0
13	Gordon C, 2013, TRANSPORT POLICY, V27, P73	Australia	0	5	0
14	Cruz CO, 2013, LOCAL GOV STUD, V39, P352	Portugal	1	21	0
15	Chang Z, 2013, TRANSPORT POLICY, V30, P153	Hong Kong	3	10	1
16	Luan XF, 2014, TRANSPORT RES REC, P127	Mainland China	0	2	1
17	Carpintero S, 2014, PUBLIC MONEY MANAGE, V34, P43	Spain	3	8	1
18	Tseng HP, 2014, J CIV ENG MANAG, V20, P548	Taiwan	0	5	1
19	Bon B, 2015, HABITAT INT, V45, P223	France	0	1	0
20	Cruz CO, 2015, J CONSTR ENG M, V141	Portugal	0	2	2
21	Carpintero S, 2015, PROJ MANAG J, V46, P35	Spain	0	7	2
22	Foxabad MC, 2015, J S AFR STUD, V41, P1199	South Africa	0	0	0
23	Ramos-Santiago LE, 2016, TRANSPORT RES REC, P30	U.S.A	0	0	1
24	Cohen R, 2016, TRANSPORT RES REC, P37	Italy	0	0	0
25	Alpkokin P, 2016, J TRANSP GEOGR, V54, P476	Turkey	0	2	3
26	Carpintero S, 2016, TRANSPORT POLICY, V49, P159	Spain	0	0	3
27	Hong S, 2016, PUBLIC MONEY MANAGE, V36, P447	South Korea	1	3	3
28	Ke YJ, 2017, CONSTR ECON BUILD, V17, P90	Australia	0	0	1
29	Sturup S, 2017, AUST J PUBL ADMIN, V76, P288	Mainland China	0	0	1
30	Feng K, 2017, J CONSTR ENG M, V143	Mainland China	0	0	1
31	Chang Z, 2017, TRANSPORT RES A-POL, V105, P106	Hong Kong	0	0	3

Note:
[a]Author: Only the first author is presented in Figure 1. The detail information of 31 collections is included in references and Supplemental Data File
[b]Location: It refers to the geographic region by the first authors' address in 31 collection
[c]LCS = Local citation score: Number of citations to the paper from within the 31 collections
[d]GCS = Global citation score: Number of citations to the paper from all sources, as reported in WOS
[e]LCR= Local cited references: Number of records in 31 collections that are cited by the paper

Figure 2.3 Historiography of core URT PPP papers

Node 3 disseminates six papers of core studies, which are mutually exclusive. Within Node 3, Siemiatycki (2006) paper examined the implications of PPPs on the development of URTs in Vancouver, Canada and identified an absence of technological innovation and an inability to control the costs from escalating during the planning process. This paper was referenced by Siemiatycki (2007) (Node 6), Carpintero and Petersen (2014) (Node 17), Ramos-Santiago *et al.* (2016) (Node 23), Alpkokin *et al.* (2016) (Node 25), Carpintero and Siemiatycki (2016) (Node 26), and Sturup (2017) (Node 29). The works mentioned above examined policy development, formulation, and implementation of URT PPPs, though they have eschewed referencing each other's works.

With the findings by the historiographic mapping, it is therefore suggested that research associated with policy issues for URT PPPs has been undertaken in a piecemeal manner that has stymied the creation of an integrated knowledge-based, which is needed to ensure their successful delivery and operation. In addition, nodes in the main path have limited connection with other research papers. Hummon and Dereian (1989), for example, identified that the primary path could be the most significant citation chain and, therefore, can be used to extract the underlying developments within a field. The main path here is comprised of Node 3 (Siemiatycki, 2006), Node 17 (Carpintero and Petersen, 2014), Node 27 (Hong, 2016) and Node 31(Chang and Phang, 2017). The theme of this main path focuses on how cost-efficient URT PPPs can be delivered and the sharing of experiences with their implementation from countries such as Canada, China, Japan, Singapore, Spain, and South Korea. Notably, Hong (2016) (Node 27) and Chang and Phang (2017) (Node 31) have suggested that bundling and unbundling PPP contracts for URT can influence their cost-effectiveness and how they are managed. However, they did not cite other core papers that focused on similar topics, such as Solino and Vassallo (2009) (Node 7), Cruz *et al.* (2015) (Node 14), and Carpintero and Petersen (2015) (Node 21).

Research published within a similar period and focusing on very minor and specific subject areas may explain why particular papers did not have the necessary connections with the main path. Moreover, having a limited relationship with key scholarly works may have contributed to the inadequate links within this main path.

From historiography revealed so far, it is shown that research within the URT PPPs literature has been undertaken in a fragmented manner. To provide an ameliorated understanding of the nexus between knowledge that has been propagated within the URT PPPs, an in-depth review of URT PPPs literature is presented in the next section of this Chapter.

2.4 Analysis II: In-Depth Review of URT PPPs Literature

The in-depth review of URT PPPs literature as part of the systematic review has identified several emergent themes, summarised and critically reflected upon. As noted in Figure 2.4, these themes are (1) industry structure, (2) governance and (3) financial sustainability. However, it needs to be acknowledged that the research focus of several papers may overlap with a number of these themes. To address this issue, themes are separately categorised in accordance with the bundling of contracts and the LVC mechanism (e.g., Chang and Phang, 2017).

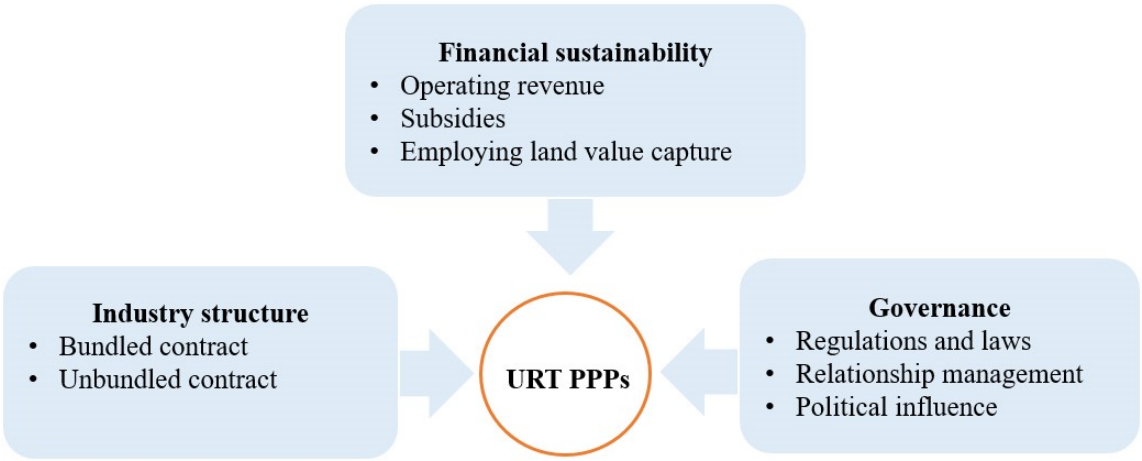


Figure 2.4 Main emerging URT PPP research themes

2.4.1 Industry Structure

The railway industry's structure can be divided into two primary dimensions (The World Bank, 2017): (1) horizontal (i.e., the railway is managed by its discrete geographic focus); and (2) vertical (i.e., separation of the owners responsible for managing the rail infrastructure and the entity that operates the trains. There has been a tendency for governments to maintain ownership and control of their railway

networks but have sought to encourage contestability and private sector participation to provide their train services to obtain cost efficiencies.

Policymakers organising the vertical structure of URT PPPs projects can either use a contracting strategy based on a bundled or unbundled approach. For example, Pulido *et al.* (2018) defined a bundled approach where a "project is implemented based on one PPP agreement with a single private sector partner. In this situation, the private sector partner generally assumes responsibility for civil infrastructure construction, mechanical and electrical work, procurement of rolling stock, and operation of the system (p.311). The distinct differences between bundled and unbundled contracts are presented in Table 2.3.

A bundled contract provides cost-effectiveness since an SPV assumes all of the responsibilities and risks associated with the project and is provided with an incentive to minimise costs over the assets' life-cycle (Phang, 2007). Drawing on the experience of the Beijing Line 4 PPP project, Chang (2013) estimated that the public sector saved 9.4% of total CAPEX and OPEX when a bundled contract was used.

While, despite these reported savings, the experiences of using bundled contracts for URT elsewhere in the world have been negative. For example, even though strict contracting, DBFO in a rapid transit line in Vancouver, Canada still suffers the 22% cost overrun of CAPEX (Siemiatycki, 2006). For the OPEX, Hong (2016) found that the build-transfer-operation in the metro in Seoul, South Korea, only achieved a slight reduction compared to the other public-operated metro. Furthermore, Carpintero and Petersen (2015) observed that if the construction company controls an SPV's equities in a bundled contract, it will prioritise the short-term benefits during the construction stage rather than the whole life cost optimisation.

Pulido *et al.* (2018) define an unbundled approach as a "project being split into various contracts (e.g., PPP agreement), each addressing one project component or a combination of them: (1) construction of civil works, (2) electromechanical equipment, (3) procurement of rolling stock, and (4) O&M of the system" (p.311). While, an unbundled approach provides the flexibility to replace contractors and undertake

future rail expansions as it enables the public sector to adjust when conditions change (Pulido *et al.*, 2018). Advocates for unbundling of contracts for URT PPPs have suggested the following benefits can be derived (Solino and Vassallo, 2009; Cruz *et al.*, 2015): (1) increased competition during the bidding process; (2) reduction in financial risks; (3) guaranteed the integrity of service operation; and (4) a reduction OPEX.

As a PPP contract is a long-term arrangement, usually 25 to 30 years, the public sector's transaction costs can also be reduced (de Bettignies and Ross, 2004). Nevertheless, in some URT PPP cases, contracts are sometimes less than the so-called norm. For example, Cruz *et al.* (2015) observed that an operation contract in Porto, Portugal was five years. This short-term PPP contract had the advantage of pressuring the incumbent contractor to be efficient and provide a high level of service quality.

Definitive criteria are absent for choosing between a bundled or unbundled contract for URT PPPs (Chang and Phang, 2017). The upshot in this instance is that policymakers are still left with a quandary, whether “to bundle or unbundle”. Hart (2003) has suggested that when the quality of construction can be specified, but not in operations, then an unbundled contract should be deployed as cost efficiencies can be obtained compared to bundling. In the case of URT PPPs, it is necessary to consider construction and operations and the property development that surrounds stations where quality is difficult to define and specify.

Table 2.3 Main consideration for using the contract

Consideration	Description	Bundled Contract	Unbundled Contract
Interface risk	Risk arises where interfaces are managed between civil infrastructures, mechanical and electrical works, rolling stock, and O&M obligations.	+[a] SPV takes responsibility for managing interface risks.	-[b] The public sector takes responsibility for managing interface risk.
Firewall risk	Risk relates to the implementing agency being unable to exercise remedies to resolve situations where mistakes in one of the project components affect the entire system's performance.	+ SPV is incentivised to resolve the problem that the system is not working as the failure of one of the project components.	- Even though the whole system is not in service due to individual parts, the public sector may still need to pay for the other unfaultable components of the project.
Farebox risk	The risk is that the ridership may be lower than anticipated, which results in revenue shortfalls.	+ The public sector has the freedom to transfer all farebox risk to the SPV or partially retain it by providing subsidies on an availability basis.	- The public sector retains farebox risk and may only partially transfer its risk to the operator.
Flexibility	Demand that is adjusting components (e.g., service level) of the projects at various points.	- The public sector may need to trigger a special and expensive negotiation with the incumbent SPV for the adjustment.	+ The new demand can be introduced whenever a new unbundled contract is entered.

Future expansion of the system	Demand that is expanding the network of the URT system.	- To expand the network, the public sector needs to terminate the existing bundled contract, which has proven to be inflexible and extremely expensive.	+ The public sector could launch a new unbundled contract to meet the demands for expanding the network.
Competitive pressure	Potentiality for an increasing number of bids and bidding price competitive.	- The difficulty of forming different consortia and higher risk may reduce the number of potential bidders and limit competitive prices.	+ Unbundled contracts may maximise price competition for each of the components of the project.

Adapted from Pulido *et al.* (2018)

Note: + = advantage; and − = disadvantage.

2.4.2 Governance

The governance of PPPs is particularly important as it acts as a medium for enabling the private sectors to achieve their profits and as an instrument for protecting the public interest (Skelcher, 2010). Aspects of governance that can adversely impact the performance of URT PPPs include:

- *Regulations and laws*: The presence of legislation enables authorities to ensure the accountability, responsibility, quality and transparency of PPP procurement (de Jong *et al.*, 2010; Mandri-Perrott, 2010; Bray and Sayeg, 2013; Reynaers, 2014; Fombad, 2015; Alpkokin *et al.*, 2016). However, when regulations and laws are immature, they can impede the effectiveness of the projects. For example, Hodge and Coghill (2007) revealed that when there was an absence of regulation that explicitly stated who was accountable for the operation of URT PPPs, the public invariably loses the opportunity to complain about the transit service. Siemiatycki (2006; 2007) found that when regulation fails to ensure sufficient transparency in the delivery of URT, the public cannot access the necessary information to make sense of the project's decision-making process. Ke *et al.* (2017) observed that when there was excessive regulation such as prescribing the expected return, the private sector would be discouraged from participating in a URT PPP.
- *Risk allocation and sharing*: Allocating risks in PPPs is a challenge. All too often, the transfer of risk to the private sector comes at a price (Hovy, 2015, p.1). Transferring risk that the government can manage better is likely to diminish their ability to obtain value for money. Put simply, risks should be allocated to the party best able to manage them at the lowest cost (Hovy, 2015, p.1). Within a PPP environment, it is generally accepted that political (e.g., the uncertainty of government and expropriation) and legal risks (e.g., changes in law and regulations and those associated with the approvals process) are borne by the government (Xiong *et al.*, 2018). In the case of the private sector (i.e., the SPV), the risks allocated to them typically include financial (e.g., inflation and interest) and those of an operational nature (Ke *et al.*, 2017). However, some risks are shared, such as those relating to market conditions (e.g., demand and supply) (Li

et al., 2005b; Love *et al.*, 2017; Xiong *et al.*, 2018). To this end, Hovy (2015) recommends that risks be allocated to the party best able to manage them at the lowest cost. A point has also been previously made by Li *et al.* (2005b). In addition, Hovy (2015) suggests that consideration should be given to the extent to which parties can influence the total impact of risk (p.2). A compelling example is provided by Li *et al.* (2005b) and Hovy (2015), who distinguish between risk occurrence and impact. So, the government may be better positioned to control the risk of vandalism on trains by providing security. However, the private sector may manage the impact of risk by designing the railcars with vandalism-resistant materials (Hovy, 2015, p.3).

- *Relationship managemen*t: The establishment of relations between the public and private sector has been the subject of considerable debate, as they tend to impair the competitiveness of the bidding process (Sturup, 2017), even they can improve mutual trust and ameliorate a URT PPP's performance (Gordon *et al.*, 2013a; 2013b). A reduction in information asymmetry is critical for relationship development and can be used to establish a win-win relationship for both parties (Robinson and Scott, 2009), particularly when the public sectors have equity in the SPV (Cohen and Boast, 2016).
- *Political influence*: Studies have demonstrated that politics can influence the decision-making process of the project's life cycle. Political opportunism rather than cost-effectiveness has been identified as a primary reason for constructing URT using a PPP (Carpintero and Petersen, 2014). Furthermore, the level of public and political acceptability for URT PPP projects can influence the effectiveness of their planning and design (e.g., selection of the route, the integration of bus network and the accessibility of pedestrianised streets) (Carpintero and Siemiatycki, 2016).

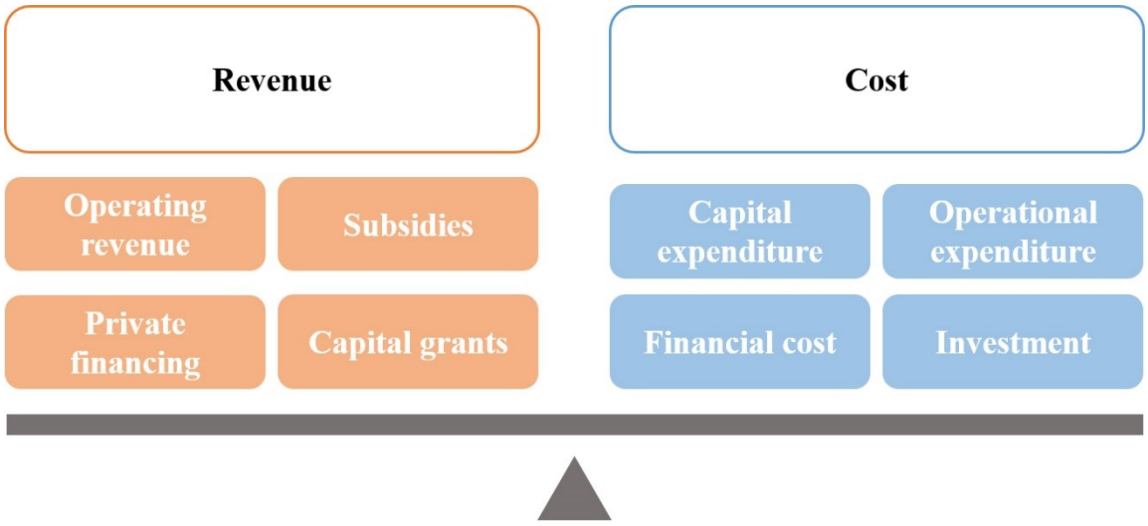
2.4.3 Financing Sustainability

Many governments have reformed their URT departments and agencies to reduce costs, improve services, and obtain a better return on investment (Pulido *et al.*, 2018). Initiating and revitalising URT projects generally requires significant capital investment. As fiscal constraints have hindered the ability to fund URT (Chong and

Poole, 2013), governments have employed PPPs as an alternative procurement strategy to source private investment and stimulate innovation (Lesley, 1995; Roumboutsos and Saussier, 2014; Chang and Phang, 2017). However, if a PPP for a URT receives support from the central government, then loans tend to be provided under favourable or below-market conditions. As a result, CAPEX and borrowing can be reduced (Lesley, 2015; APMG International, 2016).

The World Bank (2017) has defined the sustainable financing of railways as having "sufficient long-term financial resources to cover operational costs, to invest, and to meet a debt or other financing requirements (p.48). The relationships between variables identified in The World Bank (2017)'s definition have been conceptualised and produced in Figure 2.5.

However, the contribution of PPPs to the financial sustainability of URTs has received a considerable degree of scepticism (e.g., Shaoul, 2002; Carpintero and Siemiatycki, 2016; Hong, 2016). For example, Shaoul (2002) questioned whether the London Underground PPP policy would cover the total cost of construction and operation, and the investment would provide a return on capital employed. While this concern was ignored, this became a reality for taxpayers as they were slugged with an additional cost of US$308.8 million from 2003 to 2007 with cost increases and delays during its refurbishment process (Committee of Public Accounts, 2010). These cost increases and delays could have been avoided, but politics were suspected to be at play in this instance. Addressing this issue is beyond the scope of this section. Still, it needs to be conceded that no matter what governance mechanisms are put in place and the strategies to mitigate cost increases/decreases in transportation infrastructure projects, political machinations will inevitably materialise and contribute to impacting their performance. At this juncture, it needs to be noted that there is a dearth of empirical evidence that indicates political decisions ultimately cause transportation projects to experience cost overruns (Love and Ahiaga-Dagbui, 2018; Love *et al.*, 2019).



Adapted from The World Bank (2017)

Figure 2.5 Revenue and cost equilibrium of URT

Operating Revenue

A URT system's operating revenue is the main element needed to sustain its financial sustainability (The World Bank, 2017). Transit demand, tariff, and revenue collection are critical components of a URT system's operating revenue. Several studies, however, have demonstrated that many URT PPPs projects have failed to achieve adequate operating revenue due to shortfalls in transit demand (Kiggundu, 2009; Carpintero and Petersen, 2014). The shortfall in transit demand is typically influenced by:

- *Service*: A URT has limited influence over its demand capacity. However, a URT does have considerable influence over their share of transport demand and, therefore, the capacity of traffic that they carry, as transit demand is derived from commuters' desires (The World Bank, 2017). It follows, therefore, that if a URT can provide a timely, reliable, high-value service, it will increase its market share of the over demand capacity as commuters will be more inclined to use this mode of transport; and
- *Demand forecast*: Transit demand forecasts are critical for URT systems as they provide the primary input for planning and controlling all functional areas such as operations planning, marketing, and financing (Milenkovic and Bojovic, 2016). However, transit demand forecast often tends to be inaccurate due to the uncertainty of trip distributions and optimistic forecasts, which may be

deliberately overly inflated to ensure rail projects are constructed (Flyvbjerg *et al.*, 2005). For URT PPPs, Bray and Sayeg (2013) have argued that optimism bias in transit demand forecasts is derived from government interference or unintended optimism contained in tenders provided by the private sector. For example, the URT PPPs projects constructed in Bangkok, Kuala Lumpur and Manila have experienced significantly lower than expected ridership (i.e., 48% shortfall) a year after opening. For example, in Madrid, Spain, three URT PPPs have also been subjected to shortfalls in transit demand due to over optimist forecasts and were constructed as part of election promises to secure votes (Carpintero and Petersen, 2014).

When optimistic transit demand forecasts are made during the planning process, a misallocation of funds and losses in revenue viability may occur (Skamris and Flyvbjerg, 1997). Whether actual transit demand can provide the required revenue validity of URT PPPs remains a challenge (Phang, 2007; Carpintero and Petersen, 2015; Cruz *et al.*, 2015; Carpintero and Siemiatycki, 2016; Hong, 2016; Ke *et al.*, 2017).

Subsidies

Government subsidies have often been used to balance demand risk (i.e., transit demand) and a URT's revenue stream, but the provision of such financial support has been the subject of considerable criticism (Brandao *et al.*, 2012; Kim, 2013; Tserng *et al.*, 2014; The World Bank, 2017). According to Parry and Small (2009), discrepancies between OPEX and fare revenue can range from 29% to 89%. Despite such differences, it has been suggested that subsidies can provide economic and social benefits, even when shortfalls are more than 50% of OPEX. Contrastingly, Carpintero and Petersen (2014) have argued that the public sector should retain a substantial part of the demand risk by providing a minimum income guarantee (MIG) to accommodate any shortfall in transit demand. In this instance, Hong (2016) has suggested that the public sector may be prone to suffering a financial loss as the special purpose vehicle (SPV) may intentionally present shortfalls in their revenue to receive a minimum revenue guarantee (MRG) from the government.

Several studies have employed quantitative methods to determine the best use and impact of government subsidies for URT PPPs (e.g., Feng *et al.,* 2017). For example, Brandao *et al.* (2012) applied real options theory to analyse the incentive and risk-sharing effect of minimum demand guarantee (MDG) and their impact on the government. Contrastingly, Tserng *et al.* (2014) used the game theory to develop a generic Governmental Debt Guarantee (GDG) model to determine measurements for mitigating governments' financial exposure risk. Using a genetic algorithm-based model, Feng *et al.* (2017) demonstrated that a balance between satisfying the project's financial viability and saving public funds was attainable.

Employing Land Value Capture

Studies collected under the systematic review framework reported that LVC as an alternative financing paradigm could support URT PPPs (Kiggundu 2009; de Jong *et al.* 2010; Luan *et al.* 2014; Ramos-Santiago *et al.* 2016; Chang and Phang 2017; Sharma and Newman, 2018a). Based on it, an additional in-depth review that collected more extensive studies was conducted to present a more comprehensive examination on the use of LVC to support URT PPPs. This additional in-depth review is abundant and essential and will be presented below. Section 2.5 summarised the threads of LVC knowledge. Then, Section 2.6 presents integrating PPP and LVC to deliver URTs.

2.5 Threads of LVC Knowledge

In consideration of the likelihood of lower-than-expected operating revenue and subsidies, LVC has been identified as an alternative financing paradigm to support the use of URT PPPs (Kiggundu, 2009; de Jong *et al.*, 2010; Luan *et al.*, 2014; Ramos-Santiago *et al.*, 2016; Chang and Phang, 2017; Sharma and Newman, 2018a).

The concept of LVC is presented in Chapter 1. Furthermore, Smolka (2013) has proposed that LVC as the mobilisation for the "community at large some or all of the land value increments (unearned income) generated by actions other than the landowners such as public investments in infrastructure or administrative changes in land use norms and regulations (p.2).

Here, an examination of the LVC literature reveals three underlying threads of knowledge come to the fore: (1) its impact on land/property price by URT systems; (2) the use of instruments for generating income (i.e., tax or fee-based and development-based); and (3) the development of accessibility-oriented frameworks in conjunction with the identification of factors contributing to its success.

2.5.1 Impact of URT Systems on Land/Property Prices

Transport projects can produce land value uplifts as people compete to benefit from being close to railway stations and reducing their commute times (Transport for London, 2017). Thus, identifying the influence of URTs on land values is critical to determining the economic viability of LVC (Mathur, 2019). Table 2.4 summarises the literature that measures different URT projects' impact on land/ property prices. The key issues that have been addressed in the literature include:

- *Examining multiple areas of land/properties and their prices associated with variances in different URT systems/stations' catchment areas.* For example, URT systems, in conjunction with other modes of transport, can have a positive impact on properties prices, as experienced in cities such as Rome (Italy) and Santander (Spain) (Cordera *et al.*, 2019). In Dubai (United Arab Emirates), URT systems have been revealed to increase the value of dwellings (13%) and commercial properties (76%) within 700 to 900 meters of a metro station (Mohammad *et al.*, 2015). In Shenzhen (China), the price effects of URT accessibility are stronger in suburban areas than those closer to the central business district (CBD) (Yang *et al.*, 2020c).
- *Optimising measurement approaches for estimating land/property prices.* Assessing the impact of URTs is typically undertaken using a hedonic pricing model to compare prices of lands/properties within a certain distance from a metro station (Mohammad *et al.*, 2013). Furthermore, using a difference-in-differences estimator in a hedonic price model can decrease the chance of yielding coefficients and improve the estimation of the new URT service's impact on house values (Dubé *et al.*, 2013). Similarly, selecting a spatial Durbin model and the geographically weighted regression rather than the conventional

ordinary least squares approach to process the hedonic price model can achieve a more accurate assessment (Zhong and Li, 2016).

- *An exploration of the factors (e.g., timing and planning strategy) influencing land value increases by URT systems.* Several studies have examined residential property prices within the 800m-catchment of the Gold Coast Light Rail Transit (LRT) system (Australia) and observed that they began to significantly increase between the project's announcement and financial commitment (Yen *et al.*, 2018; Balbontin and Mulley, 2020). Planning strategies such as TOD, particularly mixed land-use, have received widespread attention in China. In the case of Wuhan (China), using a TOD strategy has positively influenced property prices within an 800m-catchment of URT stations (Li and Huang, 2020).

Table 2.4 Summary studies examining the impact of URT on property/land prices

URT Type	Project	Catchment Area	Location	Type	Value Measure	Outcome	Author
Commuter	Boston Commuter Rail	400m	Boston, US	Residential	Purchase of property	6.70%	Armstrong (1994)
Commuter	METRA	400m	Chicago, US	Residential	Purchase of property	20%	Gruen (1997)
Commuter	North Shore CRT	1500m	Montreal, Canada	Residential	Purchase of property	2.2% to 4.8%	Dubé *et al.* (2013)
Heavy	Helsinki Metro	400m	Helsinki, Finland	Residential	Purchase of property	3.5% to 6%	Laakso (1992)
Heavy	Izmir Metro	400m	Izmir, Turkey	Residential	Purchase of property	0.7% to 13.7%	Yankaya and Celik (2004)
Heavy	Shanghai URT system	200 and 500m	Shanghai, China	Residential	Purchase of property	1.1% and 3.3%	Pan and Zhang (2008)
Heavy	KoRail	400m	Seoul, South Korea	Residential	Purchase of property	0.3% to 2.6%	Bae *et al.* (2003)
Heavy	Mass Transit Railway networks	Hong Kong Island, Kowloon and New Territories	Hong Kong, China	Residential	Purchase of property	3.52% (2001) and 4.73% (2011) when a 10% increase in the rail's accessibility	He (2020)
Heavy	Dubai Metro	Within 700m and 900m	Dubai, United Arab Emirates	Residential and Commercial	Purchase of property	12.9% (Residential) and 76% (Commercial)	Mohammad *et al.* (2015)

Heavy	Bangalore Metro	Bangalore	Bangalore, India	Residential	The sale price of the property	4.5%	Sharma and Newman (2018b)
Light	DART LRT	400m	Dallas, US	Residential	Purchase of property	-5.2% (1999), 7.2% and 18% (2002)	Weinstein and Clower (1999and2002)
Light	MAX LRT	450m	Portland, US	Residential	Purchase of property	10.60%	Al-Mosaind *et al.* (1993)
Light	Santa Clara LRT	400m	Santa Clara, US	Commercial	Purchase of land	23%	Cervero and Duncan (2002)
Light	Tyne and Wear Metro	200 and 1000m	England, UK	Residential	Purchase of property	- 42% to 50%	Du and Mulley (2007)
Light	Mandurah line	400m, 800m and 1600m	Perth, Australia	Residential	Government's valuation of land	28%, 13% and 8%	McIntosh *et al.* (2014)

2.5.2 Tax or Fee and Development-Based Instruments

To capture the viable increase in the value of land, LVC can be generally classified into two categories (Suzuki *et al.*, 2015):

- *Tax- or fee-based* methods employ indirect tax or fee instruments to extract surplus from property owners.
- *Development-based* methods utilise the direct transaction of properties whose values have been increased by public regulatory decisions or infrastructure investment.

The two categories of LVC can be subdivided into instruments used to determine the financial viability, as noted in Table 2.5.

Policymakers can apply several criteria to justify using an LVC instrument, such as economic efficiency, equity, sustainability, and revenue yield (Peterson, 2009; Mathur and Smith, 2012; Zhao *et al.*, 2012a). While there is a tendency to use these LVC instruments separately, they can also generate revenue together (Suzuki *et al.*, 2015; Mathur, 2019). For example, in Portland (US), the local government has successfully combined different tax or fee-based LVC instruments (i.e., special assessment districts and tax increment financing) to fund 30% to 70% of its major streetcar project (Portland Streetcar Inc., 2011).

Development-based LVC has been successful in many Asian cities. For example, in Tokyo, transit agencies have cooperated with landowners within station catchment areas to redevelop neighbourhoods to increase and capture the value of land (Suzuki *et al.*, 2015). In this case, a TOD strategy (i.e., mixed land use and high density) was used to collect revenue to cover redevelopment costs (Murakami, 2015). In Hong Kong, the MTR cooperates with developers to fund URT systems using TOD strategies (Cervero and Murakami, 2009).

Table 2.5 A summary of LVC's instruments

Categories	Instruments	Description	Countries
Tax or Fee-based	Property and land tax	Tax levied on the estimated value of land or land and buildings combined, with revenues usually going into budgets for general purposes.	Developed countries, including Australia, the UK, and the US
	Betterment charges and special assessments	Surtaxes imposed by governments on estimated benefits created by public investments, requiring property owners who benefit directly from public investments to pay for their costs.	Colombia, Israel and the US
	Tax increment financing	A surtax on properties within an area will be redeveloped by public investment financed by municipal bonds against the expected increase in property taxes.	US
Development-based	Land sale or lease	Governments sell land or development rights, whose values have increased due to public investment or regulatory change, in return for an up-front payment, leasehold charge, or annual land rent payments through the lease term.	India, China (including Hong Kong)
	Joint development	That is a well-coordinated development of transit station facilities and adjacent private properties between transit agencies and developers. When the private sector is fully involved in delivering a URT with land/property development, it is referred to as the "Entrepreneur Rail Model".	China (including Hong Kong), India, Japan, the US
	Air rights sale	Governments sell development rights beyond the limits specified in land use regulations or created by regulatory changes to raise funds to finance public infrastructure and services.	Brazil
	Urban redevelopment scheme	In the targeted redevelopment area (typically around URT stations), the developer cooperates with landowners to consolidate piecemeal land parcels into a single site where the local government changes land use to a mixed one and increases FARs to collect revenue to cover redevelopment costs and finance infrastructure.	Japan

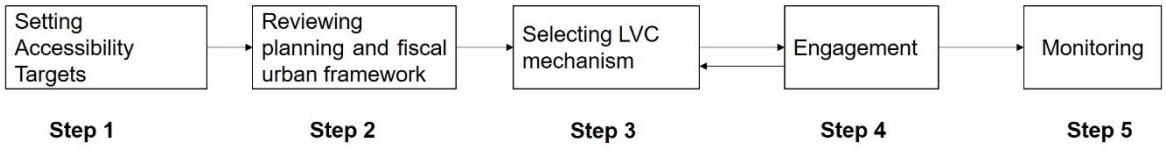
Adapted from Peterson (2009), Alterman (2012), Zhao *et al.* (2012a), Suzuki *et al.* (2015), Mathur (2019) and Sharma and Newman (2020)

2.5.3 Accessibility-Oriented Framework and Success Factors

To ensure the economic viability of a URT PPP is supported by LVC, policymakers need to have access to frameworks drawn upon to guide and understand the key factors that influence its successful implementation (Medda, 2012; Chang and Phang, 2017; Mathur, 2019). These issues are examined below.

Accessibility-oriented Implementation Framework

Transport infrastructure provides households and businesses with greater accessibility[2] to employment, retail outlets, entertainment venues and educational institutions (Geurs and Wee, 2004). Accordingly, if a URT improves accessibility, then the value of land/property will increase, thus, justifying and supporting the use of LVC (Levinson and Istrate, 2011). With this in mind, a five-step implementation framework[3] for LVC, presented in Figure 2.6, has been propagated by Medda (2012). The framework commences with the premise that accessibility targets can create good uplifts in land value, captured by both the public and private sectors (Step 1). Then, the local government can review their planning and fiscal framework to support the implementation of LVC (Step 2). In light of the local government's recommendations, it can select the most appropriate LVC instrument (Step 3). Next, an interactive process contingent on stakeholders' engagement must be undertaken to ensure chosen the most appropriate mechanism (Step 4). In the framework's final stage, the monitoring process assesses the social and economic effects of implementing LVC (Step 5).



Adapted from Medda (2012)

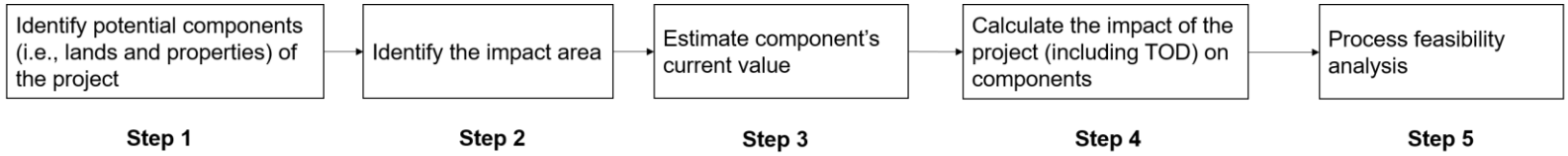
Figure 2.6 Accessibility-oriented implementation framework of LVC

[2] Accessibility can be defined in several ways (Handy, 2020). Here, the researcher uses the definition of Geurs and Wee (2004) as it focuses on passenger transport (e.g., URT), which refers to accessibility as "the extent to which land-use and transport systems enable (groups of) individuals to reach activities or destinations using a (combination of) transport mode(s)" (p.128).
[3] Akin to Medda (2012), McIntosh *et al.* (2015) also proposed the accessibility-oriented implementation framework of LVC.

A feasibility analysis needs to be undertaken in conjunction with the accessibility-oriented framework. Figure 2.7 presents the launch of a feasibility analysis (Blanco *et al.*, 2016). It can be identified that the process for conducting a feasibility analysis commences with identifying potential components (i.e., lands and properties) of a project (Step 1) and the areas where URT systems are likely to experience land price increases (Step 2). Determining possible land/property value increases is an arduous process, but this can be done by conducting an ex-post study of other cities and/or soliciting expert views. Additionally, statistical data, technical, geo-referenced information and origin and destination surveys can be used. Policymakers can then use databases based on real estate transactions and cadastral databases (geo-referenced) to estimate the current value of land/property (Step 3 and Step 4). The final stage of the feasibility focuses on comparing the estimated increment of land value generated with its costs (Step 5).

Critical Success Factors

Acquiring an understanding of the factors that contribute to the successful performance of LVC and the economic viability of URT can help policymakers develop strategies for its effective implementation (Suzuki *et al.*, 2015; Mathur, 2019). In Figure 2.8, it is summarised that the critical success factors (CSF) influence the performance of LVC, particularly in the context of URT systems and networks. The CSFs can be categorised into three dimensions: (1) collaboration between stakeholders; (2) institutional requirements; and (3) project development considerations. Table 2.6 examines the CSFs that have been identified in greater detail. In the case of Delhi Metro (India), for example, key factors that hindered the success of LVC were the absence of institutional authority (e.g., zoning power) and an ineffective inter-governmental collaboration framework (Mathur, 2019).



Adapted from Blanco *et al.* (2016)

Figure 2.7 Feasibility analysis of LVC

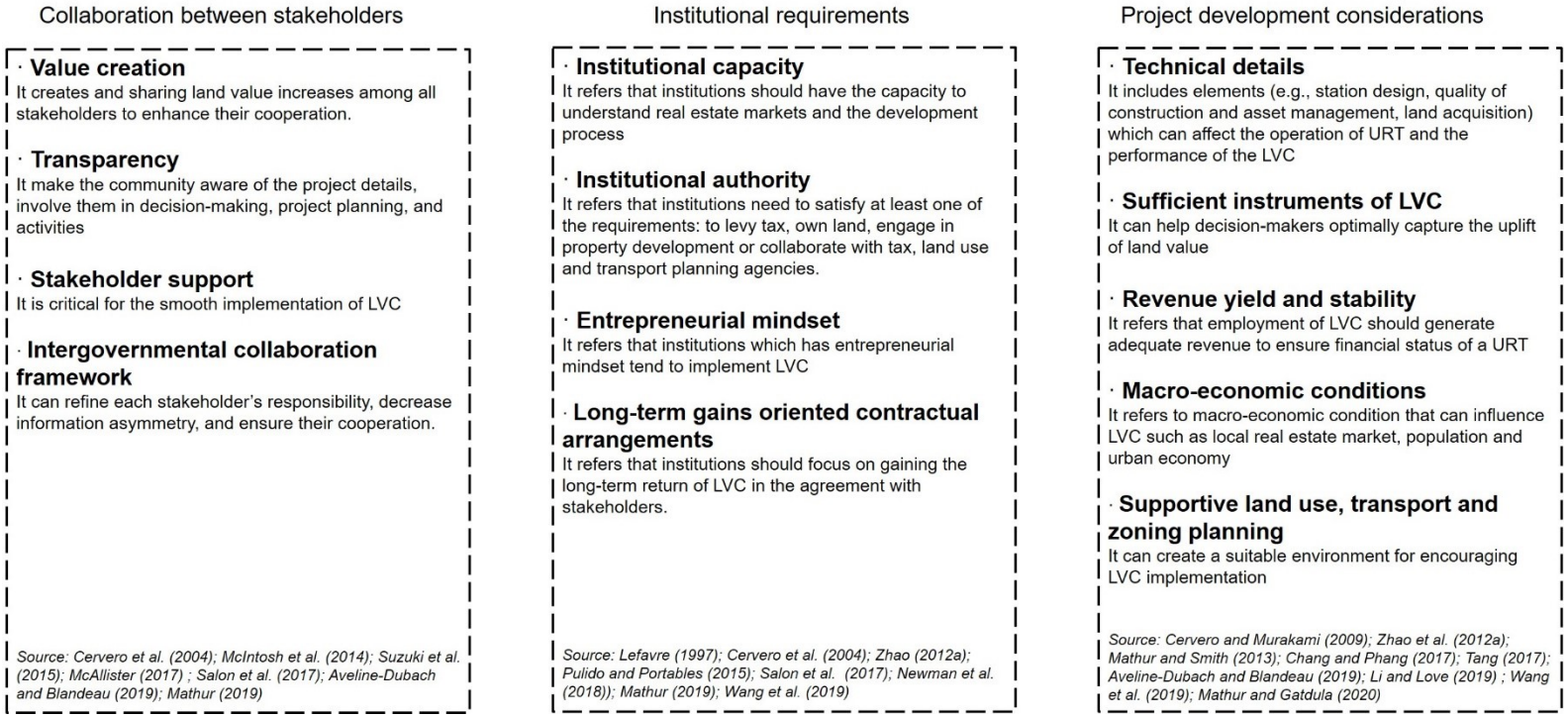


Figure 2.8. Critical success factors influencing the adoption of LVC

Table 2.6 Critical success factor influencing the adoption of LVC

Dimensions	Critical Success Factors	Description	Author
Collaboration between stakeholders	Intergovernmental collaboration framework	An intergovernmental collaboration framework can refine each stakeholder's responsibility, decrease information asymmetry, and ensure cooperation. It can provide benefits to the implementation of LVC.	Suzuki *et al.* (2015)
	Value creation	Creating and sharing land value increases among all stakeholders could enhance intergovernmental cooperation.	McIntosh *et al.* (2014); Suzuki *et al.* (2015)
	Stakeholder support	During LVC, various stakeholders (e.g., government, transit agencies, developers and even citizens) may oppose its implementation. Any opposition in the process of LVC, such as the acquisition of land and adjustments to zoning or introducing a new tax, could hinder its viability. Thus, ensuring extensive stakeholders' support is critical for the implementation of LVC.	Cervero *et al.* (2004); Salon *et al.* (2017); Aveline-Dubach and Blandeau (2019); Mathur (2019); Mathur and Gatdula (2020)
	Transparency	LVC-based property development often involves the transfer of land from the public to the private sector. However, such land transfer is often perceived with suspicion. Therefore, implementing agencies should make the community aware of the project details and involve them in decision-making, project planning, and activities.	Suzuki *et al.* (2015); McAllister (2017)
Institutional requirements	Institutional capacity	The implementation of LVC requires institutions to have the capacity to understand real estate markets and the development process. If the institution engaged in the performance of LVC lack such capacity, they may misjudge the real estate market and fail to manage the property development successfully.	Lefavre (1997); Zhao (2012a)

	Long-term gains oriented contractual arrangements	An implementing institution should focus on gaining the long-term return of LVC in agreement with stakeholders. For example, it can lease land to the private sector at an initial lower annual fee (if the real estate market is not very strong) but retain the option to negotiate a higher fee in the future and/or tie the fee to an increase in a local or a regional real estate market index	Mathur (2019)
	Institutional authority	To capture the value of land, institutions (e.g., transit agencies) need to satisfy at least one of several requirements: (1) the authority to tax those who benefit; (2) close collaboration with the taxing institution; (3) ownership of land that increases in value; and (4) authority to be engaged in the property development (5) close collaboration with transport and land use planning institution.	Cervero *et al.* (2004); Salon *et al.* (2017); Mathur (2019); Wang *et al.* (2019)
	Entrepreneurial mindset	Traditional transit agencies usually focus on ensuring reliable and safe transport services. Some transit agencies with an entrepreneurial mindset tend to broaden their tasks to develop an economy aligned with transport and participate in land/property development with the private sector. As a result, LVC is more likely to be implemented by these entrepreneurial transit agencies.	Pulido and Portables (2015); Salon *et al.* (2017); Newman *et al.* (2018)
Project development considerations	Supportive land use, transport and zoning planning	Supporting land use planning and zoning can create a suitable environment for encouraging LVC implementation. For example, TOD can provide a high Floor Area Ratio (FAR), mixed land use and close-linked rail networks to promote the performance of LVC.	Cervero and Murakami (2009); Mathur and Smith (2013); Mathur and Gatdula (2020)

Macro-economic conditions	LVC is influenced by various macro-economic conditions such as the local real estate market, the scale of development projects, population, and urban economy. They can affect the uplift of the land value and then affect the performance of LVC	Chang and Phang (2017); Tang (2017); Aveline-Dubach and Blandeau (2019)
Technical details	Technical detail (e.g., station design, quality of construction and asset management, land acquisition) can affect the operation of URT and the performance of the LVC. For example, If the URT's operation quality is comprised, this will impact the level of service and ridership and lower property rent within LVC implementation.	Mathur and Gatdula (2020); Sinha (20201)
Sufficient instruments of LVC	Due to legal and political restrictions, some jurisdictions cannot select every instrument of LVC. As a result, the decision-makers can only use limited instruments of LVC, and the uplift of land value fails to be captured optimally.	Wang *et al.* (2019)
Revenue yield and stability	If the employment of LVC fails to generate adequate revenue streams, the financial status of a URT may not be sustained.	Zhao *et al.* (2012a)

2.6 The Practice of URT PPPs with LVC

When LVC is used as part of a strategy to deliver infrastructure, the financial information associated with its role in supporting development typically contains noise, rendering it almost impossible to obtain accurately (Gallent *et al.*, 2020). Thus, the review of this section has relied upon the extant literature to acquire information about its use and role in ensuring the financial viability in supporting the delivery of URTs with PPP arrangements (Table 2.7). Table 2.7 shows that development-based LVC is the most popular approach used in practice with the reasons being twofold as it: (1) provides an explicit link between value creation and capture without introducing new or increasing taxes, which decreases the likelihood of public opposition (Enoch *et al.*, 2005; Leavitt *et al.*, 2008; Suzuki *et al.*, 2015; Jonas *et al.*, 2019); and (2) avoids potentially negative impacts on *vertical equity*; that is, the ability to pay and prioritise the needs of different groups of people who are dependent on public transport (Yen *et al.*, 2020).

Table 2.7 A summary of URT PPPs with LVC

Example	**LVC Category**	**Source**
Shenzhen, China	Development-based	Luan *et al.* (2014)
Hong Kong, China	Development-based	Chang and Phang (2017); Aveline-Dubach and Blandeau (2019)
Tokyo, Japan	Development-based	Chang and Phang (2017)
Bangalore, India	Development-based	Sinha (2021)
Delhi, India	Development-based	Council of States (2013)
Hyderabad, India	Development-based	Hyderabad Metro Rail Limited (2014)
Brisbane, Australia	Tax or fee-based	Murray (2016)
Singapore	Tax or fee-based	Chang and Phang (2017)

Cities throughout China, for example, have been able to acquire a significant revenue stream from using development-based LVC to support their URTs delivered using a PPP (Kiggundu, 2009; Chang and Phang, 2017; Xue and Fang, 2017). The Hong Kong Mass Transit Railway (MTR) adopted a collaborative approach to developing land around its stations to cover its CAPEX and OPEX (Phang, 2007; The World Bank, 2017). In 2015, the MTR secured a profit of US$5.31 billion fare revenue from stations' commercial businesses and property rental and management businesses (MTR

Corporation Ltd., 2016). Furthermore, Luan *et al.* (2014) have suggested that the experiences of a URT utilising LVC in Shenzhen (China) have demonstrated that a dependency on farebox revenue can be reduced due to property sales and/or rental income.

The experiences acquired from these cities utilising a development-based LVC are transferable to broader contexts, jurisdictions and countries (Sharma and Newman, 2018a). However, it needs to be acknowledged that the adoption of development-based LVC cannot guarantee the success of a URT PPP. The use of LVC to support URT PPPs is a dynamic, complex and challenging issue. The success of using is LVC highly dependent on a wealth of variables (e.g., scale, the degree of inter-governmental collaboration, the effectiveness of real estate marketing, and the extent of urban planning) being aligned to provide the ideal conditions to enable its adoption (Bon, 2015; Acharya, 2017; Chang and Phang, 2017; Mathur, 2019).

Meanwhile, there have been limited URT PPPs that have employed development-based LVC (Table 2.7), which have tended to take the form of a share issue privatisation (SIP) or a joint venture (e.g., Phang, 2007; Luan *et al.*, 2014; Chang and Phang, 2017; Sharma and Newman, 2018a). In the case of a SIP, the government provides a stake in a public-owned enterprise that raises capital from investors through a public share offering and thus can be categorised as a form of PPP arrangement (Phang, 2007). A joint venture is defined as a contractual arrangement whereby the private and public sector pools their assets and resources to undertake a particular activity and agrees to share in profits and losses (Asian Development Bank, 2008). Nevertheless, most URT PPPs projects have been delivered under BOT/DBFO/Concession models (Lesley, 1995; Cruz and Marques, 2013; Carpintero and Petersen, 2014; Hong, 2016).

2.7 Research Gap to Use Development-Based LVC for URT PPPs

The systematic review on URT PPPs and additional examination of LVC literature identified several emergent themes that future studies can inquire about. Between these emergent themes, research needs to examine and develop robust structural and financial models to deliver URT PPPs. In particular, using development-based LVC is

an area that has received limited attention even though it can potentially provide governments with a viable option for ensuring the successful delivery of their URT PPPs (The World Bank, 2000; Bray and Sayeg, 2013; Love *et al.*, 2017; Sharma and Newman, 2018a).

How can URTs be successfully supported by PPP and LVC across their life-cycle is, therefore, a recurring question resonating throughout the transport literature and confronts policymakers (Luan *et al.*, 2014; Chang and Phang, 2017; Sharma and Newman, 2017). The absence of a robust framework that can be used as a frame of reference to explain "how" LVC can bolster the financial feasibility of a PPP has stymied progress toward addressing this question.

Attempts to address this research gap have been made by developing principles and roadmaps to implement development-based LVC, but studies eschew the role of PPPs in financing URTs (Medda, 2012; Suzuki *et al.*, 2015; Transport for London, 2017). Indeed, combining PPPs with LVC is a complex issue due to the uncertainties surrounding determining land values, managing stakeholders' expectations, and varying requirements of local government agencies (Tang *et al.*, 2004).

Despite these difficulties, Chang and Phang (2017) are steadfast in their conviction that the scope and financial mechanisms of a PPP, which mainly utilises examples of development-based LVC, can be designed and integrated to provide a viable solution for procuring URT systems. There is likely to be less opposition from taxpayers when a government procures URT systems in this instance. Having taxpayers' support has been identified as a critical success factor for delivering PPP projects (Ahmadabadi and Heravi, 2019). Furthermore, in developing countries (e.g., India and Philippines) where PPPs form an integral part of government infrastructure investment strategies, an issue that has impacted the ability to use tax-based LVC effectively is the absence of adequate cadastral systems to assess land value (Suzuki *et al.,* 2015; Buensuceso and Purisima 2018; Leigland 2018). As a result, development-based LVC tends to be a more available option.

Taking heed of Chang and Phang's (2017) invaluable insights and the general acceptance for the need to embrace development-based LVC, this research aims to develop a framework to integrate its use with PPP agreements to provide policymakers with a frame of reference for procuring their URT systems.

2.8 Chapter Summary

This Chapter provides a literature review of the URT PPPs with LVC, which identifies that this is an area that has received limited attention within the extant literature. The review demonstrates that current research has been undertaken in a fragmented manner and identifies gaps in the literature, which have tended to be concentrated around structuring (e.g., unbundle or bundle contracts) of URT PPPs, governance, and financing (e.g., LVC). Moreover, the review shows that the use of LVC and PPP to deliver URT is recommended in the literature. In particular, integrating development-based LVC with PPPs to deliver URT is considered more appropriate to the global area. However, the practice of URT PPPs with development-based LVC is limited, and its success relies on an array of political, socio-economic and geographical factors. The corollary is the lack of research that can be used to develop a robust framework to help policymakers successfully deliver URT systems and networks with PPP and LVC.

To this end, the systematic review on URT PPPs with an additional in-depth examination of LVC studies demonstrates that this research can make an essential contribution to the normative literature by developing the framework that policymakers can use to procure URTs with innovative approaches (i.e., PPP and LVC). It bridges the significant knowledge gap regarding URT PPPs and development-based LVC. Also, it provides critical insights for policymakers to improve the financial sustainability of rail infrastructure. These results of reviews help the researcher identify the critical issues (e.g., industry structure, governance and financing sustainability) that can contribute to the successful delivery of rail infrastructures with PPP and LVC, and potential cases for follow-up investigations.

This research will develop, examine and enrich a series of frameworks in the following chapters through a structured case study approach. The sophisticated research methodology will be presented in the next Chapter.

CHAPTER 3 RESEARCH METHODOLOGY

3.1 Chapter Introduction

This chapter identifies and justifies the interpretive qualitative research approach to address the research objective presented in Chapter 1. Within the scope of interpretive qualitative approach, a structured case study approach as the research design is adopted to develop the framework to use PPP and LVC for URTs. Following this, research methods including data collection (i.e., semi-structured interviews and documentary sources) and content analysis are discussed sequentially. The research evaluation methods (i.e., qualitative reliability and validity) and research methodology limitations are also presented.

3.2 Interpretive Qualitative Research Approach

A research approach is a plan involving the intersection of philosophy, the procedures of inquiry (i.e., research design), and methods of data collection, analysis, and interpretation (Creswell, 2009). The selection of a research approach should be based on the nature of the research problem being addressed (Myers, 2013). With this in mind, the justification of the research approach for this study will firstly introduce the emerging nature of URT PPPs with LVC. Then, it will discuss why the interpretive qualitative research approach is suited to this study.

3.2.1 Emerging Nature of Using PPP and LVC to Deliver URTs

As indicated in Chapter 2, there is limited experience using PPP and development-based LVC to deliver URTs and has been examined by only a few studies. Derived from these extant studies, the threefold emerging nature of using PPP and LVC for URTs is presented below.

First, limited experience is insufficient to formulate a testable hypothesis. The previous studies above make progress in using LVC and PPP to support URTs by presenting their practical experience in different cities and identifying the critical issues (e.g., policies and agreement structure) that can influence its successful adoption. However, the critical issues in different studies are not the same, and their relationship is still unclear. For example, it is identified that fare regulation and bundled contracts are essential to the successful delivery of URT PPPs with LVC (Chang and Phang, 2017).

At the same time, land-use policies are identified as the primary factor that can significantly influence the implementation of using LVC to support URT PPPs (Sinha, 2021). However, the relationship between fare regulations, bundled contracts and land-use policies cannot be identified from extant studies in Chapter 2. Thus, the insights from the extant studies are not sufficient to constitute the theoretical underpinning and then formulate a testable hypothesis for examining the use of PPP and LVC for URTs.

Secondly, access to crucial objective data necessary to understand the policymaking process of rail infrastructure procurement is limited. Some objective data (e.g., numbers of passengers, fare, and investment and revenue of project) have been used in previous studies above to support the analysis of the operation of rail infrastructure (Luan *et al.*, 2014; Chang and Phang, 2017). However, it is difficult to obtain objective data that can reflect the decision-making process of using PPP and LVC for URTs. For example, the financial information associated with the role of LVC in supporting the development of rail infrastructure typically contains noisy data or has not been released due to commercial confidentiality, rendering it almost impossible to obtain accurately (Gallent *et al.*, 2020).

Thirdly, subjective data has been successfully used to study the rail infrastructure supported by the PPP and LVC. The subjective data that involves consciousness, judgment and choices have proven to enable the researcher to understand the process of policymaking in the transport and urban planning area (Grosvenor, 2000; Dandekar, 2005). With this in mind, subject data has been used in extant studies. For instance, the researcher gathers the subjective perspective from interviews and uses them with documents to describe the collaboration between SPV and the government and justify its contribution to the efficient use of LVC and PPP for rail infrastructure (Aveline-Dubach and Blandeau, 2019).

3.2.2 Interpretive Approach

Interpretivism is based on a life-world ontology that believes realities are multiple and relative. Under this ontology, realities vary across human experience and cannot be inquired only through detached, objective evidence (Leitch *et al.*, 2010).

Epistemologically, interpretivism considers that human interactions and meaningful actions construct a reality of knowledge (Burrell and Morgan, 1979; Ponelis, 2015). In relation to this, the interpretive approach usually captures the meaning derived from the human interaction to depict the complexity of reality (Carson *et al.*, 2001; Black, 2006). As the interpretive approach generates knowledge from human interaction, it often applies an inductive inference whereby reasoning proceeds from the specific empirical evidence to general insight (Babbie, 2007; Creswell, 2009). Hence, the interpretive approach can help the researcher build the knowledge with the subjective views from the respondents, seek an understanding with the specific context of where they live and work, and develop the general theory or the pattern of meaning (Ponelis, 2015).

The interpretive approach is ideally suited to this study. The emerging nature of using LVC and PPP for URTs has shown that access to objective data is limited, and subjective data is the suitable option to examine this research question. Thus, the interpretive approach can help the researcher yield a richer understanding of URT PPPs with LVC by capturing the meaning from respondents and developing the general theory to achieve the research objectives of this study.

3.2.3 Qualitative Research

The underlying philosophical assumption (e.g., interpretivism) will lead researchers to embrace qualitative or quantitative research for their studies (Creswell, 2009). The definition of qualitative and quantitative research is presented below:

- *Qualitative research* aims to explore and understand the nature of social or human problems, including their meaning, quality and the context in which they appear (Busetto *et al.*, 2020). Qualitative research usually draws on empirical evidence (e.g., personal experience, interviews, observational and historical records, and visual texts) to inquire about regular and problematic moments and meanings in the lives of individuals or groups (Denzin and Lincoln, 2005).

- *Quantitative research* aims to examine the relationship between variables to test objective theories. Quantitative research is typically reliant on the collection of numerical data using statistical processes to analyse and measure variables to inquire about a particular theory (Creswell, 2009).

The interpretive approach presented in this thesis will adopt qualitative research due to the limited experience and prevailing studies of using PPP and LVC to deliver URTs. The emerging nature of this research question above has shown that there is not sufficient theoretical underpinning to formulate a testable hypothesis. As a result, quantitative research cannot be conducted as it needs a reliable and testable hypothesis (Creswell, 2009). By comparison, qualitative research is suited to this study as it can be guided by the interpretive approach and is instrumental in exploring an emerging problem, enabling a holistic understanding of a phenomenon and developing the theory through limited empirical evidence (Sofaer, 1999; Anderson, 2010; Myers, 2013).

To this end, this investigation is ideally suited to the interpretive qualitative research approach. Corroborating the selection of interpretive qualitative research for this investigation is the fact that other studies that have examined PPP and LVC for rail infrastructures chose the same approach (Tang *et al.*, 2004; Luan *et al.*, 2014; Suzuki *et al.,* 2015; Chang and Phang, 2017; Wang *et al.*, 2019).

3.3 Research Design

Research design represents a structured approach to research inquiry and comprises a logical and systematic plan of connecting empirical evidence and the research question (Myers, 2013). A case study is a typical research design within the scope of interpretive qualitative approach and is used in many fields in which the researcher develops an in-depth analysis of a phenomenon, often a program, event, activity, process, or one or more individuals (Creswell, 2009; Myers, 2013; Ponelis, 2015). A case is bound by time and activity, and researchers collect detailed information using a variety of data-collection procedures over a sustained period (Stake, 2005; Yin, 2009).

The case study is appropriate to this research for several reasons. First, a case study can focus on “how” and “why” questions and describe the processes, individual or

group behaviours in its total setting, and/or the sequence of events in which they occur (Stake, 2005; Myers, 2013). This feature makes the case study appealing for issues in applied disciplines such as engineering and management. Indeed, using a case study can inquire into the process, problem, and programs emerging in the delivery of rail infrastructure through PPP and LVC to engender understanding and improve project implementation.

Second, a case study can use various research methods, obtain sufficiently-detailed descriptions that can be transferred to similar situations, and generate in-depth insights (Davies, 2007; Merriam, 2009). Based on this feature, the researcher can use a case study to achieve the aim of this research through transforming the experience and knowledge of using PPPs and LVC for rail infrastructure derived from a specific context to a generic framework for global policymakers.

And third, a case study is feasible and sufficient for every stage of research spanning from theory building and testing (Eisenhardt, 1989; Flyvbjerg, 2006; Merriam, 2009; Yin, 2009). In particular, the case study is helpful in areas where the general idea is adopted as a guide to the empirical research, but existing theoretical knowledge is inadequate, and the hypothesis has not been formulated (Chetty, 1996; Mouton, 2001). The emerging nature of using PPPs with LVC to deliver URTs lacks sufficient empirical evidence, and its theoretical development is fragmented and immature (Chapter 2). Therefore, using a case study can integrate different views and information and establish a broader, deeper and more holistic understanding of effectively utilising PPP and LVC for URTs. In sum, a case study can play an essential role in advancing a field's body of knowledge and thus is appropriate to this research.

A case study usually adopts a standardised, one-way and linear-path framework to progress from the start of research to reach its closure (Eisenhardt, 1989; Yin, 2009; Myers, 2013). As a result, there is a limitation for case study to capture the ongoing refinement of the initial research questions and theory and conduct a continuous comparison of data with emergent themes (Carroll and Swatman, 2000, p. 236). Hence, the structured case approach is used in this research to overcome this limitation and will be discussed next.

3.3.1 Structured Case Approach

The structured case approach can reconcile the limitation of generalisation in the linear framework of the traditional case study approach by providing a mouldable, structured and dynamic method to the research process (Love *et al.*, 2006). In the structured case approach, sequential conceptual frameworks are established through research cycles to examine and revise the understanding gained from research objectives until the data saturation has occurred.

The conceptual framework is the critical component of the structured case approach throughout the whole research process. The research cycle is organised in four stages: plan, collect, analyse, and reflect. When the conceptual framework is confirmed or revised, it forms the basis for a new research cycle. Finally, when the conceptual framework extends and reconciles the extant literature or represents practical considerations, the research process is deemed to be complete.

The structured case approach is conducive to building theory, discovering relationships between concepts, and explaining, predicting/or providing understanding for complex issues (Carroll and Swatman, 2000). Thus, the structured case approach can be adopted to garner an understanding of the complex array of issues that need to be considered to develop a framework that policymakers can use to guide their decision making during the procurement of infrastructure (Love *et al.*, 2006). With this in mind, the structured case approach can help the researcher effectively develop a robust framework for URT PPPs with LVC by systematically identifying its critical issues and explaining the relationships between them.

The structured case process used for this research is depicted in Figure 3.1. Here CF_1, CF_2, CF_3, and CF_4 are used to demonstrate the process of knowledge and theory building. The research process commences with reviewing the extant literature and recognising key issues and their correlations and then generates the original conceptual framework (CF_1) to understand the integration of PPP and LVC for URTs. Then, the CF_1 is confirmed and revised, forming the basis of CF_2, which enacts the research cycle, presented in Figure 3.1 (below). The research cycle then transforms CF_2 into

CF_3 and CF_4. Finally, the final PPP and LVC framework is developed by integrating CF_1, CF_2, CF_3, and CF_4 with prevailing theories and knowledge.

The development of CF_1 is presented in Chapter 4, and the transformation from CF_1 to CF_2, CF_3, and CF_4 is presented in Chapter 5. The inter-case comparison between the four conceptual frameworks and the final PPP and LVC framework and systemic model development is presented in Chapter 6.

3.3.2 Unit of Analysis

The unit of analysis is the main body that is analysed in the case study and can be expressed in multiple forms (Ponelis, 2015). For example, the unit of analysis can be an individual, such as a person who has had an experience of interest to the study, an event, such as a decision, a social process, an implementation process, an organisation or part thereof (McClintock *et al.*, 1979; Rowley, 2002; Myers, 2013). Essentially, the unit of analysis varies according to the dimensions of the scope of activities. These activities are bound together as they are embedded in the same case, incorporating identifiable boundaries, and a sequence of common questions is applied to them (McClintock *et al.*, 1979).

The units of analysis in a study are related to the "what" and "who" that will be or are being investigated and analysed. In this research, the units of analysis are the "critical assets" that comprise rail infrastructure, adjunctive facilities, land and real estate. The reasons for selecting these critical assets as the unit of analysis are twofold: first, they are the main deliverable objects that emerge in the procurement of URTs (Cervero and Murakami, 2009; Suzuki *et al.*, 2015); and second, they can cover the multiple forms that bound activities for using PPP and LVC to deliver URTs. These forms include the "project" that lasts for a limited time and the "ongoing operation" that produces repetitive outputs in the long term (Luan *et al.*, 2014; Chang and Phang, 2017). As a result, analysing critical assets can comprehensively reflect how PPP and LVC can determine and influence the deliverable objects related to URTs (e.g., rail infrastructure and real estate) within a project or the ongoing operation.

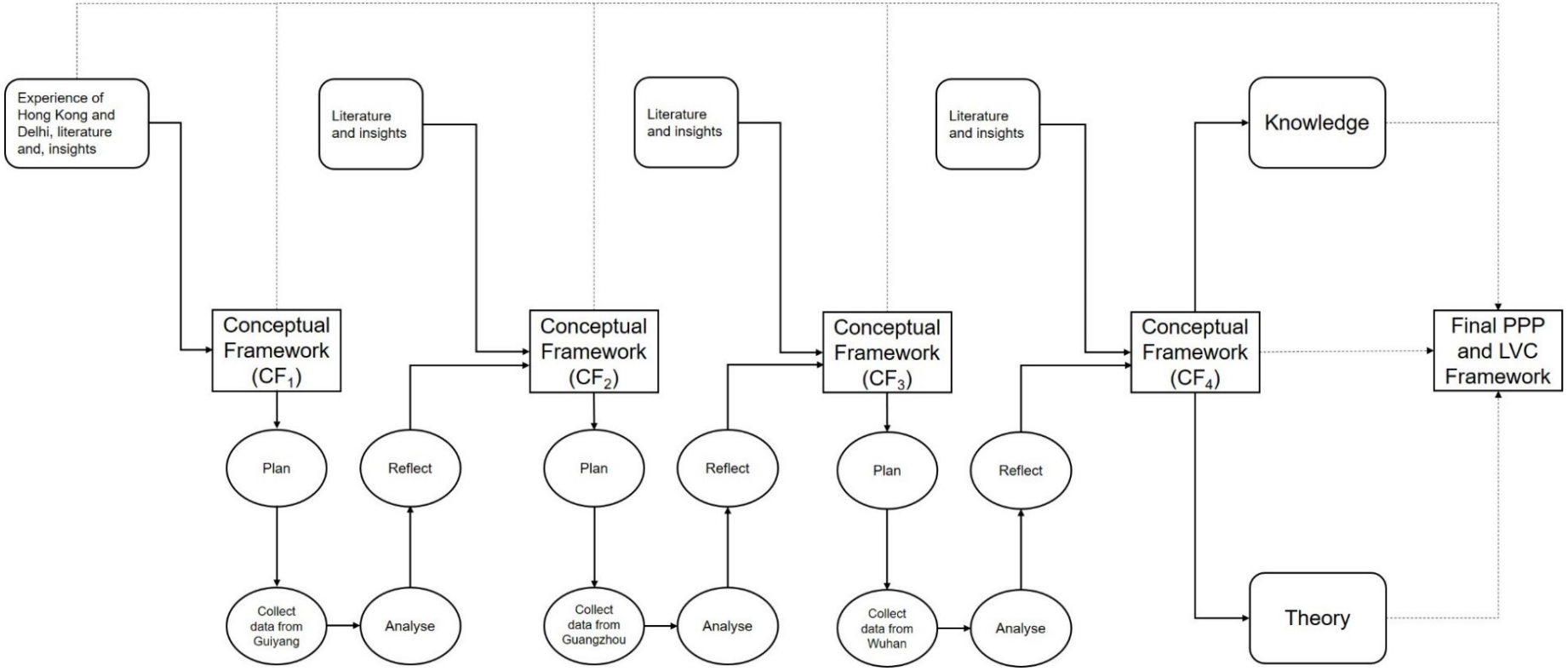


Figure 3.1 Research process of structured case

3.3.3 Case Selection

The criteria for selecting cases and determining the number to be undertaken form a critical aspect of a qualitative case study. The criteria for selecting cases should be highly relevant to the research question (Carson *et al.,* 2001). Therefore, the underlying principle in selecting appropriate cases is to choose information-rich ones with respect to the topics under investigation (Patton, 2002).

In addition, the number of cases required can vary (Holloway, 1997). For example, using a single-case study can contribute to answering a research question (Flyvbjerg, 2006). Alternatively, multiple cases may be considered more compelling, robust and conducive to providing a valid basis for understanding and developing theory (Yin, 2009). However, Eisenhardt (1989) suggests the ideal number of cases to be undertaken should be between four and ten.

In this structured case study, five cases were selected. The first and second cases develop the original conceptual framework (CF_1). The remaining three cases are used to validate CF_1 and develop CF_2, CF_3, and CF_4 sequentially. The cases selected for CF_1 are from Hong Kong (China) and Delhi (India), whose detailed descriptions can be found in Chapter 4 below. The rationale for selecting these cases to develop CF_1 is twofold:

- They are antipodes. The Hong Kong case is deemed a successful and shining example of development-based LVC, which can help researchers learn from their positive experiences, whereas the Delhi case failed miserably. Lessons can be learned from the latter case as to why it went wrong. In essence, these two cases are selected to garner an understanding of "what goes right" and "what goes wrong" when implementing development-based LVC within the context of PPPs.
- Both cases employed a PPP with a development-based LVC instrument (i.e., joint development). This instrument has been widely used throughout mainland China, Hong Kong, India, Japan, North America and the United Kingdom (Zhao *et al.*, 2012b; Suzuki *et al.,* 2015; Abiad *et al.,* 2019).

Spanning from CF_2, CF_3 and CF_4, URT PPPs with LVC in three cities in China were selected for this research: (1) Guiyang (Western); (2) Guangzhou (Eastern); and (3) URT Wuhan (Central). Their detailed descriptions can be found in Chapter 5 below. The rationale for selecting these cases in three Chinese cities is fourfold:

- These cases are selected from economic regions (i.e., Eastern, Central, Western and North-eastern cities) in China to mitigate potential bias derived from the regional differences (National Bureau of Statistics, 2011; State Council of China, 2020). In addition, although they have varying population sizes and are subject to different economic conditions, Guiyang, Guangzhou, and Wuhan possess similar political and governance structures.
- These three cities have used development-based LVC to support their URT systems for more than five years. All three cities utilise development-based LVC to provide significant financial returns to support their URTs, which guarantees that sufficient empirical evidence can be used to support this research.
- These three cities have awarded PPP agreements for their URT systems, which ensures the acquisition of formal and public files (i.e., contract and feasibility reports) to be used to support this research.
- These three cases in Guiyang, Guangzhou and Wuhan are feasible to organise interviews with various stakeholders to obtain a rich picture of the issues confronting the practical use of LVC and PPP for URT systems.

A potential concern is that Guangzhou and Hong Kong have similarities in the contextual backdrop (e.g., geographic proximity, GDP, population size, and industrial structure). Thus, Guangzhou may not be considered an independent case. However, two features of Hong Kong and Guangzhou make them have significant differences under the use of LVC:

- *High population density*. In 2019, the population density of Guangzhou was 2,059 per square kilometre (Guangzhou Government, 2019), whereas the population density of Hong Kong in the same year was approximately three times this at 6,930 (Hong Kong) per square kilometre (Hong Kong Government, 2020) and;

- *High property price*. In 2019, the average residential property price in Guangzhou was US$4,144 per square metre (Delmendo, 2020), whereas Hong Kong's average residential property price was more than US$22,507 per square metre – nearly five times that of Guangzhou (CRBE, 2019).

Compared to Guangzhou, Hong Kong tends to have a far more profitable and prosperous real estate market and successfully obtains significant revenue through development-based LVC. Thus, the Guangzhou case could be a complementary case that provides a general reference for cities from either mainland China or the rest of the world.

3.4 Research Method

The research methods refer to the actual procedures and techniques involving data collection, analysis, interpretation and evaluation that researchers propose for their studies (Yin, 2009; Myers, 2015; Creswell, 2009).

In this structured case study, the research methods begin to be collecting a series of in-depth semi-structured interviews and documentary sources as the primary source of empirical evidence. Then, the content analysis is adopted to analyse and interpret empirical evidence to determine the research findings. Finally, the research findings are evaluated to ensure they meet the criteria of qualitative validity and reliability.

3.4.1 Data Collection Strategy

Qualitative research is flexible and adaptable in allowing single or multiple methods to collect data to investigate a research problem (Cavaye, 1996). A wide variety of data collection methods can be used, including interviews and documentary sources (Mouton, 2001; Myers, 2013). Using multiple data sources is conducive to triangulating them, conducting analysis, generating significant insights, and validating research findings (Eisenhardt, 1989; Miles and Huberman, 1994; Love *et al.,* 2002; Yin, 2009; Myers, 2013). The data collection methods are semi-structured interviews and documentary sources in this research. Table 3.1 presents the strengths and

weaknesses of semi-structured interviews and documentary sources used in this research.

Table 3.1 Key issues of interviews and documentary sources

Methods	**Types**	**Strengths**	**Weaknesses**
Semi-structured interviews	Individual interviews	- provide first-hand experience and historical information - offer potential data access - make use of well-known practices of planning, documenting, and analysing	- cause selection bias - existing bias of respondents - existing challenges due to the respondent's unwillingness to speak
Documentary sources	Internal documents and reports; externally published documents; websites; reports; newspapers	- provide data access - provide a high quantity of data - offer consistency - create better understanding, especially of the context	- require an understanding of what the documentation was originally intended for - may be irrelevant to the research subject - require clarity of the analysis purpose - may be hard to assess the authenticity, credibility and representativeness of a document - may cause time-consuming to access and retrieving data

Adapted from Creswell (2009), and Martinsuo and Huemann (2021)

Based on the research process of the structured case study, the data collection strategy of this research is divided into two stages. The first stage is to collect empirical evidence from documentary sources to capture the details and nuance of the Hong Kong and Delhi cases to develop the CF_1. The semi-structured interviews were not conducted in this stage as limited studies on URT PPPs with LVC cannot generate a series of themes to prepare the meaningful interview question protocol.

The second stage is to collect empirical evidence from in-depth semi-structured interviews and documentary sources to validate CF_1 and transform it to CF_2, CF_3, and CF_4 to address the research question of this study. In the data collection process of CF_2, the interviews were conducted with the interview question protocol drawn upon the CF_1 and literature review. In the data collection process of CF_3 and CF_4, the interviewer was conducted with the same interview protocol and added new questions drawn from the previous conceptual framework. For each case in this stage, semi-structured interviews and documentary sources were collected simultaneously and were concluded when data saturation emerged.

3.4.2 Semi-Structured Interviews

A semi-structured interview is a verbal interchange where the researcher attempts to elicit information from respondents by asking questions (Longhurst, 2003). The semi-structured interview can keep respondents and researchers focused on the predetermined themes of the study but still maintain flexibility to explore new and relevant issues that emerge in the interview process (Dunn, 2005; Poneils, 2015). As a result, the semi-structured interviews can help the researcher delve into a more profound understanding of the issues and identify events and activities that cannot be observed directly (Taylor *et al.*, 2015).

The semi-structured interviews were conducted throughout the second stage of the structured case study (i.e., from CF_2 to CF_4) and used as the primary and secondary sources of empirical evidence. As a primary source of empirical evidence, they were conducted to understand how to effectively integrate PPP and LVC to deliver URT systems to collaborate with documentary sources to develop the conceptual

frameworks of Guiyang, Guangzhou and Wuhan. As a second source of empirical evidence, they confirmed the information gathered from documentary sources and validated the conceptual frameworks.

Locating and recruiting the respondents is critical to the semi-structured interviews (Allen, 2017). As the literature review previously identified, the experience of URT PPPs with LVC is limited. The critical issue of locating and recruiting respondents in this research is to ensure they have related experience on URT PPPs with LVC. With this in mind, the initial respondents in each city were identified from publicly-available information of policies and technical reports used to implement projects that deliver URT systems through PPP and LVC. Then, the subsequent respondents were identified through snowball sampling. Therefore, all these respondents were involved in the implementation process of URT PPPs with LVC. They comprise senior government officers, rail transit and land agency project managers, engineers, financial experts, and urban planners.

Another critical component for the semi-structured interview is developing an appropriate interview protocol (Jacob and Furgerson, 2012). The interview protocol should include questions spanning from general areas to specific aspects of the critical assets' deliveries, identified by reviewing the normative literature and examining the available documentary sources (Oppenheim, 1992). The semi-structured interview protocol for this structured case study is outlined in Appendix B.

The interview protocol was used as a flexible guide rather than a rigid framework to help the researcher conduct the semi-structured interviews with respondents (Dunn, 2005). In this research, each respondent, in their initial interview, would be first asked the most general question of the protocol to help the researcher to understand the broad view of the URT delivery. The researcher would then select another question from the interview protocol or encourage respondents to keep talking about the issues that are new and related to the study with an open-ended question. During the interviews, respondents were allowed to speak freely without interruption or intervention. Respondents can be required by the researcher to explicitly understand their ideas and draw a clear picture of their perspectives on the topic of the study. Before the end of

the initial interview for each respondent, the researcher would ensure all questions in the protocol have been asked. However, due to respondents' experience and job responsibility, not everyone can answer each interview question in the protocol.

This research undertook 27 in-depth semi-structured interviews between August 2019 and July 2021. Most of the interviews were undertaken face-to-face and lasted between 45 to 120 minutes. Follow-up interviews were conducted to seek clarification and/or request additional information using Microsoft Teams/WebEx and telephone due to travel restrictions caused by the Covid-19 pandemic. Also, due to the Covid-19 pandemic, the semi-structured interviews were conducted in two stages. The first stage took place before 2020. There are twenty interviews conducted in mainland China. These interviews were undertaken firstly in Guiyang, then in Wuhan and Guangzhou, and finally in other cities. The second stage of semi-structured interviews took place between 2020 and 2021. Another seven interviews were conducted in Australia through remote interviews, whose respondents came from Guiyang, Guangzhou, Wuhan and other cities of mainland China. Table 3.2 presents the composition of total semi-structured interviews in this research.

Table 3.2 The composition of semi-structured interviews

City	**Year**	**Local government**		**Managers in the transit agency**	**Professionals in engineering and management sectors**	**Total**
		Government staff	**Experts engaged in policymaking**			
Guiyang	Before 2020	2		2	1	9
	Between 2020-2021	1			3	
Guangzhou	Before 2020		1	2	3	8
	Between 2020-2021				2	
Wuhan	Before 2020		2	2		5
	Between 2020-2021				1	
Other cities*	Before 2020			2	2	5
	Between 2020-2021				1	
						27

* Refers to the respondents familiar with URT PPP with LVC in other cities.

There are several details in the collection of semi-structured interviews, which may be of concern. The first is the role of semi-structured interviews conducted with respondents in other cities of mainland China. These semi-structured interviews in other cities add new information related to the study and validate whether the data from the cases in Guiyang, Guangzhou, and Wuhan is aligned with their experience and follows the national policies. Notably, using PPP and LVC to deliver URT systems is also new to Chinese cities. As URT PPPs with LVC has just started, potential respondents familiar with it are limited in selected cities. As a result, the interviews conducted with respondents in other cities are an essential supplementary data source to enhance the reliability and validity of this research.

Secondly, the sample size of 27 semi-structured interviews is akin to studies of a similar nature (Luan *et al.*, 2014; Chang and Phang, 2017; Aveline-Dubach and Blandeau, 2019; Sinha, 2021). Table 3.3, below, shows the sample size of related research that inquired into the delivery of URT with PPP/LVC in high-quality academic journals. The small number of interviews can facilitate this research's data saturation because studies of URT PPPs with LVC are still in the incipient stage. As a result, a few interviews with sufficient critical documents can conduct reliable analysis on issues of URT PPPs with LVC.

Finally, all semi-structured interviews were recorded by notes with respondents' permission and then checked for accuracy. Although using digital equipment can improve the quality of interviews recording, it was not permitted by respondents. All respondents are involved in the high-investment deliveries of URTs through PPPs and LVC, and therefore are very sensitive and want to prevent themselves from any potential risk that may come from the voice recording. As a result, using notes to record the interview is the sole selection. The advantages of using notes to record interviews are that it would not interrupt the flow of conversation and make respondents feel comfortable about having their ideas and comments recorded. All notes of interviews are transformed into digital form for data analysis.

Table 3.3 The size and composition of empirical evidence in academic articles that examined URT PPPs with LVC

Journal	Year	Title	Case numbers	Case location	Documentary size and source	Interview size and composition	Citation in this Research
Transportation Research Record	2014	Emerging Public-Private Partnerships in China's Rail Mass Transit: Case of Shenzhen	1	Shenzhen (China)	Not specified	Not specified	Luan *et al.* (2014)
Transportation Research Part A: Policy and Practice	2017	Urban rail transit PPPs: Lessons from East Asian cities	4	Hong Kong (China), Tokyo (Japan), Beijing (China), Singapore	Not specified	Not specified	Chang and Phang (2017)
Urban Studies	2019	The political economy of transit value capture: The changing business model of the MTRC in Hong Kong	1	Hong Kong (China)	The document size is not specified; the documents comprise academic publications, annual reports, policy documents, newspaper articles, consultancy reports	15 interviews; the respondents include major stakeholders of Hong Kong's transit system	Aveline-Dubach and Blandeau (2019)
Land Use Policy	2021	Harnessing land value capture: Perspectives from India's urban rail corridors	2	Bangalore (India);	The document size is not specified; the documents comprise government documents, legal archives, media articles and also online site surveys of various government authorities	The interview size is not specified; the respondents comprise government officials, lawyers, activists, civil society actors and journalists who were concerned with the two metro projects	Sinha (2021)

3.4.3 Documentary Sources

Documentary sources are typically referred to as unobtrusive measures to provide empirical evidence that can allow researchers to build a richer picture than gathered by interviews alone (Myers, 2013). The documentary source can provide essential details of the event (e.g., the investment and return of the project) and can cross-check findings with other sources (e.g., interviews), which make the event visible and traceable (Prior, 2003; Myers, 2013). Therefore, documents can be used as an additional source of empirical evidence (e.g., a supplement to semi-structured interviews) and be a critical record to present the event's activities (Prior, 2003; Myers, 2013).

In this research, documentary sources were used as the primary and second sources of empirical evidence. As a primary source of empirical evidence, the documentary source was collected to categorise, investigate, interpret and identify the activities in each delivery of URTs supported by PPP with LVC. The documentary source was firstly used to independently develop the conceptual framework of the Hong Kong and Delhi cases. The documentary source was then used to collaborate with semi-structured interviews to develop the conceptual frameworks of the Guiyang, Guangzhou, and Wuhan cases. As a second source of empirical evidence, documentary sources were used to confirm the information gathered from semi-structured interviews and validate the conceptual frameworks.

The authenticity and credibility are critical to the documentary source (Scott, 1990). With this in mind, the criteria for this research used to collect the documentary source was required to be twofold. The first is that documents should be related to the implementation process of LVC and PPP for URT systems and networks, including their planning, design, land coordination and acquisition, development, operation and regeneration. The second is that documents should come from authoritative sources and professional institutions. They included peer-reviewed academic publications, different levels of governments, transit agencies, investment banks, multilateral banks, bond rating agencies, railway associations, and local newspapers.

A total of 101 publicly-available digital documents collected through the internet are used for this research. Based on the structured case approach research process, these documents are collected in two stages. In the first stage, a total of 31 public documents were available between 1999 and 2020, which describe and examine the entire development process of the Hong Kong and Delhi cases (Appendix C). In the second stage, 70 public documents were available between 2008 and 2021, describing and examining the entire development process for the Guiyang, Guangzhou, and Wuhan cases (Appendix D). These core documents are classified into five categories:

- *Official documents*: refer to documents that provide the critical information of URT's delivery (e.g., agreement structure, project description, technical specification and operation performance). These documents are usually published by the transit agencies and their contractor, key stakeholders of PPP (e.g., SPV) and the metro association comprised of all Chinese transit agencies. For example, official documents can include the PPP contractual agreement and prospectus of rail assets (MTR Corporation Ltd., 2000; Delhi Metro Rail Corporation Ltd., 2008), Annual Report (MTR Corporation Ltd., 2018, 2020), and technical reports (Guangzhou Road Engineering Research Centre, 2018);
- *Government documents*: refer to documents published by the administrative authorities, which contain the regulation, investigation, and guidance about delivering URT through PPP and LVC. For example, they can include a series of inquiries on the defects of URTs that the Council of State undertook in India (e.g., Council of States, 2013; Transport and Housing Bureau, 2019), Government Audit Report (Comptroller and Auditor General of India, 2013), and policies in each city (e.g., Hong Kong Legislative Council, 1999; Guiyang Government, 2015; Chinese Central Government, 2016; Guangzhou Government, 2017a);
- *Academic publications*: refer to the scholarly articles published in high-quality, peer-reviewed journals, which can supplement the information, contextual backdrop, and analysis on URT PPPs in each case. For example, they can include studies on using PPP and/or LVC to support URT for each case (e.g., Tang *et al.*, 2004; Cervero and Murakami, 2009; Pratap, 2013; Chang and Phang, 2017);

- *Expert reports*: refer to the documents published by the professional institutions (e.g., investment banks, multilateral banks, bond rating agencies), which can supplement the information, contextual backdrop, and analysis on delivering URT through PPP and LVC in each case. Examples include expert reports on the development of URT in cases (e.g., The World Bank, 2020a), and financing documents (e.g., Haitong Securities Company Limited, 2015, 2016; Guangfa Securities Company Limited, 2019); and
- *Newspapers*: refer to the documents published by reliable local media, providing public opinions and meticulous details of URT PPPs and validating information mentioned by other documentary sources. For example, these newspapers can provide historical and independent records of delivering URT with PPP and LVC (e.g., Dutta, 2012; Raja *et al.,* 2012; Das, 2013).

3.4.4 Content Analysis

A frequently-used method for qualitative research is content analysis. The content analysis was defined as a research technique to make replicable and valid inferences from empirical evidence to their context (Krippendorf, 2004). In other words, content analysis can help researchers identify coherent and meaningful insights (e.g., themes, categories and patterns) from the empirical evidence and make inferences based on these regularities (Myers, 2013). In particular, content analysis has been widely adopted in studies on transport management and urban planning areas (Bowen, 2009; Mayring, 2000; Mills *et al.*, 2006; Ponelis, 2015). For example, Antonson (2014) adopted content analysis to analyse the planning documents and written submissions to examine the public's participation in the transport infrastructure planning process. Likewise, Grubbauer and Čamprag (2018) examined the legislative mechanisms, contractual strategies, and modes of governance involved in delivering a project by referring to legislative and planning documents, expert reports, and media through content analysis.

In the use of content analysis, the insights (e.g., themes, categories and patterns) are constructed by the coding that can be conducted in two main approaches: an emergent approach or a priori-directed approach (Ponelis, 2015). In the emergent approach, no

prior themes are established, and themes emerge through repetitive scrutiny and comparison of the empirical evidence. In a priori-directed approach, the coding themes are established before the analysis and are based upon previous literature, and the themes are then applied to the empirical evidence. During the process of a prior directed coding, additional codes can also be developed, and the initial coding scheme is revised and refined (Kibiswa, 2019).

In this research, content analysis was used as a primary method to analyse semi-structured interviews and documentary sources to understand the effective use of PPP and LVC to support the delivery of URT systems. All empirical evidence from semi-structured interviews and documentary sources were inputted into NVivo Version 12, which enabled the researcher to use the content analysis to organise, analyse and obtain insights about the delivery of URT through PPPs and LVC in each case (Pershing, 2002; Bryman, 2004).

As the experience of URT PPPs with LVC is limited, and a structured case approach can use the research cycles to generalise findings iteratively, this research divided the content analysis into two stages. In the first stage, the researcher uses the emergent approach to code and analyse the empirical evidence of Hong Kong and Delhi cases to develop CF_1. In the second stage, the researcher uses the prior directed approach to code and analyse the empirical evidence of the Guiyang, Guangzhou and Wuhan cases to develop CF_2, CF_3 and CF_4.

In the first stage that analyses the Hong Kong and Delhi case (i.e., CF_1), all empirical evidence from the documentary sources is put into NVivo and then coded as a series of creating nodes. Then, the cluster analysis, a function within Nvivo 12, was used to explore the potential themes that emerged from the nodes. Finally, the themes were extracted to enable the researcher to identify and explain the relationship between nodes. The analysis was iterative and deemed complete when no new information emerged from the case. Figure 3.2, below, exposed how the researcher used the NVivo 12 software to analyse the Hong Kong and Delhi cases. In addition, Appendix E provides an example to show the relationship between the coding system and category.

In the second stage that analyses the Guiyang (i.e., CF_2), Guangzhou (i.e., CF_3), and Wuhan (i.e., CF_4) cases, all empirical evidence from the semi-structured interviews and documentary sources are inputted into NVivo 12. Following that, the prior coding themes established by the CF_1 were applied to the empirical evidence of the Guiyang case and then coded into a series of creating nodes. At the same time, additional codes can also be developed to code the information to several creating nodes and then constitute new themes. The analysis was an iterative process and was deemed complete when no further information emerged from the case, which would finally be used to develop the CF_2 and establish a new prior coding theme for the Guangzhou case. The analysis process of the Guangzhou case is undertaken in the same way that is applied to the Guiyang case, which develops the CF_3 and establishes a new coding theme that was subsequently used to analyse the Wuhan case for developing CF_4. Figure 3.3 illustrates how the researcher used the NVivo 12 software to analyse the Guiyang, Guangzhou, and Wuhan cases. The relationship between the coding system and category is similar to that shown in Appendix E.

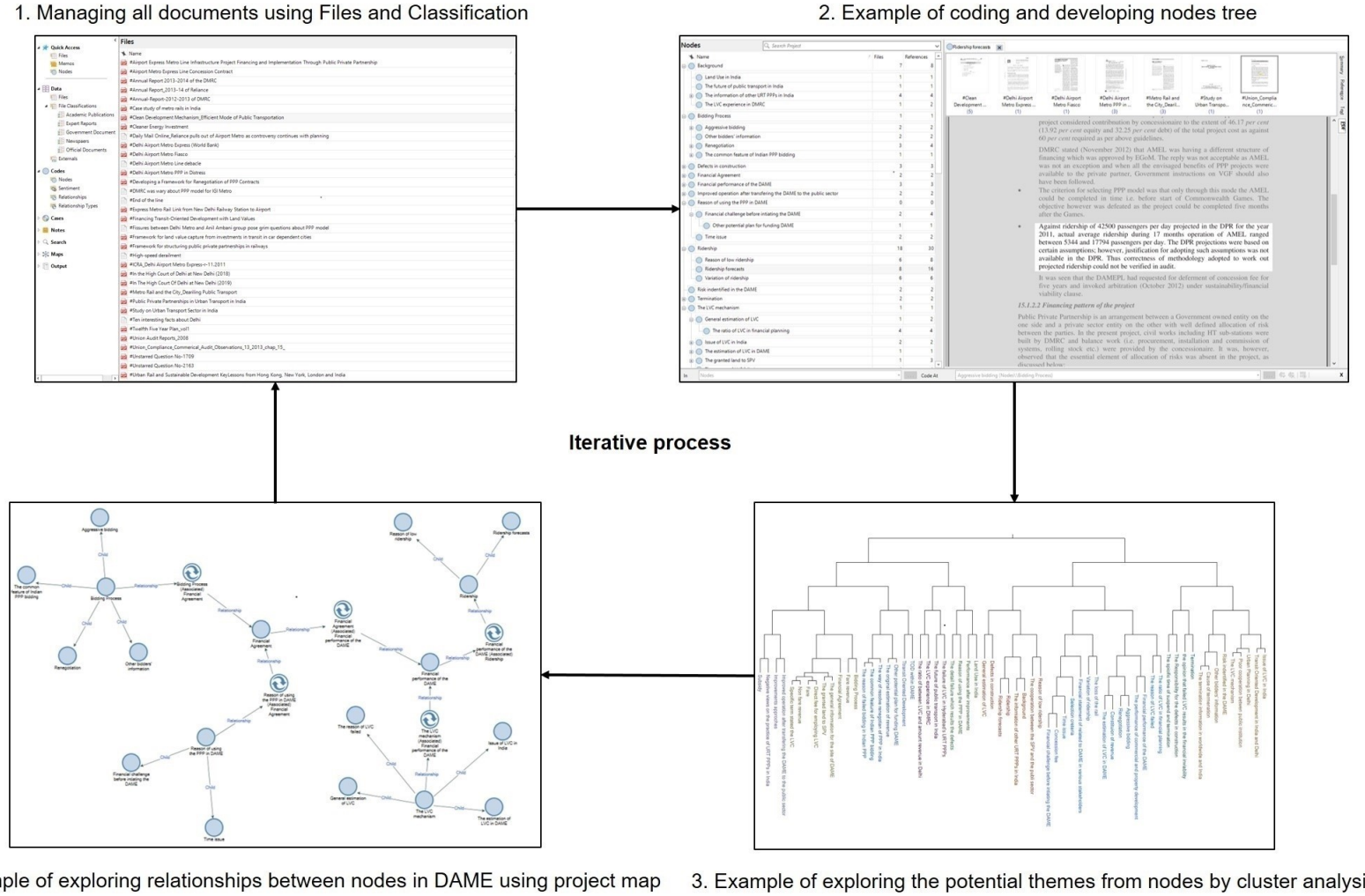


Figure 3.2 An example of the content analysis process using the NVivo software for the Hong Kong and Delhi cases

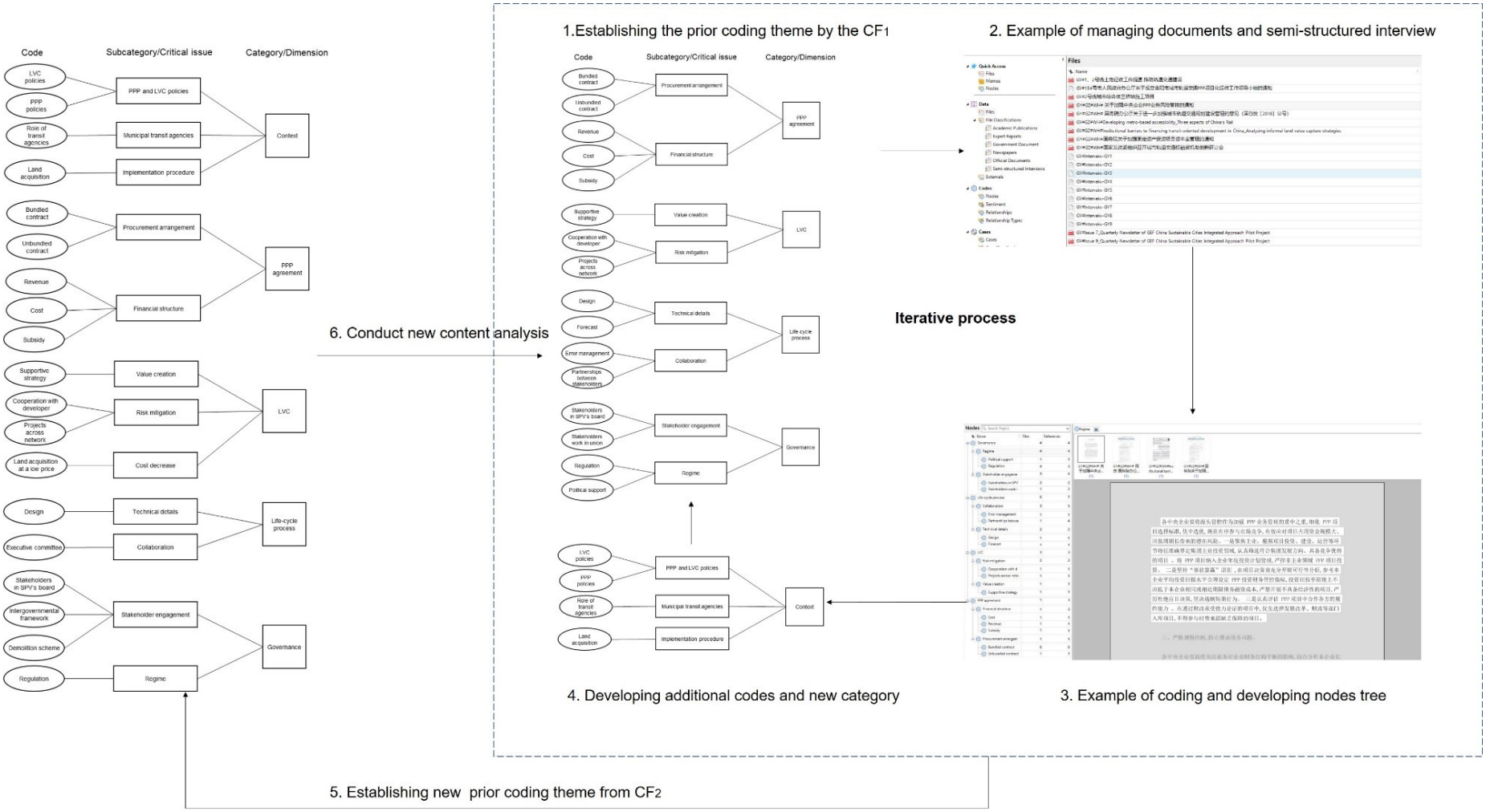


Figure 3.3 An example of the content analysis process using the NVivo software for the Guiyang, Guangzhou, and Wuhan cases

3.5 Research Evaluation I: Qualitative Reliability

The reliability for qualitative research relies on consistency (Leung, 2015), or as Stern (1979) suggests: "for observations to have scientific value, there must be the assurance that different observers of the same people or events would use abstractions in the same way" (p.21). At the same time, reliability in qualitative research is related to an issue "where the assessment of research subjects is carried out with a certain degree of subjectivity by the researcher(s) themselves" (Love, 2001, p.82). To meet the consistency requirement and be coherent with different researchers' subjectivity, qualitative reliability was proposed to rely on explicitly-described observational procedures (Creswell, 2009). In relation to this, qualitative researchers should document as many steps as possible of the study's procedures and make sure there are no obvious mistakes in the transcription and no shift in the meaning of the codes (Gibbs, 2007; Yin, 2009).

In this Chapter, the steps of conducting research have been explicitly presented to add to the reliability of the study. They include:

- The detailed procedures of conducting the structured cases approach, collecting empirical evidence from semi-structured interviews and documentary sources and using content analysis through NVivo software (Section 3.3 and Section 3.4);
- The interviews protocol (Appendix B), the publication that supports the size of the semi-structured interview sample (Table 3.3) and document sources (Appendices C and D) that are used to develop a conceptual framework; and
- The content analysis used for semi-structured interviews and documentary sources is completed by the sole researcher, ensuring no shift in the definition of codes.

Notably, it is impossible to determine the semi-structured interviews' reliability as they were undertaken on a one-to-one basis (Love, 2001). With this in mind, the researcher has ensured that the findings identified from the semi-structured interviews were consistent in developing conceptual frameworks for URT PPPs with LVC.

3.6 Research Evaluation II: Qualitative Validity

The validity of qualitative research is to determine whether the findings are accurate from the researcher's standpoint, the respondent, or the readers of an account (Creswell and Miller, 2000). Based on this definition, qualitative validity indicates that the researcher checks for the accuracy of the findings by employing specific procedures (Gibbs, 2007). Therefore, the research should adopt multiple procedural approaches to enhance the researcher's ability to assess the accuracy of findings and convince readers of that accuracy (Creswell, 2009). In this research, three procedural approaches are adopted to ensure the study's validity.

3.6.1 Triangulation

Triangulation can establish a credibility procedure where researchers pursue the merging of various data sources to explore research themes and involve using multiple research methods of a phenomenon to overcome the problem of bias and ensure validity (Creswell and Miller, 2000; Black, 2006). In this research, researchers triangulate the empirical evidence collected from various documentary sources (i.e., office documents, government documents, academic publications, expert reports, and newspapers) and semi-structured interviews to generate insights and themes on URT PPPs with LVC.

3.6.2 Member Checking

Taking specific descriptions, the themes or the main results of the research back to respondents and inquiry whether they feel these findings are accurate can enhance the study's validity (Creswell, 2009). In this research, the researcher conducts follow-up interviews with several respondents to provide an opportunity for them to clarify the delivery process of URT with PPP and LVC and comment on the research findings (e.g., some dimensions of the conceptual framework).

3.6.3 Internal Validation of Conceptual Frameworks.

Validating the conceptual frameworks can add to the validity of the study, which was proposed to be completed in two approaches (Proverbs, 1998):

- *Internal validation*: means that the findings are triangulated or converged by the literature and academic validity through publication in peer-reviewed journals; and
- *External validation*: indicates expert opinion on the feasibility of the conceptual frameworks presented.

Due to the Covid-19 pandemic and China's travel restrictions, this research cannot organise the experts to assess the feasibility of the conceptual framework presented systematically. Therefore, this research uses two approaches to use internal validation for the conceptual frameworks. The first approach to internally validate the research findings is triangulating different empirical evidence and converging the broader literature. The research process of a structured case approach can enable researchers to develop conceptual frameworks based on empirical evidence and literature iteratively. Therefore, the conceptual frameworks presented in Chapters 4 and 5 have been internally validated by empirical evidence and broad literature.

The second approach to internally validate the research findings is to disseminate them to international peer-reviewed journals such as *ASCE Journal of Infrastructure Systems, Research in Transportation Business and Management, Cities, Transportation Research Part A: Policy and Practice*. There are four published journal papers and one under review, presented at the beginning of this thesis (p.ii). These submissions were the product of this thesis, and their dissemination has been a continuous process, with each paper reporting a very focused and specific aspect of the contribution to knowledge that has been made. All of these papers required changes before their acceptance and publication. The review process raised many important and sometimes fundamental issues, which have been addressed and incorporated into this research, making this study more robust and the reported findings more significant. Therefore, the academic validity of the framework and systemic model and the research reported in this thesis is supported.

3.7 Limitation of Qualitative Research

This qualitative research uses the structured cases approach to increase the study's reliability, validity, and generalizability. However, there are still three limitations to this qualitative research. First, this research is conducted based on the five cases, which may be unworkable to generalise its findings to the whole population. Second, the documentary source collection of this research is not systematic, and semi-structured interviews were not undertaken with all participants involved in the delivery of URTs through PPP and LVC due to the availability or their reluctance to be interviewed. Consequently, there is a potential for bias and misinterpretation regarding the relationships and features within URT PPPs with LVC. Finally, the researcher's background is centred on engineering and urban planning, which may lean toward specific themes (e.g., project management and urban development) and overlook the economic issues (e.g., fare price mechanism).

3.8 Chapter Summary

The research methodology has been described and justified in this chapter. Based on the aim and objectives of this research, the research approach and its philosophical assumptions were firstly justified. The research design (i.e., structured case approach) and the process designed for data collection and analysis were then explained. Finally, the qualitative research's reliability and validity (i.e., triangulation, member check, and internal validation) were discussed to provide detailed insight into the study. The methodological approaches applied in this thesis were justified as valuable and appropriate in achieving the aim and objectives of the research. A detailed examination of the empirical evidence from the Hong Kong and Delhi cases to develop the conceptual framework (CF_1) can be found in Chapter 4. Following this, three detailed case studies (i.e., Guiyang, Guangzhou, and Wuhan) are presented in Chapter 5 to validate CF_1 and transform it to CF_2, CF_3, and CF_4. Finally, the inter-case comparison between CF_1, CF_2, CF_3 and CF_4, and the development of the final PPP and LVC framework and systemic model are provided in Chapter 6.

CHAPTER 4 INITIAL CONCEPTUAL FRAMEWORK (CF_1)

4.1 Chapter Introduction

This chapter sets out to establish the conceptual framework to explain "how" LVC can bolster the financial feasibility of a PPP. Thus, an exploratory case study is used to create the initial conceptual framework (CF_1) for this study. This case study examines the experience of Delhi Airport Metro Express (DAME) and Hong Kong's Mass Transit Rail (MTR) with 31 publicly available and critical documentary sources between 1999 and 2020.

Parts of this Chapter have been published in Cities and Research in Transportation Business and Management.

Li, X., and Love, P. E. D. (2019). Employing land value capture in urban rail transit public-private partnerships: Retrospective analysis of Delhi's Airport Metro Express. Research in Transportation Business and Management, 32, 100431.
Li, X., and Love, P. E. D. (2022). Procuring urban rail transit infrastructure by integrating land value capture and public-private partnerships: Learning from the cities of Delhi and Hong Kong, Cities, 122, 103545.

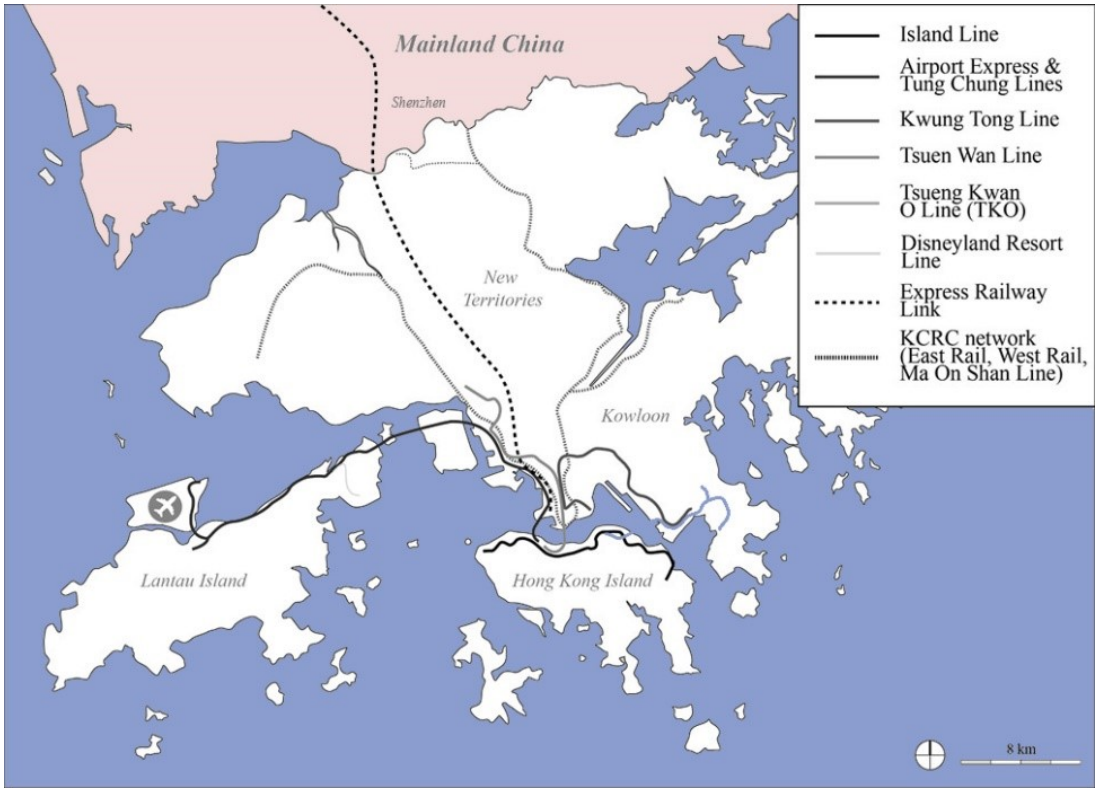
4.2 Hong Kong Mass Transit Railway

Hong Kong is the most densely populated city globally, with approximately 7.4 million inhabitants living in a mountainous land area of 1099 square kilometres (only 24% of the land is built-up) in 2016 (United Nations, 2016). The average population density on Hong Kong Island, for example, is 15,620 persons per square kilometre. More specifically, the Kwun Tong District has 59,400 people per square kilometre (Census and Statistics Department, 2017). Furthermore, Hong Kong has relatively low levels of car ownership compared to other developed cities. There are only 76 cars per one thousand population by 2018, compared with 110 in Singapore (2018), 303 in London (2018) and 187 in Tokyo (2018) (Legislative Council, 2019).

Considering Hong Kong's high density and low-car-ownership, people are reliant on its Mass Transit Rail (MTR), which is one of the most efficient and successful in the world (Phang, 2007; Chang and Phang, 2017). The MTR's network comprises 220.9-kilometres of rail track, shown in Figure 4.1. In 2017, it accounted for 49.1% of the franchised public transport market (including buses, urban rail, tram and ferries

services) and achieved over two billion passenger trips (Census and Statistics Department, 2017; MTR Corporation Ltd., 2018).

The Hong Kong MTR is a publicly owned enterprise but engages in divestment by providing a share issue privatisation (SIP). As a result, the MTR is identified as a joint venture PPP (Chang and Phang, 2017). A joint venture PPP is also often referred to as an institutionalised PPP whereby public and private partners jointly manage and deliver the service (Cruz and Marques, 2012). Under this joint venture PPP, both the private and public sectors pool their assets and resources to perform a series of activities and share profits and losses (Phang, 2007; Asian Development Bank, 2008).



Adapted from Aveline and Blandeau (2019)

Figure 4.1 The network of Hong Kong MTR

4.2.1 Delivery Details

Legislators and government regulate the contractual arrangement of the MTR Corporation under the specific detailed clauses that contain finite terms (i.e., 50 years) for the franchise, monitoring and fare setting processes (Hong Kong Legislative

Council, 1999). The Hong Kong government is the major shareholder, holding approximately a 75% share in the MTR. It has a critical role in supervising and supporting the MTR and therefore assigns directors to its board to participate in its overall strategies, corporate governance, finance and stakeholders (Transport and Housing Bureau, 2019; MTR Corporation Ltd., 2020). The directors are charged with protecting the public's interest and decreasing information asymmetry (MTR Corporation Ltd., 2000; Tang *et al.*, 2004).

Additionally, the Hong Kong government provides policy guidance and privileges to support the delivery of MTR services. For example, the Hong Kong government increased the cost of car ownership to encourage people to use the MTR (Cullinane, 2003; Suzuki *et al.,* 2015). The government has also granted the MTR exclusive land development rights along its rail corridor by offering favourable land-use terms and conditions for property development (Aveline-Dubach and Blandeau, 2019).

The MTR utilises a 'bundled contract' with a single entity responsible for its financing, infrastructure, rolling stock, line maintenance and operation, and development-based LVC (Suzuki *et al.*, 2015; Chang and Phang, 2017). As a result, the MTR has decreased its transaction costs, resolved conflicts among stakeholders, and reduced whole life-cycle costs (Tang *et al.*, 2004). A bundled contract allows the MTR to further bolster ridership and property values by utilising TOD urban development policy. Such an approach to urban development is defined as "a series of principles that promote creating a network of well-designed human-scale urban communities focused around transit stations" (Growth Management Queensland, 2009, p.2).

A TOD policy aims to provide commuters with an efficient connection between a rail station and other transport modes such as buses and ferries. By employing a TOD approach with a 'bundled contract', the MTR can manage its stations and ensure that surrounding lands/properties are developed into a compact, high-density, and mixed land use (Tang *et al.*, 2004). As a result, this has augmented daily ridership by more than 35,000 passengers, generated property price premiums in the range of 5 to 30 per cent and therefore justifies the employment of an LVC mechanism (Cervero and Murakami, 2009; Chang and Phang, 2017).

The returns materialising from the MTR's LVC mechanism include property rental and management, commercial station business and property development over 50 years (MTR Corporation Ltd., 2000; 2020). Table 4.1 illustrates the profit from LVC for the MTR from 2011 to 2017. It can be seen here that LVC's returns have contributed 50% to 60% of its total share of profits. Notably, property rental and management and commercial business profits steadily increased from 2011 to 2017, while those from property development have significantly fallen. It has been suggested that the performance of LVC is influenced by an array of factors such as the local real estate market, the scale of development projects, population, urban economy and land availability (Chang and Phang, 2017; Tang, 2017; Aveline-Dubach and Blandeau, 2019). Such factors are susceptible to changes in macroeconomic conditions. Thus, solely relying on LVC to fund a URT is a high-risk strategy. In light of such risks, the MTR put in place a financial plan to mitigate them.

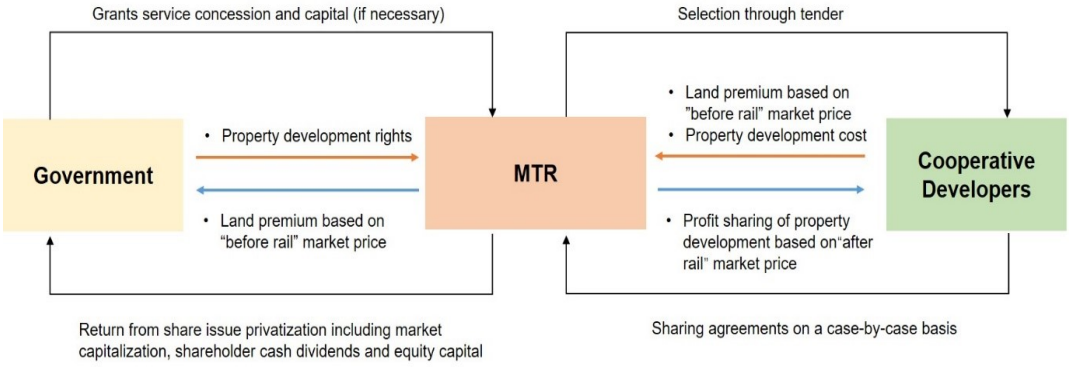
Table 4.1 The MTR's operating profit contributions

MTR Operations	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Hong Kong transport operation (US$ billion)	0.79	0.83	0.85	0.89	0.91	0.97	0.95
Hong Kong station commercial businesses (US$ billion))	0.39	0.42	0.52	0.57	0.61	0.64	0.70
Hong Kong Property rental and management businesses (US$ billion)	0.32	0.36	0.39	0.43	0.47	0.50	0.52
Hong Kong Property Development (US$ billion)	0.62	0.41	0.18	0.53	0.37	0.04	0.14
Total Profits (US$ billion)	2.19	2.10	2.07	2.55	2.45	2.29	2.72

Adapted from MTR Corporation Ltd. (2016, 2018)

Figure 4.2 illustrates how the MTR coordinates the relationships between the government and cooperative developers. The MTR, as part of its financial strategy, acquired the property development rights from the government at a land premium based on the 'before rail' market price and, when a public tender is prepared, allocates property development rights to cooperative developers. The selected developers are required to accommodate project risks by bearing all development costs (e.g.,

construction and enabling work costs, marketing and sales expenses and professional fees) and land premiums. The MTR negotiates with its cooperative developers to benefit from property developments by profit-sharing in agreed proportions on a case-by-case basis. This financial strategy reduces the MTR's exposure to the volatility of the real estate market and related risks (The World Bank, 2017).



Adopted from Tang *et al.* (2004) and Suzuki *et al.* (2015)

Figure 4.2 The relationships between government, MTR and cooperative developers

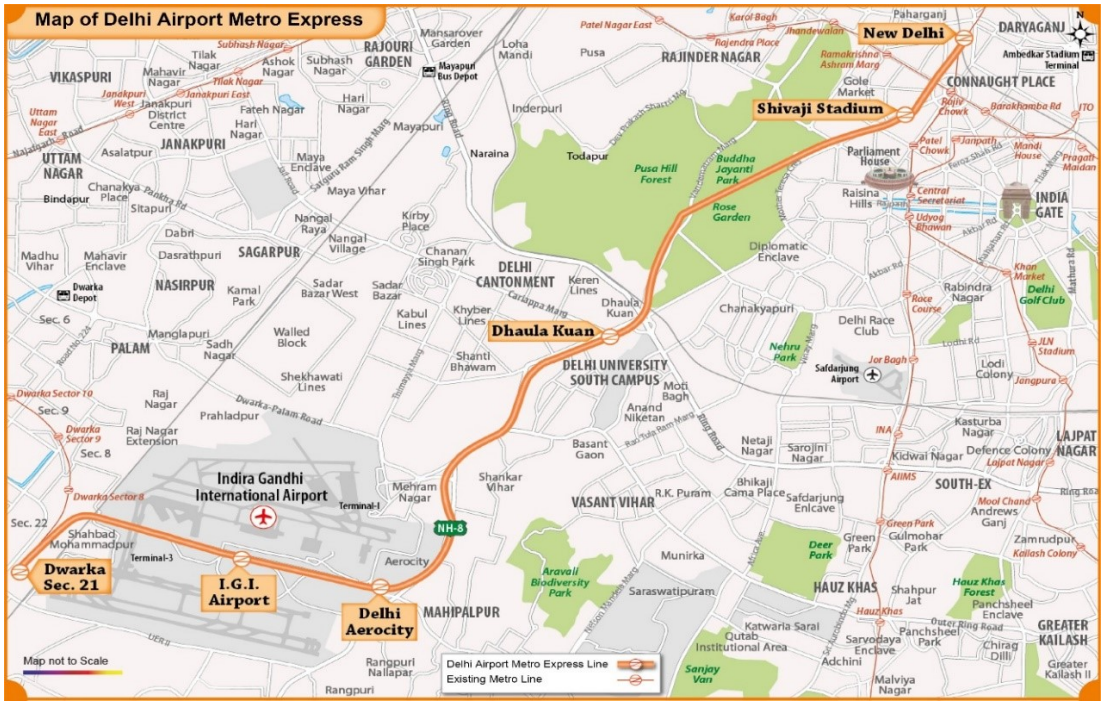
4.3 Delhi Airport Metro Express

The population of Delhi significantly increased from 9.42 to 16.75 million between 1991 to 2001 (Government of NCT of Delhi, 2014). In 2008, the number of registered motor vehicles in Delhi reached almost 5.90 million (Ministry of Road Transport and Highways, 2014). Correspondingly, Delhi experienced significant growth in air traffic. The number of airline passengers increased from 7.9 million in 1995 to 16.2 million in 2006, which resulted in Delhi's Indira Gandhi International Airport (IGI Airport) becoming the busiest in South Asia.

As the movement of passengers between the IGI Airport and Delhi City had been generally through taxis and private cars, it suffered heavy traffic congestion between these two destinations (Infrastructure Development Department, 2008). With the Commonwealth Games due to taking place in 2010 in Delhi, the Airports Authority of India (AAI) had forecasted a steep rise in air traffic. It was therefore anticipated that traffic congestion would worsen further.

To address this issue, AAI proposed designing and developing a rail solution to ease the traffic congestion and assigned this request to the Delhi Metro Rail Corporation (DMRC). The DMRC was owned by the Government of the National Capital Territory of Delhi (GNCTD) and the central Government of India (GOI) and was established to construct and operate the Delhi Metro in 1995. By 2008, the Delhi Metro had installed 116 kilometres of a railway line that serviced nearly a million passengers per day, which corresponds approximately to 9% of the total public transportation ridership in the metropolitan area (The World Bank, 2012).

Based on the Detailed Project Report (DPR), the DMRC proposed to build the DAME which is a 22.7km dedicated high-speed rail line with its estimated construction costs to be US$0.77 billion (Figure 4.3).



Adapted from Map of India (2018)

Figure 4.3 Map of Delhi Airport Metro Express

4.3.1 Challenges and Options of DAME project

The decision to construct the DAME project was confronted with many challenges from its onset. For example, The Delhi Urban Arts Commission (DUAC), the Home Ministry and the Bureau of Civil Aviation had objected to the initial proposal of DAME. The reason for this disapprobation was that DAME's original route passed through heritage and environmentally sensitive areas. Besides, there was a perception that the DAME would cause security risks in the airport. Consequently, the DMRC had to modify the government-approved plan and add a separate secure tunnel to address security concerns.

A critical challenge that confronted the DMRC was to ensure the DAME project was commissioned before the commencement of the Commonwealth Games in October 2010 (Sinha, 2015). The project had to be completed within three years. Under normal circumstances, achieving financial closure for a significant piece of transport project can be a lengthy process and must be settled before construction commences (Chaudhary *et al.*, 2011). If the DMRC had followed its traditional approval process, the DAME would not have been operational for the Commonwealth Games. Time was an essential issue for the DMRC.

Several procurement options juxtaposed with the finance arrangements (e.g., loans from domestic banks and receiving subsidies from the government) were evaluated by the DMRC (Sinha, 2015). The process to accomplish financial closure was too long for the options evaluated (Chaudhary *et al.*, 2011). It was, however, identified that a PPP model was the only way to obtain financial closure and construct the DAME in the time frame available (Infrastructure Development Department, 2008; Sinha, 2015). Thus, an 'unbundled contract' PPP was selected by the DMRC to deliver the DAME.

4.3.2 Delivery Details

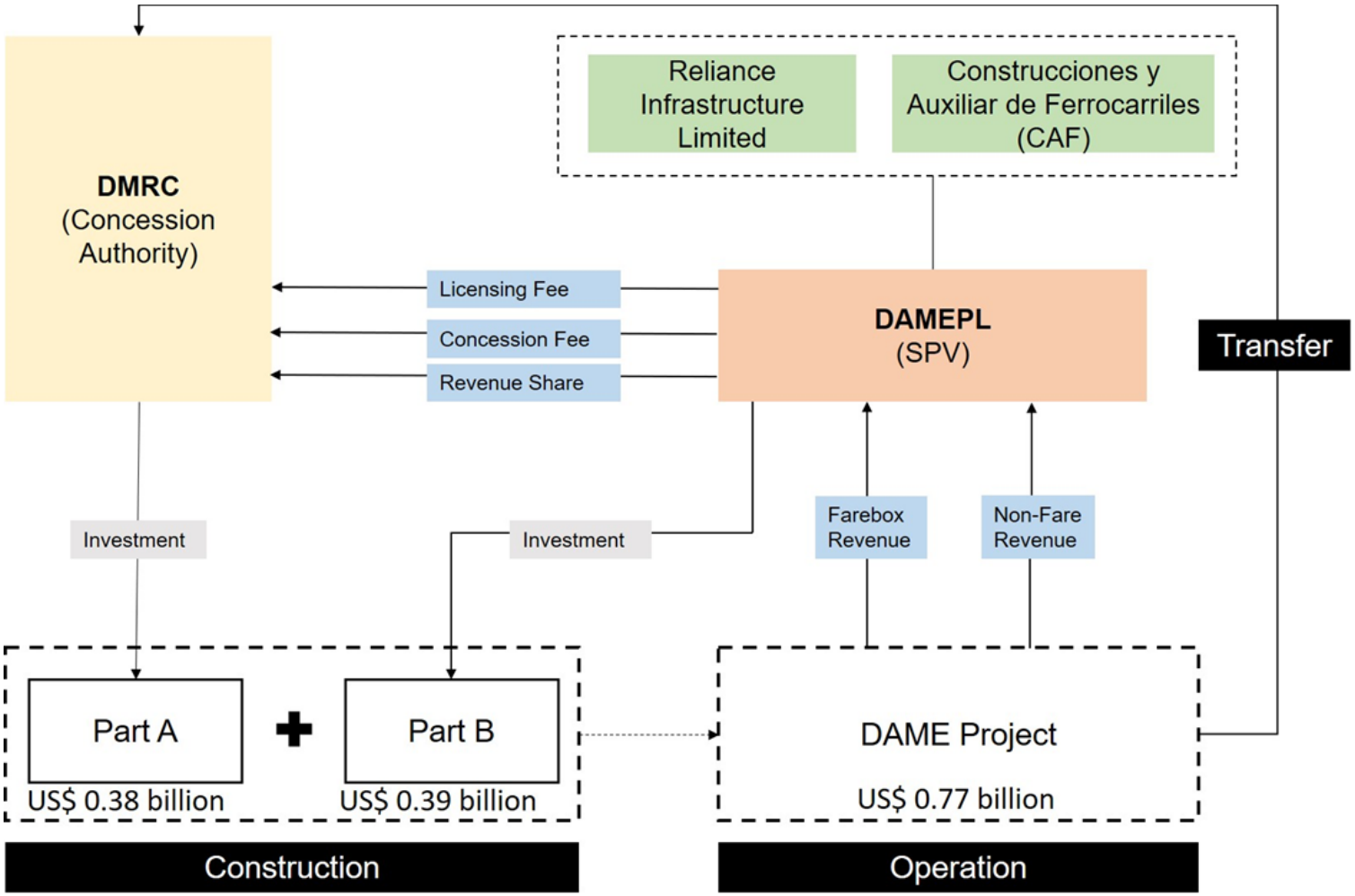
This 'unbundled contract' included an Engineering Procurement and Construction (EPC) contract for all civil works and granted a Build-Operate-Transfer (BOT) concession to the Delhi Airport Metro Express Private Limited (DAMEPL). Under the

'unbundled contract', the capital expenditure of the DAME was divided into two parts (Figure 4.4):

- *Part A* included all design, engineering, financing, procurement, construction, and testing of the civil works by the DMRC; and
- *Part B* included all design, engineering, financing, procurement, construction, installation and testing of the rail system, operation and maintenance, and other business management such as property development by the DAMEPL. An international and domestic private company established the DAMEPL[4] with a 5% and 95% stake in the project. Moreover, the DAMPL was granted a 30-year contract in January 2008 and acted as the PPPs' Special Purpose Vehicle (SPV), regulated by the DMRC[5].

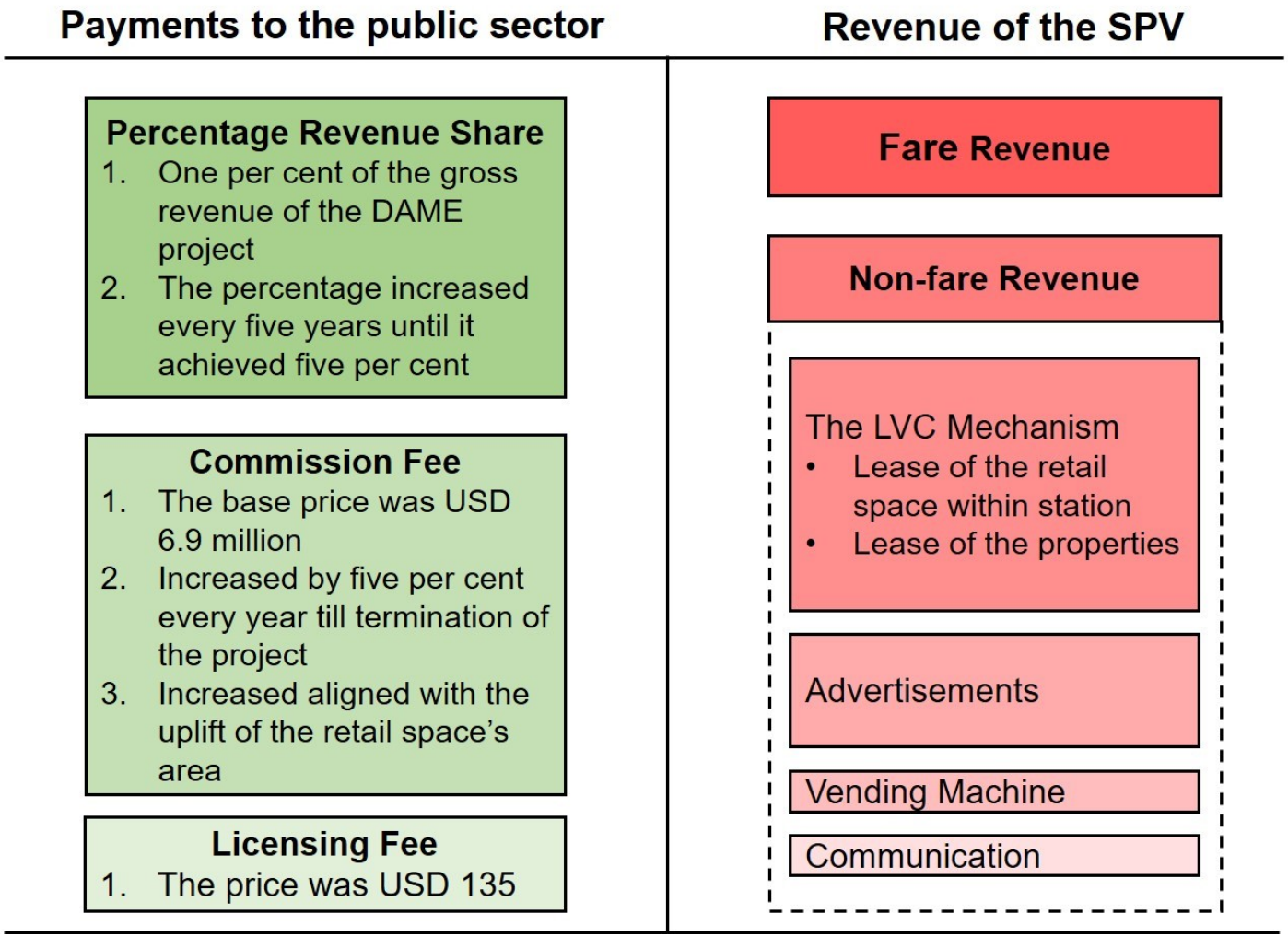
The DAME's unbundled contract's financial features addressed three issues. Firstly, the SPV did not request the public sector (i.e., DMRC and governments) to provide a subsidy to decrease the risk of operating income. Instead, it chose to receive both fare and non-fare revenue (e.g., income from advertisement, retail outlets and commercial leases within stations and properties) (Delhi Metro Rail Corporation Ltd., 2008; Pratap, 2013; Sunderasan, 2016). Secondly, the income from retail space leasing within stations and commercial properties was planned to be SPV's primary revenue source. Thus, the SPV can collect payment from these properties over the 30-year term[6] (Delhi Metro Rail Corporation Ltd., 2008; Raja *et al.*, 2012; Das, 2013; Sinha, 2015). In this case, the development-based LVC mechanism was used to support the PPP. Finally, as the SPV employed LVC, it was required to pay additional expenditure to DMRC, including the annual commission fee and a proportion of the revenue share. The annual financial agreement between the SPV and the public sector (i.e., the DMRC) stipulated in the contract is summarised in Figure 4.5. The specific terms of the LVC mechanism and payments in the contract are provided in Appendix F.

[4] The domestic company is Reliance Infrastructure Limited. It is an Indian private sector enterprise involved in a wide range of infrastructure projects.
[5] According to the concession agreement (Delhi Metro Rail Corporation Ltd., 2008), DMRC is primarily responsible for regulating and supervising SPV's activities. DMRC needed to provide necessary assistance to SPV and monitor the scope, schedule and progress of DAME's construction and operation through periodic report and inspection.
[6] According to the concession agreement (Delhi Metro Rail Corporation Ltd., 2008), the term of land for SPV's LVC mechanism was the same as the term of PPP contract.



Adapted from Delhi Metro Rail Corporation Ltd. (2008) and Comptroller and Auditor General of India (2013)

Figure 4.4 The scope of the DAME project



Summarised from Delhi Metro Rail Corporation Ltd. (2008)

Figure 4.5 The annual financial agreement between the SPV and the public sector in the DAME project

The 'unbundled contract' was successful and innovative during its formative stages. However, problems began to materialise after the line was completed. It did not commence operations until February 2011 as the SPV failed to obtain security clearance from government agencies within a specified period. Then, in July 2012, the DAME's operation was suspended by the SPV until January 2013 as civil works, which were the responsibility of the DMRC, were defective. As a consequence of the defects, the private sector terminated its contract in June 2013. The public sector was responsible for DAME's operation and therefore was required to provide compensation to the private sector (Comptroller and Auditor General of India, 2013; Council of States, 2014).

Such unsatisfied results emerged due to poor cooperation between the DMRC and SPV. The relationship between the DMRC and SPV was heavily criticised during a public inquiry, which sought to understand why the project failed. Both the SPV and DMRC disregarded their project management responsibilities, in part, and were not aware enough of each other's work practices and behaviours (Council of States, 2013). For example, both parties should have ensured that each other had undertaken critical activities to deliver DAME safely; but this was explicitly not the case. Ineffective cooperation during the delivery of DAME contributed to the project's failure and its inability to manage the project's interfaces, particularly between construction and operation.

Notwithstanding the defective civil works, the DAME's financial loss during its operation stage also must be considered. By the end of March 2013, the SPV had experienced losses totalling US$53.5 million (Reliance Infrastructure, 2013). In sum, the operational losses were attributable to an overly optimistic assessment of LVC contribution (Council of States, 2013).

The SPV estimated that the returns of the development-based LVC would contribute 70% of the project's income (Raja *et al.*, 2012; Das, 2013; Sinha, 2015). The actual returns (i.e., income from leasing retail space within stations and properties) were significantly lower than estimated. As of 31st March 2012, more than a year after the operation, the SPV could only secure leases for approximately 5500 m^2 (6%) of 86,000

m^2 available (ICRA, 2009; Dutta, 2012). This leasing shortfall significantly damaged the project's financial viability (Raja *et al.*, 2012).

The failure of LVC brought two issues to the fore. The LVCs projections were optimistic and prepared by the private sector who had limited access to reliable ridership and property data (Mclntosh *et al.*, 2015; Sinha, 2015; The High Court of Delhi, 2019). The absence of property data in India can result in flawed property valuations and thus adversely impact LVC estimations (Sharma and Newman, 2017). And second, the SPV failed to acquire its ideal level of LVC revenue due to:

- A performing poorly rail line due to delays and defects in civil works. As a result, ridership levels fell significantly. Additionally, potential retail business and commercial space leasing were lost.
- A floundering real estate market with limited land availability (e.g., single type and short term) contributed to the revenue shortfall. Thus, when the SPV was able to acquire land, it then was only able to let out a small fraction of the total commercial/retail space made available (Dutta, 2012); and
- Strained relations between the DMRC and local administrative authorities resulted in the LVC of DAME being excluded from the TOD policy of Delhi. The DAME could not acquire uplifts for the floor-area-ratio (FAR) of its properties close to metro stations, thus generating revenue.

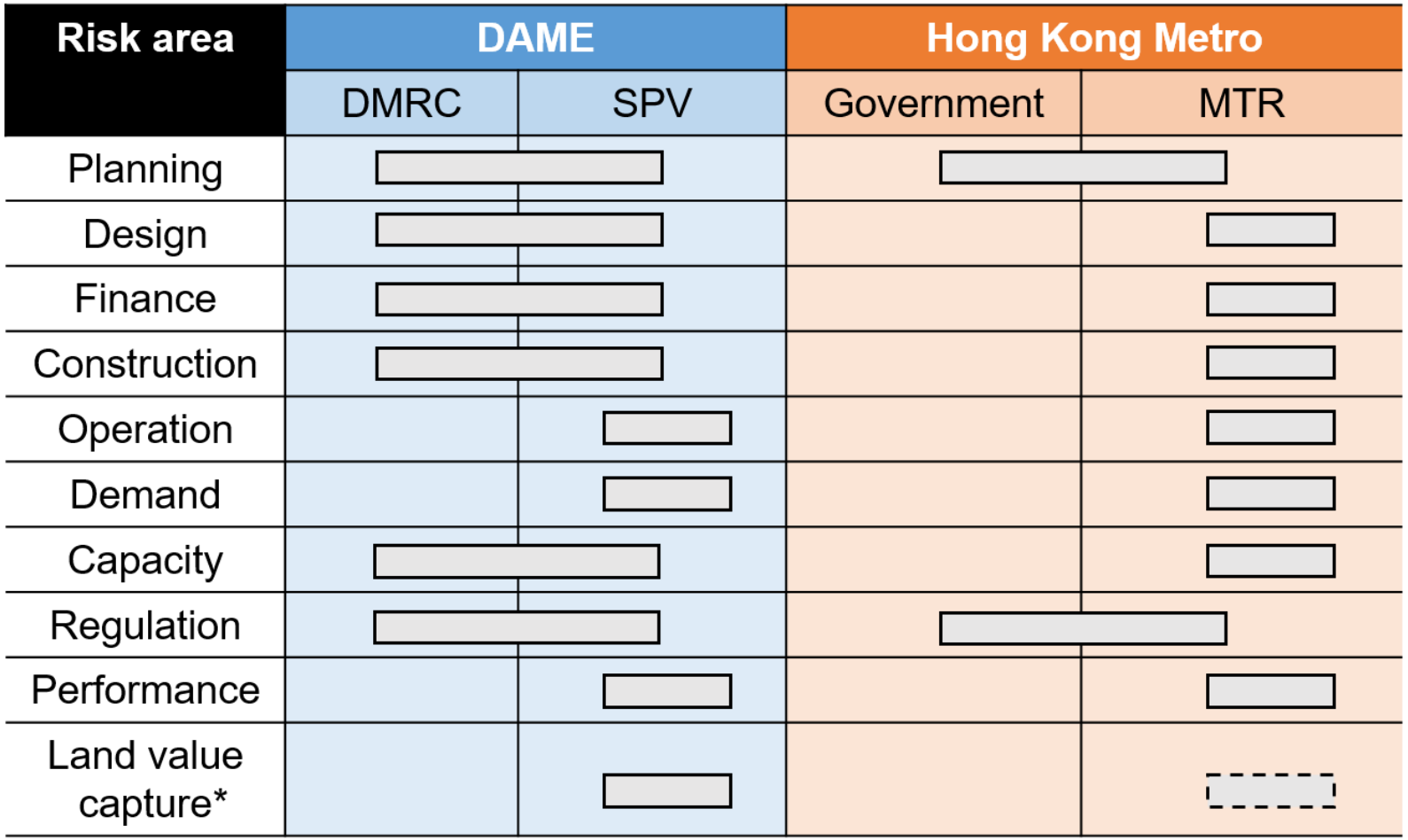
In the next section of this chapter, the characteristics of MTR and DAME will be compared.

4.4 Comparative Analysis

The comparative analysis reveals that the type of PPP contract impacts the effective use of LVC with a PPP. The MTR's bundled contract enables it to actively coordinate and resolve issues with its stakeholders throughout the project's life cycle. As a result, the MTR can reduce its transaction costs and the likelihood of conflicts between stakeholders and ensure the rail line runs smoothly and maximises the uplift of properties. Contrastingly, the DAME utilised an 'unbundled contract' with LVC. It required the public sector (i.e., DMRC) to share several risks (e.g., design, finance and

construction) and work collaboratively with the SPV to deliver the DAME. Drawing on Marques and Berg's (2011) comparative analysis of PPI contract types, the allocation of risk has been illustrated between the public and private sectors for the DAME and MTR in Figure 4.6. Notably, the DAME and SPV could not effectively collaborate and manage the project's interfaces. As a result, the contract was terminated after delays, defects, and shortfalls in revenue were experienced.

With the benefit of hindsight, the estimation of LVC's return (i.e., being 70% of the project's total income) in the DAME was overly optimistic. Moreover, the estimated return was significantly higher than other URTs that have relied upon LVC, which usually contribute 10% to 30% of total projects (Transport for London, 2017). Indeed, there are exceptions, as in the case of Hong Kong's MTR. Several factors can influence the returns provided by LVC, such as ridership levels, accessibility to transport, the location and type of the property, term of land and a project's planning (Langley, 2015; Transport for London, 2017). However, bearing in mind how macro-economic issues can influence these factors, as being presented noted above, the likelihood of the LVC failing is high. Besides using the mixed land use to uplift the value of land and property, the MTR was well aware of this problem and put mechanisms to reduce the risk of failure. In this instance, as the main shareholder of the MTR, the government facilitates the transfer of risk for property development to cooperative developers (Table 4.2). In contrast, the DAME's SPV owned by the private sector received far less support from the government and thus was exposed to significant risks associated with LVC.



* The MTR transfers part of its risks to the cooperative developers, denoted by the dotted line.

Adapted from Marques and Berg (2011)

Figure 4.6 The risk allocation between the public and private sector

Table 4.2 The comparison of Hong Kong MTR and DAME

	Hong Kong MTR	**DAME**
PPP model	Joint Venture	Build Own Transfer (excluding the civil work to the public sector)
The scope of the contract	Bundled contract	Unbundled contract
Capital Owner	The government hold the 74.98% share of the stake; the private have the rest of the stake	The domestic private company of India holds the 95% share of the stake; the international private company holds the rest share of the stake
Stakeholder management	MTR serves as a control position to coordinate the various stakeholder's interests effectively; Government has a high degree of engagement with MTR to supervise and support its delivery	Insufficient cooperation between the SPV and public sector
Supportive policy	Being supported by transport policy and beneficial term of land use from the government to improve the rail ridership and property development, and employ TOD principle to uplift revenue of LVC	Being excluded from the TOD plan, which adversely impacts the revenue of LVC
Implementation of LVC	Revenue derived from property rental and management, commercial station business and property development (including residential and commercial ones); and the term of lands used for LVC usually has 50 years	Revenue was planned to mainly come from leasing retail space within stations and commercial properties, and the term of land used for LVC only has 30 years
Financial structure	LVC's return contributed from 50% to 60% of the share of the MTR's total profits from 2011 to 2017	The estimation of LVC's return accounts for nearly 70 % of the project's income in the initial years
Risk allocation	The MTR undertakes the main risks area of the URT system's delivery. However, the MTR minimises the direct risk of property development by transferring it to the cooperative developer	The public sector and the SPV collectively undertake the URT system's delivery risk area. However, the SPV accepts all the risks of the LVC mechanism
Key factors may contribute to the return of LVC	Local prosperous estate market, high ridership level, the scale of development projects, urban economy, availability of land allocation	Low ridership level, overly optimistic prediction of LVC，floundering real estate market, short term of land, and strained relations between local administration institutions

4.5 Initial Conceptual Framework (CF_1)

The context used to develop the CF_1 MTR and DAME, which integrates land use and finance with a PPP procurement is derived from the literature (e.g., Chang and Phang, 2017; Aveline-Dubach and Blandeau, 2019) (Figure 4.7). Context can be defined as the circumstance that forms the setting for an event, statement, or idea and in terms of which it can be fully understood (Tennant, 2017). Context matters in project development as it shapes its structure and procedures over its life-cycle (Engwall, 2003). Many economic, political, legal, geographical, and institutional environments affect the performance of a projects' delivery, as the experience of DAME and MTR has been shown above. Thus, context can be viewed as a convergent concept (Love and Ika, 2021). It provides an ability to weave various understandings together to garner insights that can examine the nature of PPPs when combined with LVC. Our conceptual model comprises four dimensions:

- The nature of the PPP agreement, focusing on the core relationships and elements of the procurement arrangement;
- Development process, which identifies the critical factors needed to ensure the rail system functions well and the influence of surrounding property and land;
- Governance, which centres on the accountability, control and management of the URT, PPP and LVC; and
- LVC, which emphasises its implementation and the mitigation of its risks.

Next, each above of the above dimensions will be examined in greater detail to illustrate their interdependencies and core features within a procurement policy-making pathway:

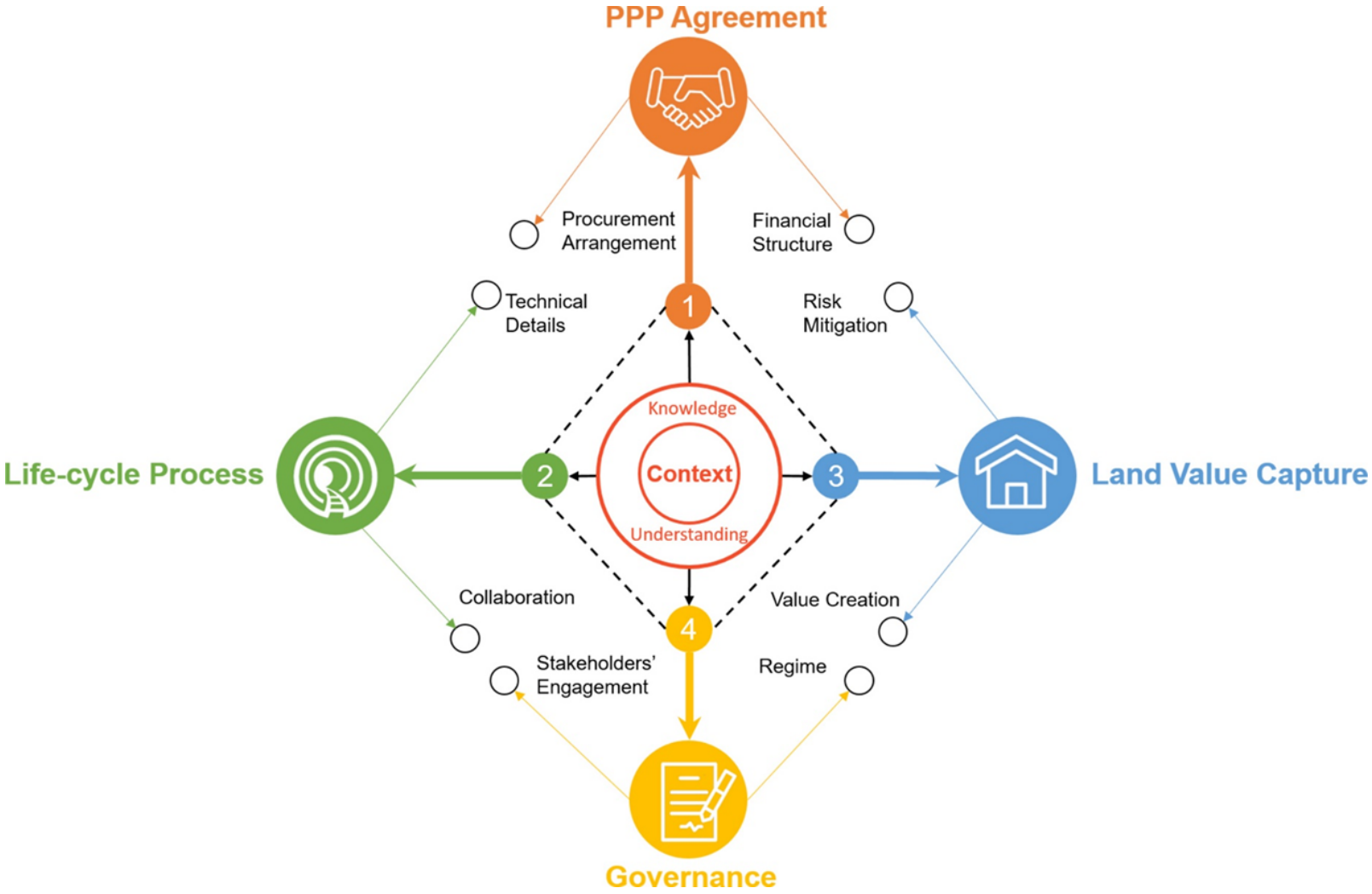


Figure 4.7 Conceptual model of URT PPP agreements with LVC

4.5.1 PPP Agreement: Procurement Forms and Financial Structure

There needs to be a drive to engender collaboration and cooperation between parties over a long period (e.g., up to 30 years) to provide high-quality service delivery and ensure value for money within a PPP. Maintaining a relationship over this period can be challenging (Hodge *et al.*, 2018). In making strides to manage PPPs better, Clifton and Duffield (2006) and Love *et al.* (2020a) have suggested that the concepts embedded with an alliance can be incorporated into its contract structure to engender collaboration. The integration of these concepts can provide a "flexible structure for the management of change" and a "mechanism for managing long-term outcomes while maintaining the original commercial intent" (Clifton and Duffield, 2006, p.582). The 'hands-on' approach of alliances, where the client "actively engages with and collaborates directly with the project design and delivery from the outset of the project tender", provides flexibility to change (Walker and Jacobsson, 2014, p.651).

A joint venture is another potential organisational form of PPP suitable for implementing LVC. In Hong Kong's MTR, the joint venture enabled effective transport and land use policy development that served the interests of the public and commercial developers. While the Hong Kong MTR has been a pioneer of LVC, it has also received extensive criticism from the public. For example, the MTR provision to provide social housing for low-income citizens is limited. This arrangement was censured as overly pursuing the property development's profit but neglecting the public interest (Wong, 2018; Aveline-Dubach and Blandeau, 2019).

The inadequate consideration of public interests was identified as a typical joint venture issue (Cruz and Marques, 2012; Cruz *et al.*, 2014). Thus, it is suggested that policymakers set clear economic and social goals for a joint venture and enact efficient and transparent monitoring processes to supervise its activities to improve this drawback. Issues that need to be considered when using LVC with a PPP are the following:

- *Financial structure*: A PPPs financial structure will balance its revenue and expenditure to ensure its viability throughout its life. Thus, the financial components and their relationships with the cash flows generated between the public and private sectors need to be considered. Grants for capital or operational expenditure, service payments, subsidies and any other potential provision of financing need to be borne in mind as they can contribute to the performance of the project (Power *et al.*, 2016; Rouhani *et al.*, 2016; Matos *et al.*, 2019).
- *Procurement arrangement*: Policymakers have a wide range of choices when using PPPs, which can be procured through various viands (e.g., strategy, project, modality, selection procedure and form) (Agra, 2017). An important viand for procuring URT systems with LVC relates to the procurement method (i.e., contract scope) of the PPP's components (Chang and Phang, 2017; Love *et al.*, 2021). Thus, the public sector (i.e., government entities) must decide whether their PPP's contract scope will *unbundle* or *bundle* its components. Here, the policymakers need to delineate the responsibilities, obligations, risks and rewards of parties in a contract and its scope (i.e., bundled and unbundled) (Pulido *et al.*, 2018). In light of the success of the MTR, when policymakers use LVC as a finance mechanism, then the PPP needs to be bundled.

A bundled procurement arrangement provides the SPV with the opportunity to seamlessly manage the flow of information throughout an asset's life cycle. This opportunity is enabled when digital technologies such as Building Information Modelling (BIM) and Systems Information Modelling (SIM) are deployed and used to support the asset management process (Love *et al.*, 2018).

4.5.2 Land Value Capture: Value Creation and Risk Mitigation

The main benefit of "LVC finance for transport investment is its flexibility in adapting a structure of incentives and risk-sharing to the features of a project, and the economic and institutional environment as a whole" (Medda, 2012, p.160). To this end, LVC can be embedded into a PPP agreement flexibly throughout an asset's life. However, due to its flexibility, it is challenging to develop a standardised approach that can provide a reliable profit model, which can be replicated across cities and countries (Medda,

2012; Suzuki *et al.*, 2015; Transport for London, 2017). Additionally, a series of factors (e.g., collaboration, stakeholder support and supportive planning strategy) have been identified to be as a frame of reference to help policymakers put into practice a development-based LVC strategy (Suzuki *et al.*, 2015; Salon *et al.*, 2017; Aveline–Dubach and Blandeau, 2019; Mathur and Gatdula, 2020). With this in mind, issues that policymakers need to consider when LVC is employed with PPP mainly are:

- *Value creation*: The success of LVC is dependent on land values increasing. Thus, strategies to stimulate land value creation must be deliberately developed (Department of Infrastructure and Regional Development, 2016; Salon *et al.*, 2017). Consequently, opportunities for increasing land values need to be explored at the stage of a project's development process (e.g., its scope, planning and execution). Accordingly, identifying, analysing and calculating the land value creation becomes a dynamic and continuous process of implementing an LVC mechanism (PwC, 2017b). Indeed, different types and terms of land/property can generate varying returns, which invariably change throughout the URT system's life. In the case of this conceptual framework, it is recommended to use the value creation strategy developed by the MTR, which focuses on generating objects with value, outcomes, benefits, activities and procedures over an asset's life.
- *Risk mitigation*: A transport infrastructure project cannot guarantee uplifts in land value. Consequently, there are risks associated with implementing LVC – it has the potential to fail (Transport for London, 2017). Various factors can impact variations in land value (e.g., type and term of land use, distance to stations, and quality of cadastral data and calculation methodologies) (Mohammad *et al.*, 2013; Sharma and Newman, 2018b; He, 2020). As a result, an ex-ante analysis of an LVC mechanism tends to be inaccurate (Blanco *et al.*, 2016). Thus, it is emphasised to acquire cheap land and use LVC across a rail network rather than an individual line to mitigate risk (Tang *et al.*, 2004; Transport for London, 2017).

Having in place a risk mitigation strategy is vital for ensuring the success of LVC in practice. The strategy should take a life-cycle perspective and embed it in the PPPs governance framework to minimise risks associated with LVC.

4.5.3 Life-Cycle Process: Technical Details and Collaboration

Delivering a URTs that is both adaptive and resilient is dependent on each phase of a project's life-cycle being performance managed to ensure sustainable outcomes are being achieved and the system can respond to change or sudden shocks (Liu *et al.*, 2015; Pulido *et al.*, 2018; Liu *et al.*, 2019). By taking a life-cycle perspective, policymakers should reduce whole-life cycle costs and maximise a project's economic and social benefits (European Comission, 2003; Medda, 2012). Two key areas that policymakers need to focus on projects:

- *Technical details*: A URTs needs to be designed, engineered, and constructed according to its technical specification to operate efficiently and effectively (The World Bank, 2017). A wealth of critical success factors has been identified as contributing to the delivery and operation of a PPP when combined with LVC, which centres around (Liu *et al.,* 2015; Suzuki *et al.*, 2015, The World Bank, 2017; Liu *et al.*, 2021): (1) an asset's technical ability; (2) continuous improvement for asset vulnerability; (3) private and public-sector input and capability; and (4) financial assurance. In light of the failure of the DAME, it is suggested that there is a need to focus on the asset's technical ability, particularly quality throughout its life. If the asset's quality is comprised, this will impact the level of service and ridership revenues and may affect the performance of the LVC.
- *Collaboration*: Needs to be engendered through the project's life to ensure PPPs are delivered effectively (Love and Gunasekaran, 1997; Cheng *et al.*, 2004; Liu *et al.*, 2015; Mathur, 2019). Indeed, the success of the MTR benefited from its broad collaboration with government and private developers (Tang *et al.*, 2004; Aveline-Dubach and Blandeau, 2019). Contrastingly, the DAME's LVC was thwarted by its ineffectual collaboration with the local land authority. Thus, various stakeholders (e.g., different institutions, governments, and private

developers) need to engender and enact collaboration relations when using LVC. To achieve this aim, as well as using an alliance to stimulate collaboration, it is suggested that an error management culture should be established to generate a learning climate where parties' learn through' their problems, particularly those related to quality, together (Cheng *et al.*, 2004; Love *et al.*, 2020b).

Collaboration is essential for learning. Knowledge creation can ensure the PPP implements a continuous improvement system that can be used to provide the system and network operates reliably and safely.

4.5.4 Governance: Stakeholder's Engagement and Regime

Governance comprises "all processes of governing, whether undertaken by a government, market, or network, whether over a family, tribe, formal or informal organisation, or territory, and whether through laws, norms, power, or language" (Bevir, 2012, p.1). Effective governance can help the public sector ensure accountability, responsibility, quality, and transparency for delivering public infrastructure (e.g., the URT system) (Mathur *et al.*, 2019; Sinha, 2021). Additionally, it can act as a normative framework for allowing stakeholders to acquire economic benefits when a URT is procured using a PPP with LVC (Suzuki *et al.*, 2015; The World Bank, 2017; Salon *et al.*, 2017; Xiong *et al.*, 2018). Thus, governance issues that have been identified as being important from the DAME and MTR and included in the conceptual model are:

- *Stakeholder engagement*: Creating and sharing value between all stakeholders can help cement collaboration (The World Bank, 2017; Mathur, 2019; Love *et al.*, 2020a). However, as can be seen from the DAME, conflicts materialised. Thus, in this conceptual framework, policymakers need to consider how they can be amicably resolved to not adversely impact decision-making and the project's performance (Medda, 2012; Panayides *et al.*, 2015; Chung and Hensher, 2018). In the case of Hyderabad (India), URT PPP covers three high-density traffic corridors of the city spanning over 72 kilometres (Hyderabad Metro Rail Limited, 2014). Its successful delivery was based, in part, on the ability of the public and

private sectors to work in unison and engage with the project's stakeholders (Suzuki *et al.*, 2015). It is suggested that stakeholders should be invited to join the SPV's board (Cohen and Boast, 2016). Consequently, information asymmetry between the SPV and stakeholders can be mitigated and therefore engender effective engagement with stakeholders.

- *Regime*: A systemic regime (e.g., incorporating legal, regulations, policies and political supports) is needed to support the risk mitigation strategy adopted to regulate the operation of a PPP and its interactions with LVC. A TOD policy, for example, has been identified as being able to increase the performance of LVC, even in car-dependent cities such as Perth in Australia (McIntosh *et al.*, 2014). However, the relationship between these institutional factors is complicated. They may support or oppose each other. For example, uplifting state stamp duty for LVC can decrease the reforming burden of local governments' existing tax system but tends to be opposed by the public (Infrastructure Australia, 2016). Thus, it is suggested to establish a regime that could coordinate and align institutional factors to improve the performance of using the LVC with PPPs.

As an ordered mode within a governance structure, regimes can enable stakeholders to systematically engage with the URT's project procurement. To this end, the initial conceptual framework (CF_1) for using LVC with PPPs to deliver URTs has been developed.

Notably, in the development process of CF_1, some common project governance issues (i.e., overly optimistic transit demand and aggressive bidding) have been identified in DAME and impair its performance. For this matter, the supplementary analysis of DAME's overly optimistic transit demand and aggressive bidding issues is provided in the next section.

4.6 Supplementary Analysis on Project Governance Issues of DAME

Section 4.3 presents that the financial losses of DAME were attributable to an overly optimistic assessment of LVC contribution (Council of States, 2013). The reason for the optimistic projection of LVC is that this prediction is developed with unreliable ridership data by the private sector (Sinha, 2015; The High Court of Delhi, 2019).

The questions here are why the ridership data is unreliable, how it influences the DAME's performance and why the private sector is willing to use these unreliable data to draft the bid? Addressing these project governance issues can provide a more holistic understanding of DAME and constitute an essential supplementary reference to identify whether similar problems exist in the remaining cases of this study.

4.6.1 Overly Optimistic Transit Demand Forecast

Transit demand forecasts are critical for URT systems since they provide the primary data input for planning and controlling their functional areas such as operations, marketing, and financing (Milenkovic and Bojovic, 2016). The transit demand forecast of DAME was projected based on two certain assumptions (The World Bank, 2012; Das, 2013; Sinha, 2015; Banerjee, 2017). That is:

1. *Hourly counts of passengers at the IGI Airport terminals*. This prediction was based on the airport's annual traffic and the likelihood of passengers using the rail line.
2. *Origin-destination surveys*. This investigation provided trip patterns and travel choices for departing and arriving air passengers who were asked where in Delhi their trip began and/or ended.

The DAME's transit demand was forecasted to be 42,500 passengers per day in 2011 and is expected to grow around 7.3% per year (Sinha, 2015). During the first 17 months in operation, the average ridership ranged between 5,344 and 17,994 passengers per day (Comptroller and Auditor General of India, 2013). So, why was the transit

demand's forecast overly optimistic? The issue of overly optimistic forecasts has been a subject of widespread debate in the transport literature (e.g., Sclar, 2001; Flyvbjerg *et al.*, 2005; Siemiatycki, 2009; Li and Hensher, 2010). However, issues such as optimism bias and strategic misrepresentation (i.e., lying) appear to be the main contributors (Flyvbjerg *et al.*, 2005). In the case of the DAME, however, the reasons for its optimistic transit demand forecast have not been officially investigated.

While there has been no investigation to explain the difference between the forecasted and actual transit demand, the history of URTs constructed in Delhi was examined to rationalise the discrepancy that materialised. Between 2006 and 2009, Delhi's Metro system's actual ridership level, on average, was 75% lower than its transit demand forecast (Tiwari, 2013). Here the Comptroller and Auditor General of India (2008) found that the transit demand models prepared by the Rail India Technical and Economic Service (RITES) [7] were flawed. Similarly, in the DAME case, the Comptroller and Auditor General of India (2013) revealed the justification underpinning RITES' models for the transit demand assumptions (e.g., hourly counts of passengers and origin-destination surveys) were again dubious. Drawing on the documentation available, the possible explanations for RITES's ambiguous transit demand forecasts include:

- *Overestimation of the air traffic at IGI Airports.* It was estimated that the air traffic at the IGI Airport would achieve 40 million in 2011-2012. Instead, the actual air traffic at the airport was less than 36 million in 2011-2012. It follows, therefore, that the shortfall in air traffic contributed to the lower ridership level of the DAME. (Infrastructure Development Department, 2008; Association of Private Airport Operators, 2011).
- *Delayed commercial projects located near IGI Airports.* 'Atrocity', a commercial development project near the IGI Airports, was anticipated to contribute to the volume of transit demand forecast. Its construction was delayed, negatively impacting DAME's passenger traffic (Das, 2013; Sunderasan, 2016; Banerjee, 2017).

[7] This is an engineering consultancy company specializing in the field of transport infrastructure and established in 1974 by the Government of India. It provided the detailed project report of the DAME, including transit demand forecast and financial advisory. Meanwhile, it also provided the transit demand forecast of the Delhi Metro (2006 - 2009).

- *Poor design and management of the line and station.* Gangwar and Raghuram (2015) suggested that the integration of the DAME line with the existing rail network was weak and thus may have contributed to the low ridership levels. Besides, passengers complained that it was difficult to access the line and transfer from stations to the airport terminals and felt unsafe travelling at night (Chakravartty, 2015); and
- *Significant defects in civil work.* Defects in civil work resulted in the line being closed for almost six months. When the DAME was re-opened, the line's speed was significantly reduced due to safety concerns. Meanwhile, fares were increased to recover losses in earnings from the line's temporary closure (JICA, 2013). This move resulted in complaints from commuters and contributed to ridership levels hovering around 10,000 people per day (Mail Today Reporter, 2013; The Economic Times, 2013).

The fare collection for the DAME's revenue overly depended on the ridership level. The project's actual ridership level was 60% lower than the transit demand forecast (Comptroller and Auditor General of India, 2013). The non-fare revenue also suffered (e.g., income generated from advertisements, vending machines, communications, retail, and LVC mechanism) (Raja *et al.*, 2012; Sunderasan, 2016; Banerjee, 2017). Moreover, the SPV could not collect its estimated revenue from its advertising due to the lower-than-expected ridership levels (ICRA, 2011; Dutta, 2012).

4.6.2 Aggressive Bidding

The overly optimistic transit demand forecast (i.e., 42,500 passengers per day) not only adversely influenced revenue but set the scene for an aggressive bidding process (Sinha, 2015). The DAME project was predicted to cost US$515.9 million and a 7.02% Financial Internal Rate of Return based on the forecasted transit demand. The DMRC solicited bids to select concessionaires. The selected SPV claimed that its bid was profoundly affected by the transit demand forecast (Delhi Airport Metro Express Pvt Ltd., 2011).

Basing a bid on an overly optimistic transit forecast can render it unreasonable and jeopardise the bidder's financial integrity (Guasch, 2004). Notably, however, the SPV's successful bid was the highest and more significant than that approved budget prepared by the RITES (Pratap, 2013; Sinha, 2015). While the SPV with the highest bid was successful, it also was prepared to commit to providing additional payments to the DMRC even though the next lowest bidder requested an interest-free loan of US$194.96 million for a more extended period or an annual subsidy of US$46.84 million.

As described above, expected fare and non-fare revenues were unable to be achieved, and the SPV experienced financial losses. The SPV terminated its contract with DMRC. However, during legal proceedings, the DMRC stated that the SPV had engaged in aggressive bidding (The High Court of Delhi, 2019). Evidence of this behaviour has been brought to the fore by multiple documents, which specifically identified the following:

- *No subsidy was requested during the bidding process*: This move increased the operating income risk of the DAME project. In fact, in India, a request for subsidies during the bidding process is considered a norm for rail PPPs (Swamy and Patel, 2014). For example, projects in Mumbai and Hyderabad requested subsidies from the government in the vicinity of 9% to 28% of the total capital cost to operating income risk and then ensure their revenue (JICA, 2013; Planning Commission, 2013).
- *An offer to provide payments to the DMRC (i.e., concession fees, revenue sharing and license fee).* While payments were identified as being significant, they could have increased due to the LVC mechanism (refer to Appendix F). In hindsight, providing payments harmed the DAME's financial viability. Drawing on DMRC's data from 23/02/2011 to 31/03/2013, the SPV only collected US$2.73 million in gross revenue but was required to provide US$10 million. As a result, the DAME experienced a net loss of US$7 million (Delhi Metro Rail Corporation Ltd., 2013, 2014).

Why did the SPV choose to adopt such an aggressive bidding strategy? Pratap (2013) provides a reasonable explanation and suggests that the SPV intended to win the project and then renegotiate their contract later. This strategy was proven to be the case as the SPV renegotiated with the DMRC to waive the commission fee and reconstruct the contract (The High Court of Delhi, 2019). Such aggressive forms of bidding have become a norm with transport PPPs in India. As of 2014, for example, more than half of 300 Indian highway PPPs were in financial distress and had requested renegotiations of their contracts (Guasch *et al.*, 2014).

Aggressive bidding may also occur as a result of the selection criteria adopted. Cruz and Marques (2013) identified that if criteria are weighted to selecting the lowest bid, an SPV is more likely to engage in aggressive bidding. In the DAME case, the public sector set the criteria for requesting a minimum subsidy and providing the highest concession fees to the DMRC (Appendix G).

4.7 Chapter Summary

This chapter reviews the extant literature and examines the antipodal experiences of the Hong Kong MTR and DAME and develops a conceptual framework that integrates for using LVC and PPPs that can assist policymakers with the procurement of their rail infrastructure. In addition, the supplementary analysis of DAME presents how the overly optimistic transit demand forecast and aggressive bidding impair its performance, which can be a reference case. The conceptual framework presented in this chapter provides a theoretical foundation for this research. Subsequent chapters will build on this framework and examine its relevance to the experience of three Chinese cities.

CHAPTER 5 THE CONCEPTUAL FRAMEWORK 2, 3, AND 4

5.1 Chapter Introduction

In Chapter 4, a conceptual framework (CF_1) is developed to assist policymakers in effectively using PPP and LVC to deliver URTs based on the antipodal experiences (i.e., success versus failure of PPP and LVC) of Hong Kong MTR and DAME. The CF_1, however, is derived from documentary sources and needs to be empirically tested and validated. This chapter will examine the applicability and feasibility of CF_1 in three selected cities in China (namely Guiyang, Guangzhou and Wuhan).

Each case study comprises three parts: (1) a brief description of the selected city, its URT development, and the use of PPP and LVC centring on rail infrastructure; (2) a description and analysis on the PPP, LVC, life-cycle process and governance dimensions of projects based on previous conceptual framework; and (3) an amendment of previous conceptual framework and development of new one.

The description and analysis of these three case studies depend on the information, comments, and opinions from the 27 semi-structured interviews between 2019 and 2021 and 70 publicly available and critical documentary sources between 2008 and 2021.

5.2 Recapitulation of Initial Conceptual Framework (CF_1)

The CF_1 encompasses "what goes right" (success) and "what goes wrong" (failure). It provides a broader context of PPPs and LVC and a robust reference point to examine the experience of integrating these two procurement strategies to deliver URTs in different cities. Table 5.1, derived from the CF_1 in Chapter 4, identifies four core dimensions that can influence the success and failure of a URT project delivered via a PPP and LVC.

Table 5.1 The initial CF_1

Dimension	Description	Critical issues	Core references
PPP agreement	Focusing on the core relationships and elements of the PPP contract, including its scope and financial structure	Procurement arrangement (i.e., contract scope) Financial structure	Clifton and Duffield (2006), Walker and Jacobsson (2014), Power *et al.* (2016), Rouhani *et al.* (2016), Pulio *et al.* (2018), Love *et al.* (2020a)
Land value capture	Emphasising LVC's implementation and mitigating risks	Value creation Risk mitigation	Tang *et al.* (2004), Medda (2012), Suzuki *et al.* (2015), Blanco *et al.* (2016), Department of Infrastructure and Regional Development (2016), Transport for London (2017), Salon *et al.* (2017)
Life-cycle process	Identifying the critical success factors needed to ensure a rail system healthy functioning well and its influence on the value on surrounding property and land	Technical details Collaboration	Love and Gunasekaran (1997), European Commission (2003), Cheng *et al.* (2004), Medda, (2012), Liu *et al.* (2015), The World Bank (2017), Pulido *et al.* (2018), Liu *et al.* (2019), Mathur (2019); Love *et al.* (2020b)
Governance	Focusing on accountability, control and the management of the URT, PPP and LVC, which contains the stakeholder engagement and regime	Stakeholder engagement Regime	Medda (2012), McIntosh *et al.* (2014), Panayides *et al.* (2015), Suzuki *et al.* (2015), The World Bank (2017), Chung and Hensher (2018), Mathur (2019)

5.3 Chinese Context

Over the last decade, China has significantly invested in constructing URTs in its major cities systems. From 2011 to 2019, China increased its investment in URTs from US$23.19 billion to $84.8 billion (CICC, 2021). By the end of 2019, forty cities had opened URT systems with 208 rail lines and 6736.2 kilometres (km) in length (Lin *et al.*, 2021). However, the expenditure needed to construct and operate these URTs places a significant financial burden on the Chinese and municipal governments (CICC, 2021). Thus, governments have begun to utilise PPI procurement approaches (e.g., PPP) and LVC to decrease their debts and deliver URT systems and networks (State Council of China, 2014a; Tan and Zhao, 2019).

5.3.1 PPP and LVC Policies

The Chinese government has developed a series of policies to limit the increase of local governments' debts, encourage the alternative financing mechanism for infrastructure development and regulate the application of PPPs for URTs. Table 5.2 presents the main policies that establish the scope and standards of PPP applications and their stakeholder's actions. As a result, there are 91 URT PPP projects with an appropriate US$ 186.6 billion in total have been registered in the public database by China's Ministry of Finance at the end of 2020 (CICC, 2021). Most of these projects have yet entered their operation stage.

In conjunction with a PPP procurement strategy, China's Central Government has developed dedicated policies to support the use of LVC to fund URTs since 2014[8] (Sun *et al.*, 2017; Wang *et al.*, 2019; Yang *et al.*, 2020b; Song *et al.*, 2021). These policies encourage the use of development-based LVC (Table 5.3). At the same time, local governments published policies to regulate further how the public and private sectors can use the development-based LVC and support the acquisition of land and the application of TOD around the rail stations (Table 5.4).

In particular, Table 5.5 take the "*Implementation Regulations for the Construction of Guangzhou Rail Transit Station Complex and the Comprehensive Development Land (Trial)"* as an example to illustrate how the local policies of Chinese city can support the use of LVC. This table presents the detailed clauses of Guangzhou's policy that support four critical aspects of using LVC. These critical aspects included establishing an intergovernmental collaboration framework, supporting the land acquisition, TOD and setting the transit agencies as the critical role in using development-based LVC.

As a result, the revenue of development-based LVC can be obtained from multiple sources, including property development, land sales, property rental and management (China Association of Metros, 2020b). The detailed definition and calculation of development-based LVC in China have been presented in Appendix H.

[8] The use of development-based LVC has been subjected to an array of institutional barriers (e.g., unsupportive planning regulation, limited opportunities, and ineffective governance), which has been removed gradually (Wang *et al.*, 2019; Song *et al.*, 2021).

Notably, not all the enterprises are eligible for applying the local government's policies to use development-based LVC with governmental support. According to the local government's policies (e.g., Guangzhou Government, 2017a), if the enterprise wants to apply the policies to acquire governmental support, it needs to invest in delivering rail projects in the local area. Even though the enterprise invested in delivering the rail projects, it did not mean that it could receive governmental support to use development-based LVC (Luan *et al.*, 2014). For example, policies of some cities (e.g., Guiyang) state that only transit agencies affiliated with and controlled by local government can receive governmental support to use LVC (Guiyang Government, 2015). Contrastingly, in other cities (e.g., Guangzhou and Wuhan), their policies do not state that only local government's transit agencies can support using LVC. However, these cities only provide governmental support to local government's transit agencies to use LVC (Sun *et al.*, 2017; Song *et al.*, 2021).

5.3.2 Centrally Administrated SOEs and Municipal Transit Agencies

Two types of State-owned enterprises (SOEs)[9] play critical roles in delivering URTs using a PPP (Xiong *et al.*, 2021):

- *Centrally administrated SOEs (CSOEs) affiliated with and controlled by China's Central Government.* The Chinese Central Government allows private enterprises and SOEs to invest in PPP projects (State Council of China, 2014b). PPPs agreements for URTs in China are subjected to competitive bidding (China Central Government Procurement, 2016). However, the CSOEs secure almost all of the projects it subjects a bid to deliver as they have a more robust financial capacity, lower profit expectations, extensive experience in infrastructure construction and closer relationships with municipal governments than private enterprises (de Jong, 2010; Tan and Zhao, 2019).
- *Municipal transit agencies are affiliated with and controlled by China's municipal governments*. It is often seen that municipal governments appoint their transit agencies who have experience delivering URTs to represent their interests

[9] According to the OECD (2015), an SOE is any corporate entity recognized by national law as an enterprise and in which the state exercises ownership. In China, an SOE refers to business entities established by central and local governments, and hose supervisory officials are from the government (OECD, 2009).

in an SPV and monitor a PPP project's delivery (Chang, 2013). Meanwhile, as mentioned in Section 5.3.1, the municipal transit agencies are usually the sole enterprises that can receive government support to use development-based LVC. They, therefore, perform a critical role in using development-based LVC and acquire significant revenue from this mechanism in each city. Table 5.6 presents the use of development-based LVC by municipal transit agencies of Guangzhou, Wuhan and Guiyang.

Table 5.2 The national policies on regulating PPP for URTs

Issue year	Policy	The relevant content	Source
2014	"Opinions of the State Council on Strengthening the Management of Local Governments' Debts" 《国务院关于加强地方政府性债务管理的意见》	Clause 2 Limit the capacity of local governments to own debts and support them in establishing partnerships with the societal capital organisations to provide public goods.	State Council of China (2014a)
2014	"Guiding Opinions of the State Council on Encouraging Societal Capital Organization* to Invest in Innovative and Key Fields" 《国务院关于创新重点领域投融资机制鼓励社会投资的指导意见》	Clause 15 Encourage the societal capital organisations to invest in URTs project	State Council of China (2014b)
2014	"Notice on Promoting the Use of Government and Societal Capital Organizations Models" 《关于推广运用政府和社会资本合作模式有关问题的通知》	Clause 3.2 Support the application of PPP delivery for procuring URT systems	Ministry of Finance (2014a)
2014	"Guidelines on the Operation of Public-Private Partnership (Trial)" 《关于政府和社会资本合作模式操作指南（试行）》	Standardise the delivery process of PPP projects' identification, preparation, procurement, and implementation; Require public sector should not take more than 50 per cent stake of the SPV	Ministry of Finance (2014b)
2015	"PPP Project Contract Guidelines (Trial)" 《PPP 项目合同指南（试行）》		Ministry of Finance (2015a)
2015	"Guidelines for Financial Viability of Public-Private Partnership" 《政府和社会资本合作项目财政承受能力论证指引》		Ministry of Finance (2015b)
2017	"Notice on Further Regulating the Debt Financing Behaviour of Local Governments" 《关于进一步规范地方政府举债融资行为的通知》	Regulate the public sector should not commit the financial return of PPP delivery	Ministry of Finance (2017)

2017	"Notice on Strengthening the Risk Management in PPP of Centrally Administered State-owned Enterprises (CSOEs) that are Administered by the Central Government" 《关于加强中央企业 PPP 业务风险管控的通知》	Regulating the CSOEs administered by the central government should significantly improve their management of PPP projects to decrease the financial risk.	State-owned Assets Supervision and Administration Commission (2017)
2018	"Opinions of the General Office of the State Council on Further Strengthening Urban Rail Transit Planning and Construction Management" 《国务院办公厅关于进一步加强城市轨道交通规划建设管理的意见》	Regulate that the public sector should fund 40 per cent of investment of URT project at least	State Council of China (2018)

* Societal capital organisations is the translation of 社会资本 (i.e., shehui ziben). The straightforward translation of shehui ziben is "Social Capital", which is different to the one that has been defined as "the structure of relations between actors and among actors" (Pretty and Ward, 2001, p.211). China is a country with the co-existence of private capitalists and entrepreneurs with the public and collective enterprise. Thus, the translation of "shehui ziben" is adapted from Xiong *et al.* (2021) as Societal Capital Organizations refers to that is not directly funded from the levels of government, including a foreign company, private firm and state-owned enterprise.

Table 5.3 The national policies on supporting development-based LVC

Issue year	Policy	The relevant content	Source
2014	"Opinions of the General Office of the State Council on Supporting Railway Construction and Implementing Comprehensive Land Development*." 《国务院办公厅关于支持铁路建设实施土地综合开发的意见》	Clause 3 "……Support rail transit agencies to revitalise construction land in various approaches, including property development, transfer, and lease; encourage transit agencies to implement comprehensive land development for existing stations and areas surrounding them; and facilitate entities that invest in rail to implement comprehensive land development for new stations and areas surrounding them to improve the capacity of raising funds and revenue of rail projects." 第三条"……支持铁路运输企业以自主开发、转让、租赁等多种方式盘活利用现有建设用地，鼓励铁路运输企业对既有铁路站场及毗邻地区实施土地综合开发，促进铁路建设投资等主体对新建铁路站场及毗邻地区实施土地综合开发，提高铁路建设项目的资金筹集能力和收益水平。"	State Council of China (2014c)
2014	"Guiding Opinions of the State Council on Encouraging Societal Capital Organization to Invest in Innovative and Key Fields" 《国务院关于创新重点领域投融资机制鼓励社会投资的指导意见》	Clause 15 "……Implement comprehensive land development around urban rail transit stations to attract societal capital organisations to participate in urban rail transit projects." 第十五条 "……对城市轨道交通站点周边、车辆段上盖进行土地综合开发，吸引社会资本参与城市轨道交通建设。"	State Council of China (2014b)
2015	"Notice of the National Development and Reform Commission on Strengthening Urban Rail Transit Planning and Construction Management" 《国家发展和改革委员会关于加强城市轨道交通规划建设管理的通知》	Chapter 3: Clause 2 "……Innovate the investment and financing mechanism, implement rail-oriented comprehensive land development, and attract societal capital organisation to participate in construction and operation through various approaches including franchising." 第三章第二条"……创新投融资体制，实施轨道交通导向型土地综合开发，吸引社会资本通过特许经营等多种形式参与建设和运营。"	National Development and Reform Commission (2015)

2018	"Opinions of the General Office of the State Council on Further Strengthening Urban Rail Transit Planning and Construction Management" 《国务院办公厅关于进一步加强城市轨道交通规划建设管理的意见》	Chapter 2: Clause 4 "……Encourage the exploration of the comprehensive land development toward the surface and underground spaces of urban rail transit, promote mixed land use, and improve the efficiency of land use." 第二章第四条"……鼓励探索城市轨道交通地上地下空间综合开发利用，推进建设用地多功能立体开发和复合利用，提高空间利用效率和节约集约用地水平。"	State Council of China (2018)

* Comprehensive land development is the translation of 土地综合开发 (i.e., tudi zonghe kaifa) refers to the approach of developing transport infrastructure with mixed land use (e.g., residential and commercial lands). They are in accord with the development-based LVC.

Table 5.4 Policies of local governments to support the use of development-based LVC

City	Issue Year	Policy	Establishing intergovernmental collaboration Framework	Supporting land acquisition	Setting the transit agencies as the critical role of using development-based LVC	Using TOD
Wuhan	2013*	"Opinions of Wuhan Municipality on Accelerating the Development of Rail Transit" "武汉市人民政府关于进一步加快轨道交通建设发展的意见"	●	●	●	
Shanghai	2014	"Implementation Opinions on Promoting the Comprehensive Land Development of Shanghai Rail Transit Stations/Depots and Surrounding Land (Trail)" "关于推进上海市轨道交通场站及周边土地综合开发利用的实施意见（暂行）"	●	●	●	●
Guiyang	2015	"Guiyang City Rail Transit Construction Management Regulation" "贵阳市城市轨道交通建设管理办法"		●	●	
Nanning	2016	"Nanning Urban Rail Transit Management Regulations" "南宁市城市轨道交通管理条例"		●	●	
Shijiazhuang	2017	"Shijiazhuang City Rail Transit Management Regulations" "石家庄市轨道交通管理条例"		●	●	
Lanzhou	2017	"Implementation Regulation of Lanzhou City Rail Transit State-owned Land Used as Investment Shares" "兰州市轨道交通周边国有土地使用权作价出资入股实施办法"		●	●	
Guangzhou	2017	"Implementation Regulation for the Construction of Guangzhou Rail Transit Station Complex and the Comprehensive Development Land (Trial)"	●	●	●	●

		“广州市轨道交通场站综合体建设及周边土地综合开发实施细则（试行）”					
Dongguan	2018	“Implementation Regulation for the Construction of Dongguan Rail Transit Station Complex and the Comprehensive Development Land (Trial)” “东莞市轨道交通站场周边土地综合开发及站场综合体建设实施细则”	●	●		●	●
Chengdu	2019	“Detailed Regulation for Comprehensive Land Development of Chengdu Rail Transit Stations” “成都市轨道交通场站综合开发实施细则” “Chengdu City Rail Transit Station Comprehensive Development Land Management Regulation (Trial)” “成都市轨道交通场站综合开发用地管理办法（试行）”	●	●		●	●
Xiamen	2019	“Xiamen Rail Transit Regulations” 《厦门经济特区轨道交通条例》		●		●	
Tianjin	2020	“Implementation Opinions on Promoting the Comprehensive Land Development and Utilisation of Tianjin Rail Transit Stations and Surrounding Land (Trial)” “关于推进天津市轨道交通场站及周边土地综合开发利用实施意见（试行）”	●	●	●		●

* Wuhan Government has published a series of policies to support the use of LVC since 2008 (Wuhan Government, 2008; Sun *et al.*, 2017). Here, the 2013 “Opinions of Wuhan Municipality on Accelerating the Development of Rail Transit” was selected as an example

Table 5.5 The illustration of Guangzhou's policy on supporting LVC for URT systems

Aspects	Clause in Chinse	Clause in English
Establishing intergovernmental collaboration framework	第五条“在广州铁路枢纽建设指挥部下设轨道交通场站综合体建设及周边土地综合开发工作协调小组（以下简称协调小组），负责轨道交通场站综合体建设及周边土地综合开发工作的政策研究、方案制订和综合协调。协调小组由市长担任组长，分管副市长担任副组长，成员单位包括市发展改革委、国土规划委、住房城乡建设委、交委、国资委、城市更新局、土地开发中心，各区政府、市属轨道交通投资建设主体等单位，办公室设在市发展改革委。”	Clause 5 “A coordination group for rail transit station complex construction and comprehensive land development* (after this referred to as the coordination group) will set up. It is responsible for policy, planning coordination of rail transit station construction and surrounding comprehensive land development. The Mayors act as the leader in the coordination group. The group members include the staff from the Municipal Development and Reform Commission, the Land Planning Commission, the Housing and Urban-Rural Development Commission, the Transportation Commission, the State-owned Assets Supervision and Administration Commission, the Urban Renewal Bureau, and the Land Development Centre, and Transit Agencies. The office will be set in the Municipal Development and Reform Commission.”
Supporting land acquisition	第二十一条“轨道交通场站综合体土地供应可结合地块实际，按照“一体规划、同步建设、统一供应”的思路，根据投资类别分为三种模式。（一）政府投资类。原则上适用于不具备综合开发条件的轨道交通场站……土地供应主要采用划拨方式。”	Clause 21: “The land supply of the rail transit station complex should be in accord with the condition of land parcels and follow the concept “integrated planning, simultaneous construction, and unified supply”. Three can be divided into three modes according to investment types.” Clause 21.1: “Government investment. In principle, it applies to rail transit stations that do not condition to process comprehensive land development……Land supply mainly approaches the government grant.”

	第二十一条（二）“运营企业投资类。原则上适用于具备局部开发条件的轨道交通场站。支持市属轨道交通投资建设主体采用统一规划、整体建设的模式，形成的国有资产委托市属轨道交通投资建设主体代为经营，相应收益弥补轨道交通项目运营亏损。土地供应采用协议出让、公开出让等方式。”	Clause 21.2: “Transit agencies investment. In principle, it is suitable for rail transit stations with comprehensive land development conditions. Support the transit agencies owned by municipalities adopt an integrated planning and overall construction model, which facilitates the transit investment using the corresponding income to make up for the rail project’s operating losses. The land supply adopts approaches such as government transfer and tender.
	第二十一条（三）“社会投资类。适用于具备较好开发条件的站点或车辆基地，采取带轨道交通站场综合体概念方案公开出让方式。出让方案须包括轨道交通设施建设。轨道交通投资建设主体对该类土地提出的开发时序、技术措施等涉及轨道交通设施保护和施工影响的要求，应当作为土地出让的必要条件。”	Clause 21.3: “Societal capital organisations investment**. It is suitable for stations that have good conditions for comprehensive land development. Land supply should adopt a tender approach with the conceptual plan of the rail transit station complex. The conceptual plan must include the construction of rail transit infrastructures. The requirements for protecting rail transit infrastructures, such as the time sequence of development and technical measures, shall be the necessary tender conditions. “
Setting the transit agencies as the critical role of using development-based LVC	第五条 （八）“市属轨道交通投资建设主体负责组织轨道交通场站综合体概念方案、周边土地综合开发规划方案的编制，开展用地选址；负责轨道交通场站综合体项目涉及的土地及房屋征收协调、规划设计方案编制及申报调整、项目报建等有关工作。”	Clause 5.1: “Transit agencies owned by municipalities are responsible for organising the conceptual plan for the rail transit station complex and the comprehensive land development plan and carrying out the land selection. Transit agencies are responsible for coordinating the land acquisition, planning and design, adjustment of land use, and project construction report.”
	第七条 “轨道交通场站周边土地综合开发规划应考虑轨道交通线网投资与周边土地综合开发收益的总体平衡。周边一级开发收益估算总额原则上大于或等于轨道交通线路投资总估算；轨道交通投资建设主体参与的二级开发收益估算应与站点投资建设和运营亏损规模匹配。”	Clause 7: “The rail transit station’s comprehensive land development plan should consider the overall balance of the rail transit network investment and its income. In principle, the total estimated income of land sales is greater than or equal to the total estimated investment in rail transit lines; the estimated property development income shall match the investment of station construction and operating losses of the rail project.”

Using TOD	第四条“本细则所称轨道交通场站周边土地综合开发，是应用 TOD 理论（Transit－Oriented Development，以公共交通为导向），在以轨道交通场站综合体为中心的 800 米（约 15 分钟步行路程）半径区域，建立集交通、商务、商业、文化、教育、居住为一体的城市功能区，通过大运量轨道交通系统（含国铁、城际轨道交通、城市轨道交通）引领城市发展，优化城市布局，实现社会效益和经济效益……轨道交通场站周边土地综合开发用地范围包括距离轨道交通场站综合体约 800 米范围、与轨道功能紧密关联的地区，具体范围可根据地形、现状用地条件、城市道路、河流水系、地块功能及用地完整性等实际情况划定。	Clause 4: “The comprehensive land development around rail transit stations should apply Transit-Oriented Development (TOD). In an 800m-catchment (appropriate 15-minutes walking distance) of rail stations shall establish an urban area that integrates transportation, business, culture, education, and residence and uses mass transit systems (including national railways, intercity rail transit, and urban rail transit) to lead urban development and optimise urban morphology and achieve social and economic benefits…… The scope for comprehensive land development surrounding the rail transit station includes an area about 800 meters away from the rail transit station complex and is closely related to transport function. The specific scope can be determined based on the terrain, land conditions, urban roads, river systems, and zoning.”

Table 5.6 The use of development-based LVC by municipal transit agencies of Guiyang, Guangzhou and Wuhan

Case	Municipal transit agency	Instruments of development-based LVC	Revenue of development-based LVC	2016	2017	2018	2019
Guiyang	Guiyang Metro Group Company	Land sales, joint development,	Revenue from land sales and property development (US$ million)	/**	41.31	24.25*	53.25
			Revenue from property rental and management (US$ million)	/**	/**		3.62
			The accumulated amount of the property and land being developed (10,000 square meters)	/**	126.85	132.85	45.9
			The accumulated amount of the commercial property that can be used for rental (10,000 square meters)	/**	/**	/**	/**
Guangzhou	Guangzhou Metro Group Company	Land sales, joint development	Revenue from land sales and property development (US$ million)	190.03	196.72	95.78*	358.98
			Revenue from property rental and management (US$ million)	12.77	23.96		47.99
			The accumulated amount of property and land developed (10,000 square meters)	/**	77.47	406.8	391.3
			The accumulated amount of the commercial property that can be used for rental (10,000 square meters)	/**	70.76	74.4	77.8
Wuhan	Wuhan Metro Group Company	Land sales (including land reserve strategy****), joint development	Revenue from land sales (US$ million) ***	180.19	1404.41	1102.84	790.31
			Revenue from property rental and management (US$ million)	7.92	8.36	/**	17.09
			The accumulated amount of the property and land that is developing (10,000 square meters)	/**	255.05	76.69	61.2
			The accumulated amount of the commercial property that can be used for rental (10,000 square meters)	/**	17.09	41.55	41.55

* China Association of Metros did not provide the separated revenue from land sales, property development, property rental and management but only presented their sum in 2018.
** The China Association of Metros did not present the data but reported that transit agencies had launched the activities in this regard.

*** The data in this row is based on the Wuhan Metro Group Company (2017, 2019). The reason is that the revenue data from land sales between China Association of Metros and Wuhan Metro Company has a significant difference. As Wuhan Metro Group Company (2017, 2019) is first-hand, the researcher presents them in the table. In particular, Wuhan Metro Group Company (2017, 2019) only report the revenue from land sales but indicate that this transit agency has engaged in property development.
**** The land reserve strategy is discussed by Sun *et al.* (2017). In essence, it is also akin to a land sale approach.

Adapted from China Association of Metros (2018; 2019a; 2019b; 2020a; 2020b; 2020c)

5.3.3 Implementation Procedure of PPP and LVC

Chinese governments have established a formal but lengthy procedure for all cities to implement their PPP projects (Zhang *et al.*, 2015). The typical PPP implementation comprises five stages (China Central Government Procurement[10], 2016):

1. Identify the potential project and perform technical feasibility analysis, the value of money assessment and municipal financial affordability.
2. Prepare and evaluate the implementation scheme, including the contract scope, risk allocation and financial structure.
3. Procure using competitive bidding and grant the agreement.
4. Establish the SPV and construct, operate and maintain the project.
5. Evaluate the project's performance and transfer the asset back to the municipal government.

Four common stages for implementing LVC in Chinese cities and relevant to Guiyang, Guangzhou and Wuhan cases also exist (Yang *et al.*, 2020b):

1. Develop the land sales/joint development (with a TOD strategy) plan based on prevailing policy, negotiate with the municipal governments and potential cooperative developers and estimate the investment and return of the project.
2. Acquire land.
3. Develop land/properties.
4. Collect revenue from LVC.

[10] China Central Government Procurement is an official website that is affiliated with China's Ministry of Finance. It publishes the official information on government procurement.

5.4 Case One: Guiyang – Conceptual Framework 2 (CF_2)

Guiyang is the capital of Guizhou province and is situated in Southwestern China. By the end of 2019, its population was estimated to be five million, and Gross Domestic Product (GDP) per capita was US$10,000.

In 2009, the Guiyang Government established and subsidised the Guiyang URT Company (i.e., municipal transit agency) to deliver its URT systems. Construction commenced on the No.1 Line in 2013, and it opened in December 2017. By the end of 2019, the daily average ridership was approximately 130,000.

In 2016 and 2017, the Guiyang Government initiated two PPP projects to procure phases one and two of No. 2 Line separately. In May of 2021, phase one and two of No.2 Line entered their operation stages and are supported by land sales and joint development approaches.

5.4.1 PPP Agreement

Phase one of No. 2 Line is 27.6 km, with an investment of US$2.77 billion. It is delivered by a bundled 30-year PPP agreement (i.e., the BOT model). The CSOEs and Guiyang Company jointly formed the SPV, holding 57.28% and 42.72 % of the stake in the project, respectively (Guiyang URT Company, 2015).

In the case of phase two of No. 2 Line, it is 13 kilometres in length, with an investment of US$1.08 billion being made. It is being delivered using a bundled 29-year PPP agreement (i.e., the BOT model) granted to a consortium. Again, the CSOEs and Guiyang URT Company jointly constitute the SPV, holding 54.18% and 45.82% of the stake in the project, respectively (Guiyang Transportation Commission, 2016).

Phase one and two of No.2 Line's PPP agreements did not include the development-based LVC (Guiyang URT Company, 2015; Guiyang Transportation Commission, 2016), underpinned by two reasons. The first is that the Guiyang Government did not consider putting development-based LVC into the PPP agreement. During an interview, a senior manager from the Guiyang URT Company stated that:

> "We [Guiyang Government and Guiyang URT Company] reckon that the PPP and LVC are two different pathways to support the delivery of URTs. We have not considered integrating them [PPP and LVC] into one contract."

Another reason why development-based LVC is hard to include in a PPP agreement relates to government support. Essentially, the Guiyang Government can directly transfer land around the station at a far lower price than the market value to the Guiyang URT Company (Guiyang Government, 2015). For example, it was able to acquire land, which had a market value of US$3.45 billion from the municipal government at a significantly lower price (Haitong Securities Company Limited, 2015). Thus, the Guiyang URT company can use this land that is acquired at a low price to conduct the development-based LVC.

However, according to Guiyang's policy, an SPV cannot receive government support to use development-based LVC (Guiyang Government, 2015). Due to this restriction, the SPV needs to undertake a high cost of acquiring land to use the development-based LVC so that it tends to exclude this mechanism from the PPP agreement. A financial expert who is familiar with rail infrastructure procurement in Guiyang explained:

> "The Guiyang URT Company can receive the governmental support to use LVC, which is based on Guiyang's policy [Guiyang Government, 2015]. However, according to this policy, the SPV cannot receive governmental support. If SPV wants to use development base LVC [to put it into the PPP agreement], it needs to acquire land through competitive bidding [without governmental support]. In doing so, acquiring land will be much more expensive than getting it with governmental support. So, the cost of using the development-based LVC for SPV is much higher than Guiyang URT Company's….."

Even though the PPP agreements of Line No.2 exclude development-based LVC, indirect financial support is provided by the Guiyang Government and Guiyang URT Company. Figure 5.1 depicts the relationship between the SPV, Guiyang URT Company and Guiyang Government under the PPP and development-based LVC. Indeed, there is an indirect financial relationship between these three institutions. Guiyang URT Company can collect revenue from development-based LVC across Line No.2 to reduce reliance on the Guiyang Government fund. Thereby, Guiyang Government can have better financial health to ensure subsidy to SPVs of No. Line 2 or even future URT PPP projects.

5.4.2 Land Value Capture

The Guiyang URT Company, as mentioned in Section 5.4.1, can receive government support to acquire land that is used for development-based LVC at a low price. In conjunction with this cost decrease strategy, the Guiyang URT Company also use the value creation approaches by using the TOD strategy (e.g., mixed land use, high density, and convenient accessibility) with its property development projects. For example, the Guiyang URT Company constructed a real estate project covering 43,850 m^2. It included apartments, retails, and a car park, which has been built around the Sanqiao stations of the No.2 Line since 2021 (Guiyang Public Resource Trading Centre, 2021).

Additionally, the Guiyang URT Company has used risk mitigation strategies to improve the effectiveness of its development-based LVC. For example, multiple property development projects around stations on the No.2 Line have been undertaken to diversify risks (Guiyang URT Company, 2019). Notably, the Guiyang URT Company shared the capital expenditure of the development projects with the developers to reduce the financial risk of deploying LVC (CCXI, 2020b).

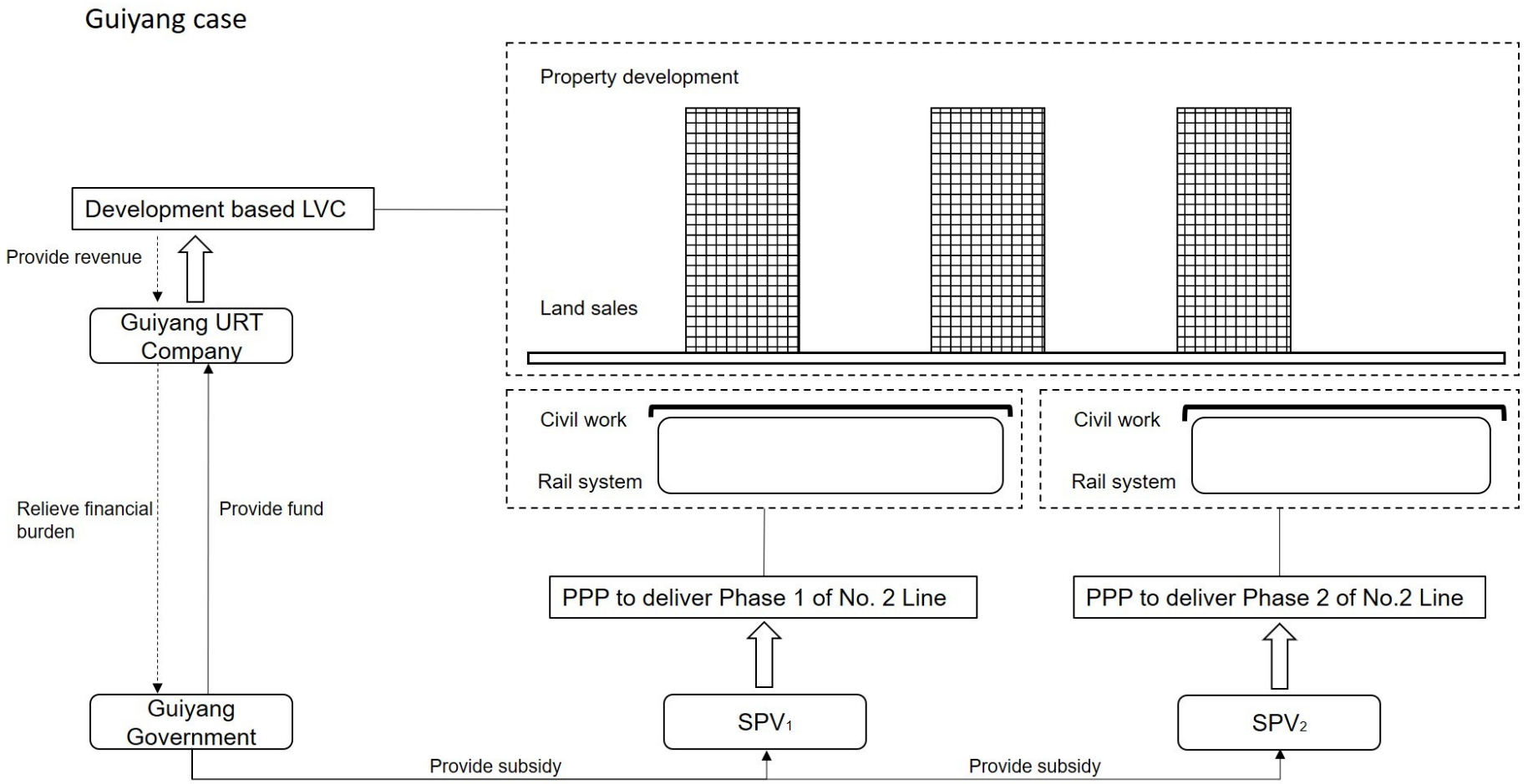


Figure 5.1 Relationships between SPV, municipal transit agency and municipal government under PPP and LVC in Guiyang

5.4.3 Life-Cycle Process

In the process of URT delivery and using development-based LVC, a critical component is land acquisition. A senior manager from the Guiyang URT Company especially emphasised this point:

> ".....Land acquisition is essential to the URT delivery and use of development-based LVC. The cost of land acquisition accounts for a significant proportion of the total investment of these projects…... If acquiring land process is not going well, its schedule is easy to be delayed, and its cost tends to increase greatly....."

The land acquisition, therefore, can, at times, result in delays and high costs for the construction of URT and the use of development-based LVC (Hayashi *et al.*, 1989; Liu *et al.*, 2021; Sinha, 2021).

Aware of these problems resulting from the land acquisition, the Guiyang URT Company required transport engineers to minimise its need while planning the route for the No.2 Line and its surrounding stations (Guiyang URT Company, 2016). Additionally, the delivery of No. 2 Line relies on the effective collaboration between Guiyang URT Company and Departments of Economics, Finance, Land and Planning, and Transport affiliated with the municipal government through an executive committee. The executive committee is established based on an intergovernmental framework[11] and comprises representatives from the institutions mentioned earlier. When the executive committee meets, representatives can efficiently communicate their interests, concerns (e.g., financial budget) and collectively facilitate the project's implementation (Guiyang Daily, 2016).

[11] It is noted worth that the intergovernmental collaboration framework in Guangzhou and Wuhan is established for all PPP delivery. But in Guiyang, the intergovernmental collaboration framework was specialized for URT PPPs.

5.4.4 Governance

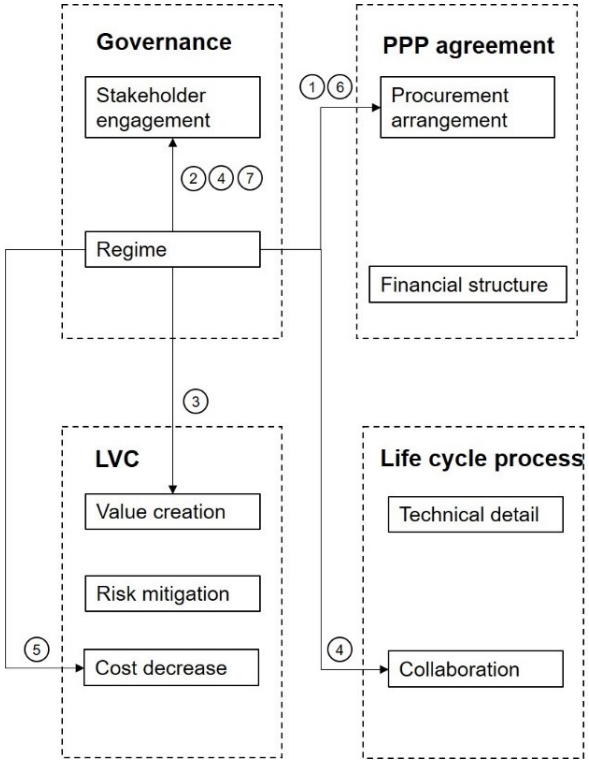
Stakeholder engagement is a crucial function of the project's governance. It stimulates collaboration between residents and the Guiyang URT company, municipal government. The Guiyang Government implements the following stakeholder engagement strategies to enable Line No.2 to be delivered effectively by:

- Establishing an executive committee based on an intergovernmental framework, as mentioned in Section 5.4.3, to improve the collaboration between its departments and the Guiyang URT Company;
- Arranging for Guiyang URT Company to hold the equity in the SPVs and form a part of the board of directors so they can effectively communicate with CSOEs and monitor the decision-making process of the project; and
- Publishing land acquisition and housing demolition scheme. The scheme assists citizens in identifying the scope, compensation standard and related regulations of land acquisition and timely provide their feedbacks (e.g., needs, opinion and doubt) to Guiyang Government (Nanming District Government, 2015).

Finally, it is identified that the systemic regime is a core aspect of governance and supports the strategies in PPP, LVC, and life cycle process dimensions, which provide the foundation to deliver projects effectively. Nearly all the respondents in the Guiyang case shared similar views regarding the project's governance. Reinforcing this point, a senior manager from the Guiyang URT Company stated:

> "…...All the actions [of PPP and LVC] need to be carried out under the relevant policy's guidance and permission [refer to a variety of central and local governments' policies (e.g., policies have been shown in Table 5.2, 5.3, and 5.4)] ……."

Figure 5.2 provides an overview of the relationship between the systemic regimes and the regulatory strategies contributing to the Guiyang cases.



Number	Policies and strategies	Publication Year	Content	Reflection in Guiyang cases
1	"Opinions of the State Council on Strengthening the Management of Local Governments' Debts"《国务院关于加强地方政府性债务管理的意见》	2014	Limit the financial capacity of local government	The municipal government adopt the PPP delivery for URTs
2	"Guideline of PPP agreement (Trial)" 《PPP项目合同指南（试行）》	2014	The local government can assign a enterprise as its representation in SPV	The municipal government assign municipal transit agency to hold stake of SPV
3	"Guiyang City Rail Transit Construction Management Regulation" "贵阳市城市轨道交通建设管理办法"	2015	The local government can provide support to the transit agency	The municipal transit agency can acquire land at a low price
4	"Notice on Establishing Guiyang Urban Rail Transit PPP Project Traffic Leading Group" 成立贵阳市城市轨道交通PPP项目化运作工作领导小组的通知."	2017	Impel departments of government and transit agencies to have meetings to share information, resolve conflicts and design the specific task	Establish an intergovernmental framework to promote collaboration between municipal government and transit agency
5	"City Complex project with Urban Rail Transit" 城市轨道交通综合体项目	2020	a TOD strategy (e.g., mixed land use, high density, and convenient accessibility)	The property development projects near the station that has residential and commercial with high density
6	"Property Law" 物权法	2007	Land for industrial use, commerce, tourism, amusement and commercial housing, as well as mixed use, should be transferred through bidding, auction or listing	The SPV need to take part in the competitive bidding to acquire land
7	"Regulations on Expropriation and Compensation of Houses on State-owned Land" 国有土地上房屋征收与补偿条例	2011	Standard of land acquisition	Develop demolition scheme to engage the citizen

Figure 5.2 The relationship between systemic regimes and regulatory strategies

5.4.5 Development of Conceptual Framework 2 (CF_2)

In sum, the Guiyang case validates CF_1, but specific aspects within the context required consideration with additional features being identified and the dimension of LVC needed to consider new issues. Therefore, the Guiyang case is used to create CF_2 and presented in Figure 5.3.

The context in CF_2 identifies the PPP and LVC policies that shape the project's processes, actors, and components. In relation to this, the municipal transit agencies, as the key actor of the project, are involved throughout the delivery of URT PPP with LVC. At the same time, land acquisition as the component of the implementation procedure is critical to each dimension of the project. It has been identified that no matter in preparing a PPP agreement, using LVC, reducing the cost across a project's life-cycle process and improving governance, the land acquisition has been paid much attention. Thus, specific aspects within context (i.e., PPP and LVC policies, municipal transit agencies and land acquisition in implementation procedure) are identified. These particular aspects constitute the URT systems' backdrop and influence the project's PPP agreement, LVC, life-cycle process and governance dimensions.

The LVC dimension of CF_2 also identifies that the decrease in the cost of this mechanism's components is essential to its success for URT PPPs. For example, the cost of land acquisition often accounts for a significant proportion of use development-based LVC (Suzuki *et al.*, 2015). As a result, decreasing the cost of land acquisition can bring twofold benefits to the use of development-based LVC. In one aspect, the low cost of land acquisition reduces the financial risk of using development-based LVC. In another aspect, under the same level of revenue collected from the development-based LVC, the lower cost of land acquisition implies more profit from using this mechanism. Based on these two aspects, decreasing the cost of land acquisition can contribute to the use of LVC and then support the URT PPPs.

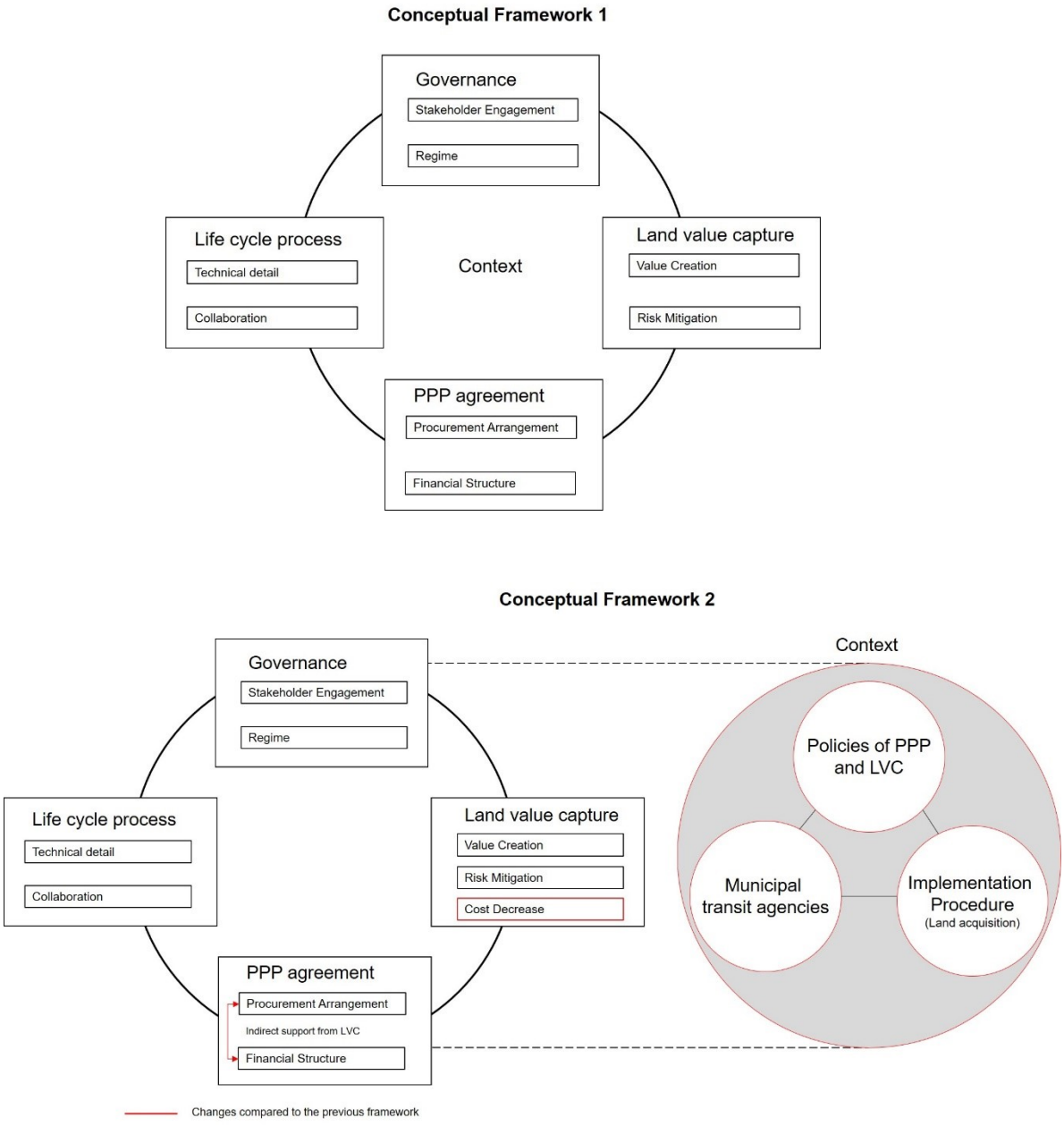


Figure 5.3 The conceptual framework (CF_2) from the Guiyang case

5.5 Case Two: Guangzhou– Conceptual Framework 3 (CF_3)

Guangzhou is the capital of Guangdong province and is situated in South-eastern China. In 2019, the population of Guangzhou exceeded 15 million, and its GDP per capita was approximately US$22,000. Guangzhou Government established and subsidised the Guangzhou Metro Group Company (i.e., municipal transit agency) in 1992 to deliver the city's URT. The Guangzhou Metro Group Company opened its first line in 1997. It has been operating the URT systems with a length of 489 kilometres and over-9-million daily average ridership by the end of 2019 (Salon *et al.*, 2014; China Association of Metros, 2020a).

Until mid-2021, the Guangzhou Government had used PPPs with development-based LVC to procure its URTs (i.e., No.11 Line) with an underground utility tunnel and two intercity rail stations (China Public-Private Partnerships Centre, 2021). An examination of LVC to support the intercity rail projects is beyond the scope of municipal governance (Li *et al.*, 2013) and is not aligned with the Guiyang and Wuhan case. Thus, in this instance, this research focuses on using development-based LVC for the 43.4-km No. 11 line and the PPPs for its 48-km underground utility tunnel as they sit under the same municipal governance structure (Guangzhou Road Engineering Research Centre, 2016; Guangzhou Government, 2017a; Wang *et al.*, 2018). Figure 5.4 illustrates the relationships between the Guangzhou Metro Group Company, Guangzhou Government and SPV procured No.11 Line and the underground utility tunnel PPP with development-based LVC.

5.5.1 PPP Agreement

The civil work of No.11 Line, with the investment of US$3.03 billion, is delivered using an Engineering-Procurement-Construction (EPC) method, which the CSOEs were awarded in 2016 (China Railway Group Limited, 2016). In the case of the underground utility tunnel of No.11 Line, with the investment of US$1.07 billion, it is being delivered with bundled 30-year PPP agreement (i.e., BOT model) granted to a consortium formed by the same CSOEs. These CSOEs and the Guangzhou Metro Group Company subsidiary jointly form the SPV, holding 66 % and 34 % stake in the project, respectively.

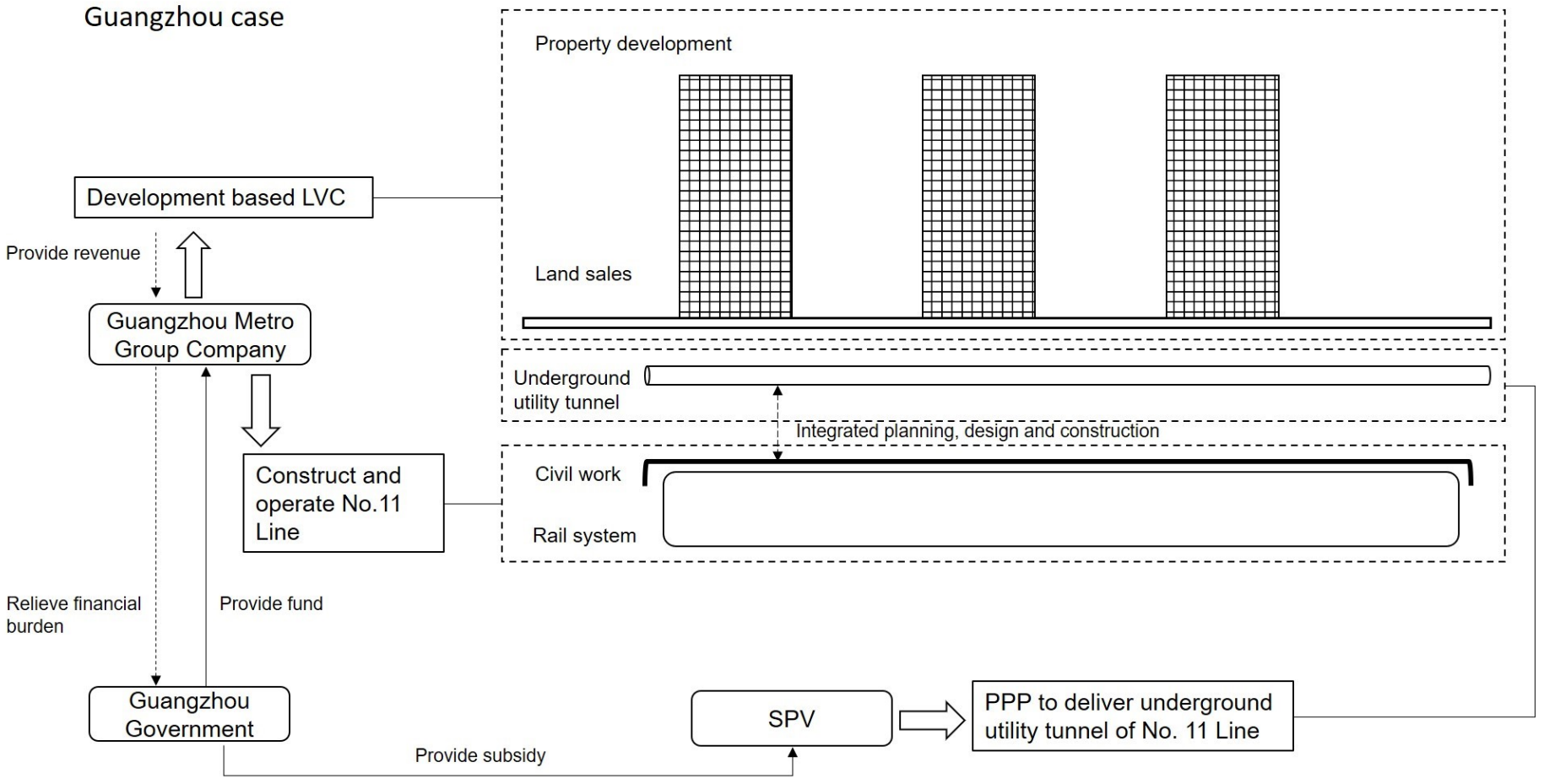


Figure 5.4 Relationships between No. 11 Line and its underground utility tunnel PPP with development-based LVC

No.11 Line's underground utility tunnel PPP omitted development-based LVC in agreement. The reasons for this omission are twofold and akin to the Guiyang case. Firstly, the Guangzhou Government did not consider including development-based LVC into its PPP agreement. During an interview with the financial expert from the Guangzhou URT Metro Group, the following comment was made:

> "Generally, we [Guangzhou Government Guangzhou URT Metro Group] will consider two types of PPP agreement. The first is to use PPP to procure partly components (e.g., civil work) of URTs……The second is to use PPP to procure whole URT systems……So far [2019], we [Guangzhou Government Guangzhou URT Metro Group] have not considered putting development-based LVC into PPP agreement….."

And secondly, the SPV cannot receive government support to decrease the cost of land acquisition in the use of LVC. In the case of Guangzhou, the municipal government can request tenders for the land surrounding stations, with a particular condition requiring the bidders to have experience in delivering URT in areas such as providing finance, construction, and managing operations and maintenance (Song *et al.*, 2021). Thus, the Guangzhou Government can help the specific bidders acquire the land at a low price. However, the Guangzhou Government only applied this approach to the Guangzhou Metro Group Company rather than the SPV before 2017[12] (Guangzhou Government, 2017a; Guangzhou Road Engineering Research Centre, 2016; Song *et al.*, 2021). As a result, if the SPV wants to use development-based LVC, it should acquire land at a high price, which increases the cost of using this mechanism.

Similar to the Guiyang case, the financial structure in the contract of No. 11's underground utility tunnel did not receive revenue from development-based LVC. However, the whole PPP project received indirect support from development-based LVC from the Guangzhou Government and the Guangzhou Metro Group Company (Figure 5.4). The Guangzhou Metro Group Company collected revenue from development-based LVC to ensure its financial viability. Accordingly, the Guangzhou

[12] After 2017, it was identified that two intercity rail stations PPP that are not under municipal governance had been applied to this approach to acquire land at a low price (China Public-Private Partnerships Centre, 2021).

Government can reduce its financial support [13] to Guangzhou Metro Group and subsidise the PPP's delivery.

5.5.2 Land Value Capture

Guangzhou has a long history of using the development-based LVC to support its URT systems. In 1992, the Guangzhou Government appointed the Guangzhou Metro Group Company to explore how an LVC strategy could support a URT (The World Union Properties Consultant, 2017). Since its appointment, the Guangzhou Metro Group Company has acquired revenue from land sales and property development (e.g., joint developments) and by operating the rail network (Guangzhou Government, 2012; Pan and Wang, 2019; Guangzhou Metro Group Company, 2020). In 2013, the Guangzhou Government introduced new regulations, which stated that the Guangzhou Metro Group Company would not play a leading role in selling land along the route of its rail network (Guangzhou Metro Group Company, 2014). As a result, the Guangzhou Metro Group Company reduced its activities in land sales and increased property development projects (e.g., residential and commercial real estate) around railway stations (CCXI, 2020a; Guangzhou Metro Group Company, 2020). Since the introduction of its 2013 regulations, the Guangzhou government has developed detailed policies to normalise and improve the use of LVC in its URT projects by introducing its implementation rules for constructing and developing land surrounding stations in 2017.

Since then, it has been identified that Guangzhou Metro Group Company has used cost decrease, value creation and risk mitigation strategies to effectively use development-based LVC. As mentioned in Section 5.5.1, the cost decrease is that the Guangzhou Government can provide Guangzhou Metro Group Company with low-price land by requesting tenders with particular conditions (Song *et al.*, 2021). With such government support, for example, the Guangzhou Metro Group Company acquired land that is more than 2.1 hectares and around a station of No. 11 Metro Line for property development with the lowest bidding price of US$1.17 billion in February 2021 (Guangzhou Municipal Planning and Natural Resource Bureau, 2021).

[13] From 2011 to 2021, the Guangzhou Government provide financial support of $ 23 billion (Department of Finance,2021)

In addition, the value creation and risk mitigation strategies used in the Guangzhou case is similar to the one used in the Guiyang case (Section 5.4.2).

5.5.3 Life-Cycle Process

Delivering Line No.11 with its underground utility tunnel and surrounding property development is complex. For this matter, the Guangzhou URT Metro Company developed a strategy to seamlessly integrate project management (including design, building, finance, operation and maintenance) of this URT systems and property development processes, particularly to enhance its safety requirements. In addition, akin to the Guiyang case, Line No.11, with its underground utility tunnel and surrounding property developments, was designed and planned to minimise the need for land acquisition (Guangzhou Government, 2017b; Guangzhou Road Engineering Research Centre, 2018).

While the project had been planned and designed to improve its life cycle performance, inadequate preparation before its bidding had an adverse impact on its execution. In August 2016, the bidding of the No. 11 Line's underground utility tunnel was undertaken, and the winning price was US$868 million. This bidding price is based on the PPP's project proposal[14] (Guangzhou Road Engineering Research Centre, 2016). The project proposal in China usually included a preliminary feasibility study that would provide a rough budget estimate (Shanghai Municipal Development and Reform Commission, 2020). However, the budget estimate drawn upon from the project proposal can be inaccurate as it is usually based on incomplete information and may result in underestimating the project's costs. In 2018, the Guangzhou Government and SPV conducted a detailed feasibility study that added an extra investment of US$203.92 million (nearly a 23% increase from the price of the winning bid). An increase in the price of materials and labour and unexpected sites (e.g., geotechnical) conditions were key factors contributing to the project's cost increase (Guangzhou Road Engineering Research Centre, 2018).

[14] The project proposal of No. 11 Line's underground utility tunnel PPP was approved by Guangzhou Government.

There has been no investigation to explain why the preparation of this project's documents is inadequate. However, a reason for it appears to be the tight time frame toward the preparation of PPP's documents before its bidding. To meet the tight time frame, the consultants and engineers may reduce the scope and quality of the project's documents and result in inaccurate cost estimation (Zou *et al.*, 2007; Ding and Xu, 2017).

The tight time frame of No.11 Line's underground utility tunnel PPP and its pressure on stakeholders have been supported by a consultant who is familiar with this project in the interview:

> "In 2016, the project [No.11 Line's underground utility tunnel PPP] was prepared on a very tight time constraint. They [Guangzhou Government and Guangzhou Metro URT Group] had to prepare the project's documents [e.g., project proposal] as quickly as possible ……."

Moreover, a formal statement by the Department of Building and Housing affiliated with the Guangzhou Government confirmed that the time frame of this project is tight (Department of Building and Housing, 2016):

> "The Central Government has selected our city [Guangzhou] into the pilot scheme[15] to implement the underground utility tunnel project. As part of this pilot scheme, delivering the No.11 Line's underground utility tunnel project is our city's promise to the Central Government. This project thus must commence its construction before the end of October this year [2016]. The time frame of this project is extremely tight. (p.1).
> 轨道交通十一号线地下综合管廊是我市作为国家地下综合管廊试点城市向国家所作承诺的示范项目， 须在今年 10 月底前开工，工期异常紧迫。" (-1-)"

[15] The pilot scheme for delivering underground utility tunnel projects was launched by the Central Government's Housing and Urban-Rural Development. If a city was successfully selected in this pilot scheme, it would receive at least US$170 million in three years from China's Central Government (Xinhua, 2015; Housing and Urban-Rural Development, 2016).

5.5.4 Governance

Like the Guiyang case, the Guangzhou Government uses the same stakeholder engagement strategies to ensure the project is delivered efficiently and free from public opposition (Tianhe District Government, 2018). Its systemic regime also supports the PPP agreement selection, the LVC life-cycle process, and other strategies in governance dimensions.

However, an overly optimistic estimate on schedule seemed to exist in the governance of this PPP project and impair its quality. According to the schedule in the detailed feasibility report of No. 11 Line's underground utility tunnel, it is required that the examination and approval of the project proposal should be achieved between January and May 2016 (Guangzhou Road Engineering Research Centre, 2018). Estimating five months can achieve the examination and approval of a project proposal that is with the investment of US$1.07 billion tends to be overly optimistic. As a result, the time frame of this PPP project was too tight to prepare the documents (e.g., project proposal) well, which made the budget estimate inaccurate and the project's costs exceeded expectations later.

5.5.5 Development of Conceptual Framework 3 (CF_3)

The Guangzhou case validates CF_2 and transforms it into the CF_3 with the consideration of the overly optimistic estimate being included in the governance dimension (Figure 5.5). The overly optimistic estimate on schedule, in this case, had resulted in a project's tight time frame. The tight time frame of the project may give rise to its inadequate preparation of documents that leads to an inaccurate cost forecast. Therefore, the CF_3 suggests using effective project governance strategies to mitigate overly optimistic estimates. These strategies, for example, can include increasing the completeness and rigour of early plans and enhancing information sharing (Siemiatycki, 2009).

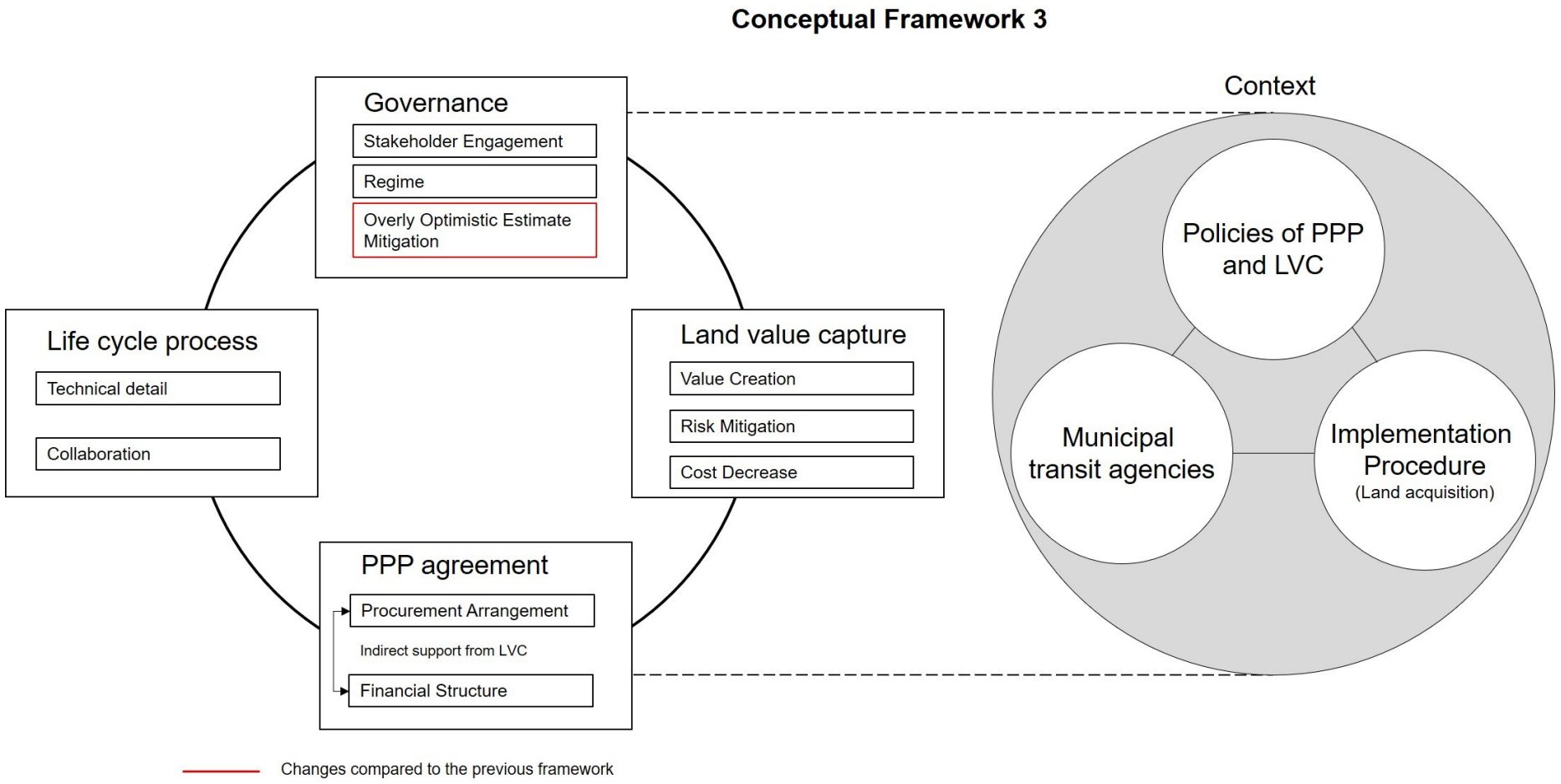


Figure 5.5 The conceptual framework (CF_3) from the Guangzhou case

5.6 Case Three: Wuhan– Conceptual Framework 4 (CF_4)

Wuhan is the capital of Hubei province and sits in central China. By the end of 2019, its population was approximately 11 million, and its GDP per capita was almost US$20,000. The Wuhan Government established and subsidised the Wuhan Metro Group Company (i.e., municipal transit agency) to construct and operate its URTs in 2000. In the same year, it started the construction of Wuhan's URTs and opened the first line was completed in 2004 (Sun *et al.*, 2107). By the end of 2019, the length of Wuhan's URT was 339 kilometres in length, and its ridership was approximately 3.4 million per day. In 2020, the Wuhan Government decided to deliver its No.12 Line length of 59.8 kilometres using an unbundled PPP agreement, receiving indirect support from development-based LVC (Wuhan Metro Group Company, 2020; Wuhan Natural Resources and Planning Bureau, 2020).

5.6.1 PPP Agreement

The unbundled PPP agreement is comprised of two parts. Part A is a 30-year BOT contract with an investment of US$4.52 billion, including No. 12 Line's most of civil work and operation. Part B includes the No. 12 Line's signal system and partly civil work that is related to the use of development-based LVC, which needs an investment of US$2.79 billion. The Wuhan Government awarded Part A to a consortium involving CSOEs to establish an SPV with Wuhan Metro Group Company jointly. The Wuhan Metro Group Company was required to be responsible for Part B and then lease signal systems at the price of US$1425 per year to SPV for ensuring it could operate the whole No.12 Line. Figure 5.6 presents the structure of No. 12 Line PPP and its relationship with the LVC.

The CSOEs and Wuhan Government selected to use an unbundled PPP agreement to procure their URTs due to new regulations being issued by China's Central Government. China's Central Governments aimed to use these new regulations to mitigate the financial risk of municipal government and CSOEs. In 2017, the Central Government required CSOEs to improve the management of their PPP projects' financial risk (State-owned Assets Supervision and Administration Commission, 2017). Since 2018, China's Central Government has further required municipal governments to use their fiscal revenue rather than borrow from the financial market

to fund at least 40% of a URT line's CAPEX to minimise debt and better manage financial risks (State Council of China, 2018).

These new regulations make selecting the unbundled contract appropriate to CSOEs and Wuhan Government. For CSOEs, the unbundled contract only requires its investment in Part A of No. 12 Line through PPP rather than the whole URT system, which reduces their financial risk. In the case of the Wuhan Government, it also benefits from the unbundled contract. The reason is that the unbundled contract can help Wuhan Government save the funds to deliver rail infrastructure as it can attract CSOEs to invest in Part A on No. 12 Line through PPP. A project manager who works in another city but has sufficient experience in URT PPPs explains this point in the interview:

> "Central Government requires municipal governments to provide funds for at least 40% of a URT line's CAPEX….. Municipal governments will provide 40% [of a URT line's CAPEX] to follow this regulation. Nevertheless, they [municipal governments] would not be willing to provide more than this amount as 40% has been a significant expenditure for them….. If selecting bundled contract, the total investment of PPP is higher [than the investment of the unbundled contract]. This [higher investment on PPP] is less attractive to CSOEs under the new regulation and may prompt them to require funds that are more than 40% from municipal governments to balance their financial risk ……So, the municipal government would select the unbundled contract."

The No. 12 Line PPP excludes development-based LVC. The reason for this procurement arrangement is similar to Guiyang and Guangzhou cases. The Wuhan government has not considered putting development-based LVC into the PPP agreement. The SPV was unable to acquire land at a low price through governmental support to reduce the cost of using LVC. Additionally, the development-based LVC, like the Guiyang and Guangzhou cases, was used by the Wuhan Metro Group Company to reduce its financial reliance on Wuhan Government. As a result, the Wuhan Government has the better financial health to ensure the No.12 Line PPP's subsidy (Figure 5.6).

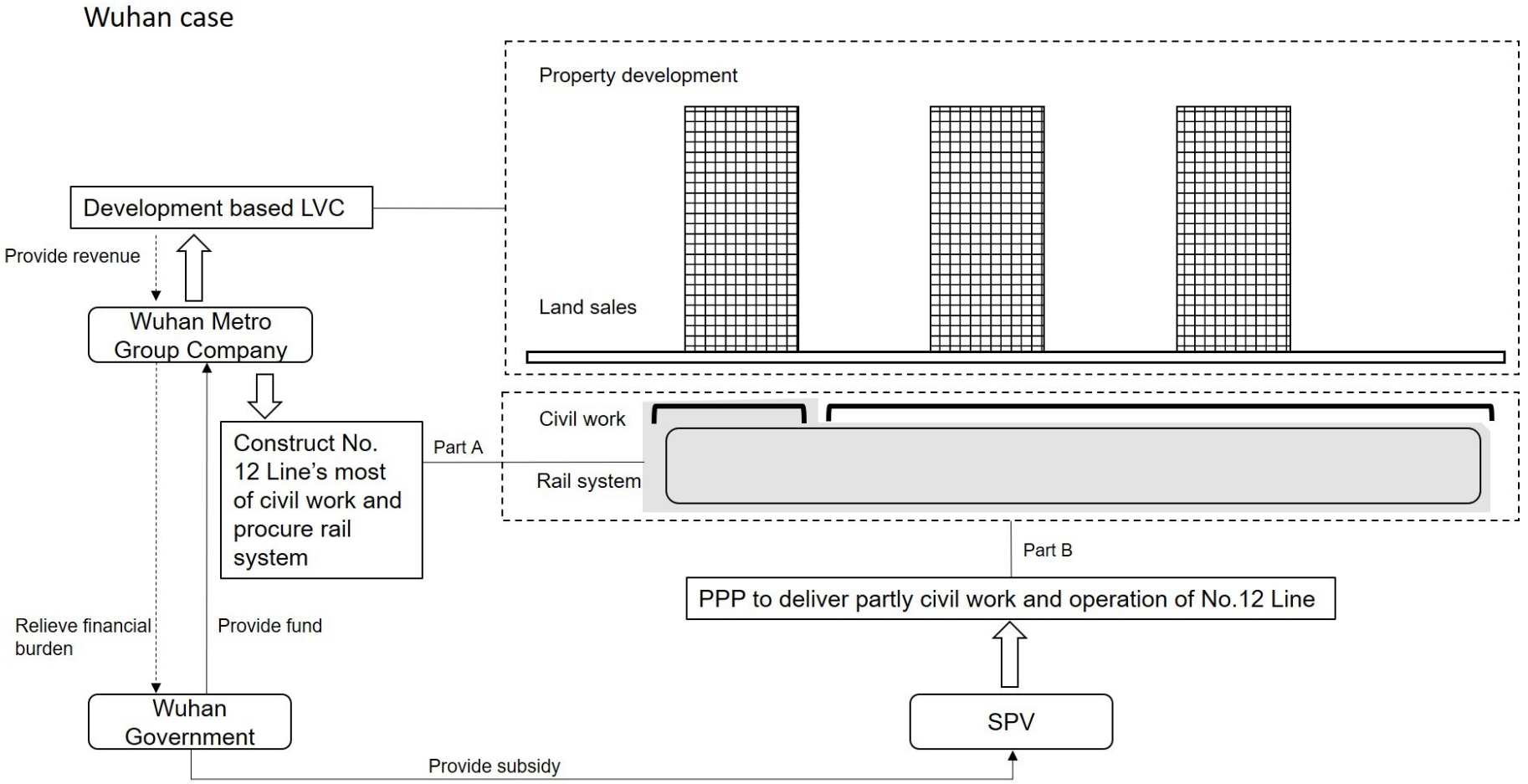


Figure 5.6 The relationship between No. 12 Line PPP and the development-based LVC

5.6.2 Land Value Capture

The Wuhan case uses the same value creation, risk mitigation and cost decrease strategy with Guiyang and Guangzhou cases. For example, Wuhan's government advocated using TOD to develop its public transportation systems through its "Master Plan (2010-2020)" for its URTs in 2010 (Wuhan Government, 2010). In 2013, Wuhan Government further regulated the Wuhan Metro Group Company to obtain revenue from land sales and property development with the cooperative developer within its stations' 500-800m catchment and acquire governmental support to acquire lands at a low price (Wuhan Government, 2014; Sun *et al.* 2017; CCXI, 2020c).

5.6.3 Life-Cycle Process

The delivery of PPP and LVC to procure No. 12 Line used the same strategies with Guangzhou and Guiyang cases to decrease the need for land acquisition, integrate URT and property development in the planning and design stage, and promote collaboration by the executive committee (Wuhan Government, 2016).

5.6.4 Governance

Like the Guiyang and Guangzhou case, the Wuhan Government uses the same stakeholder engagement strategies to facilitate the delivery of the project. Also, its systemic regime supports the selection of PPP agreement, use of LVC, improvement of the life-cycle process and other strategies in the governance dimension.

5.6.5 Development of Conceptual Framework 4 (CF_4)

To this end, CF_4 validates the CF_3 but removes the overly optimistic estimate issue as it has not been identified in the Wuhan case[16] (Figure 5.7). As the themes that emerged in CF_4 are recurring to ones in CF_2 and CF_3, the research cycle ended, and data saturation occurred.

[16] Although the interviews in the Wuhan case reported that the time frame of No. 12 Line PPP is a bit tight, which made its preparation is in harsh way. However, interviews and documentary sources collected from the Wuhan case have not indicated that the time frame of this project adversely influenced its quality.

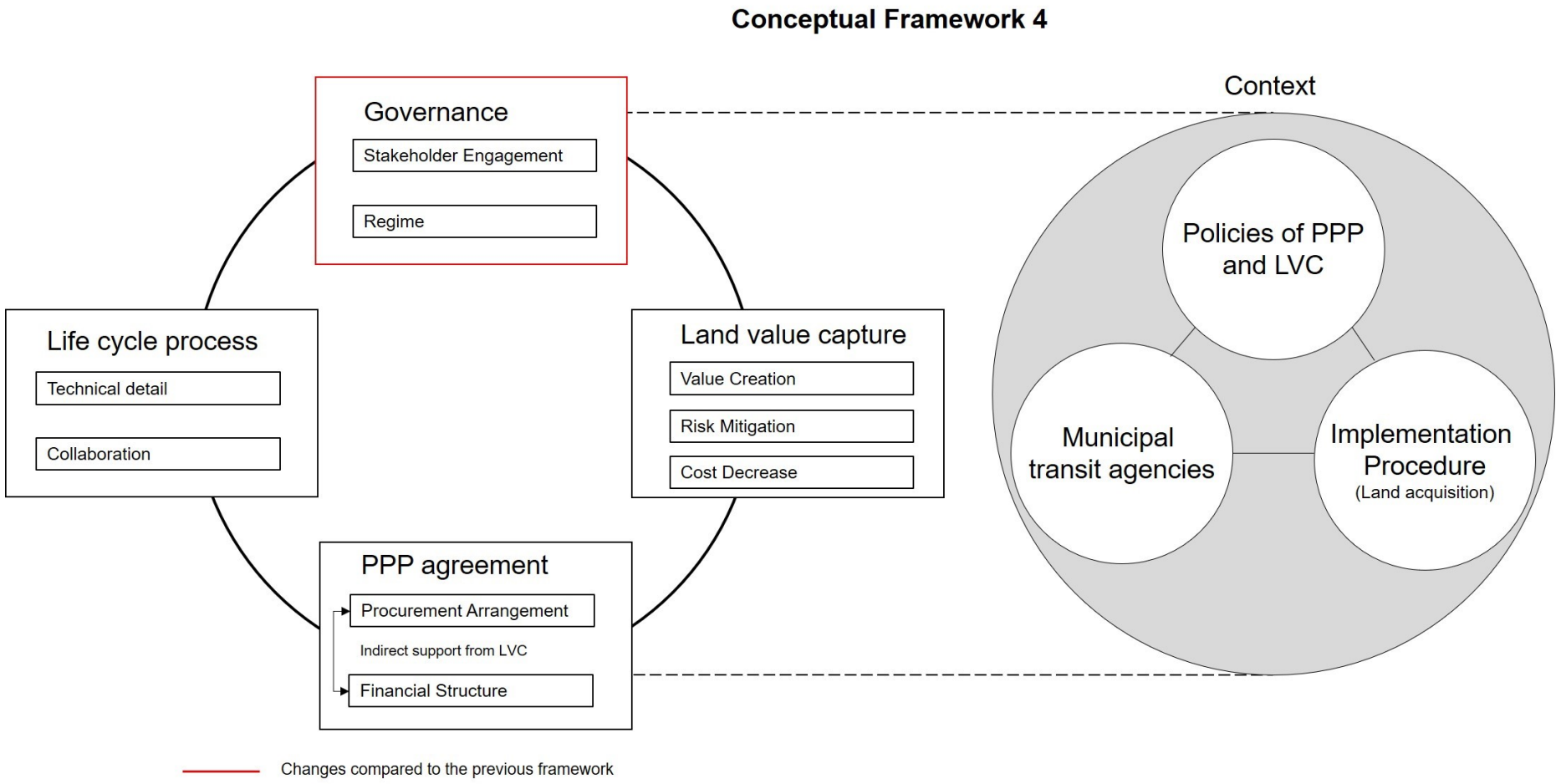


Figure 5.7 The conceptual framework (CF_4) from the Wuhan case

5.7 Chapter Summary

To empirically validate the feasibility and applicability of CF_1, this chapter uses 27 semi-structured interviews and 70 documentary sources to conduct the structured case study approach in three selected cities (i.e., Guiyang, Guangzhou and Wuhan). In each case, the experience of URT PPPs with LVC has been empirically examined with the help of a conceptual framework. As a result, the CF_1 is validated and transformed to CF_2 within the Guiyang case, CF_3 within the Guangzhou case, and CF_4 within the Wuhan case.

From CF_1 to CF_4, the new conceptual framework is developed and amended from the previous one. Based on the CF_1, the CF_2 additionally requires consideration on specific aspects (i.e., PPP and LVC policies, municipal transit agencies and land acquisition in implementation procedure) within the context and adds the issue of cost decrease in the LVC dimension. Based on CF_2, the CF_3 notices the overly optimistic estimate issues in the dimension of governance. Finally, CF_4 removes the overly optimistic estimate issues and identifies that other themes in this conceptual framework recurred to ones in CF_2 and CF_3.

The findings of each case study presented in this chapter empirically confirm that conceptual frameworks developed in this research are feasible and applicable. As a result, these conceptual frameworks are robust and reliable references for policymakers to effective use LVC and PPP to procure URT systems and networks. A further discussion about the inter-case comparison between five cases studies in this research, the development of a final PPP and LVC framework for URTs, and the identification of the systemic model to use LVC will be presented in the next chapter.

CHAPTER 6 DISCUSSION

6.1 Chapter Introduction

Previous chapters have empirically tested and refined the conceptual frameworks to help policymakers use LVC and PPP for URTs. In this chapter, an inter-case comparison between CF_1 and CF_4 is conducted to identify their similarity and difference, aiming to improve the understanding of URT PPPs with LVC in this research. Based on the findings in the inter-case comparison, a final framework is developed. A systemic model that presents the interdependency between constituents of the successful LVC strategies is also developed to support the final framework. Following this, the implications of the primary research findings in this study are presented.

Parts of this Chapter have been published in Transportation Research Part A: Policy and Practice.

Li, X., Love, P. E. D., Luo, H., and Fang, W. (2022). A systemic model for implementing land value capture to support urban rail transit infrastructure projects, Transportation Research Part A: Policy and Practice, 156, 90-122.

6.2 Inter-Case Comparison

Chapter 4 developed CF_1 by examining the experiences of the Hong Kong and Delhi case and providing their comparative analysis (Table 4.2). In Chapter 5, the CF_1 was validated and transferred to CF_2, CF_3, and CF_4 by examining the experience of three Chinese cities (i.e., Guiyang, Guangzhou and Wuhan). Table 6.1 compares and contrasts these three Chinese cases and their conceptual frameworks that have evolved during the research.

Based on the experience of these five cases in the previous chapters, the inter-case comparison will firstly discuss the context with specific aspects (i.e., PPP and LVC policies, municipal transit agencies and land acquisition within implementation procedure) between these five cases. Then, the PPP agreement, LVC, life cycle process and governance dimensions of these five cases will be compared one by one.

6.2.1 Context

From the Guiyang, Guangzhou and Wuhan cases, three aspects of their context were critical to delivering their URT systems: (1) PPP and LVC policies; (2) municipal transit agencies; and (3) land acquisition within implementation procedures. However, the three aspects within the context above have not been specifically examined in the case of Hong Kong and Delhi (Chapter 4). Thus, a re-examination of the experience of Hong Kong and Delhi is presented below. This re-examination identifies that PPP and LVC policies, municipal transit agencies and land acquisition within implementation procedures still constitute the critical aspects within the context in the cases of Hong Kong and Delhi:

- In the Hong Kong case, the delivery of its URTs must adhere to relevant policies (Suzuki *et al.*, 2015). The Hong Kong MTR performs a critical role during the delivery of its URT (Tang *et al.*, 2004). Although the MTR is privatised and not a municipal agency, its activities are still supervised and supported by the Hong Kong government (Transport and Housing Bureau, 2019; MTR Corporation Ltd., 2020). In particular, the Hong Kong Government supports the MTR in acquiring land in the implementation procedure by granting exclusive land development rights along its rail corridor by offering favourable land-use terms and conditions for using development-based LVC (Aveline-Dubach and Blandeau, 2019).
- In the Delhi case, the PPP and LVC policies regulated the delivery of the DAME project. In delivering the DAME, the DMRC (i.e., municipal transit agency) was responsible for constructing the project's civil work and awarding the PPP agreement to SPV. In addition, the amount and price of land acquisition and how SPV can use these lands for LVC are the critical content of DAME's PPP agreement (Delhi Metro Rail Corporation Ltd., 2008).

Table 6.1 Inter-case comparison for Guiyang, Guangzhou and Wuhan

Conceptual Framework			**Guiyang (CF_2)**	**Guangzhou (CF_3)**	**Wuhan (CF_4)**
Context	Policies of PPP and LVC		Shape the actor, process and component of the project	~*	~
	Municipal transit agency		Involve in the PPP actively and play a critical role in the use of LVC	~	~
	Implementation procedure		Take land acquisition as a critical step	~	~
Dimensions	PPP agreement	Procurement arrangement	Select BOT mode for procure to URT systems but exclude LVC	-*** Select BOT mode to procure underground utility tunnel of URT systems but exclude LVC	- Select BOT mode to procure the most of civil work and operation of URT systems but exclude LVC
		Financial structure	Receive indirect support from LVC through an indirect financial relationship	~	~

Land value capture	Value creation	Use TOD strategy	Launch multiple real estate projects		~			~		
	Risk mitigation	Share capital expenditure with cooperative developer			~	~		~	~	
	Cost decrease	Decrease the cost of acquiring land by governmental support			~			~		
Life cycle process	Technical detail	Decrease the need for land acquisition			~	+ Develop integrated strategies	+ Inadequate preparation of PPP due to tight time frame	~	~	- Cannot observe inadequate preparation of PPP
	Collaboration	Promote cooperation between municipal government, municipal transit agency and CSOEs			~			~		
Governance	Stakeholder engagement	Establish an executive committee based on the intergovernmental framework	Assign the municipal transit agency to hold the stake in SPV	Publish schemes of acquiring land to citizen	~	~	~	~	~	~

	Regime	Develop regulatory strategies contributing to PPP and LVC	~	~
	Overly optimistic estimate mitigation	/****	+ Appears to have an overly optimistic estimate on the schedule and adversely influence the project's quality, which should be mitigated	- Cannot identify the overly optimistic estimate on the schedule

* "~ "refers that the action is similar/same to the previous case

** "+" refers that the action is new compared to the previous case

*** "–" refers that the action is adjusted compared to the previous case

**** "/" refers that the action had not been identified

6.2.2 PPP Agreement

The PPP agreement dimension is validated, but it varies within the five cases and resultant conceptual frameworks that are developed. In the Hong Kong case, the MTR utilises a "bundled contract" with a single entity responsible for its financing, infrastructure, rolling stock, line maintenance and operation, and development-based LVC (Suzuki *et al.*, 2015; Chang and Phang, 2017). While in the Delhi, Guiyang, Guangzhou and Wuhan cases, all selected to use an "unbundled contract". Delhi's unbundled contract included the development-based LVC. Whereas three Chinese cases' unbundled contracts excluded the development-based LVC. Nevertheless, the SPV received indirect revenue from development-based LVC used by the municipal transit agencies.

Why do four of five cases in this study select unbundled contracts? A possible reason is that the unbundled contract can reduce the financial risk to the investors (Solino and Vassallo, 2009; Cruz *et al.*, 2015). For example, in the Delhi and Wuhan cases, the total CAPEX of the URT projects is U$771.3 million and US$7.31 billion, respectively. As both cases were delivered through unbundled contracts, the investors only needed to provide 390.6 million for the DAME project and 4.52 billion for Wuhan's No. 12 Line, respectively. Therefore, the investors in Delhi and Wuhan cases can reduce their financial risk to the delivery of URT PPPs.

In addition, PPP projects are able to successfully use the LVC by reducing its financial risk in the agreement but need to ensure SPV can receive the revenue from this mechanism. In the Delhi case, the DAME's PPP agreement required the SPV to undertake all risks of LVC and pay an additional fee to use it, which resulted in a significant financial loss. In the three Chinese cases, the LVC was excluded from the PPP agreement to avoid using it at a high cost of land acquisition. As a result, the SPVs excluded the financial risk of using LVC. At the same time, SPVs were able to receive indirect revenue of LVC from the municipal government and transit agencies.

6.2.3 LVC

The LVC dimension is validated, but the cost decrease issue is additionally identified within the three Chinse cases. A re-examination on the Hong Kong and Delhi case is thus conducted, which identifies that the cost decrease in the dimension of LVC also contributes to their success and failure:

- In the Hong Kong case, the MTR can acquire property development rights from the government at a land premium. Then, the MTR can require the cooperative developers to pay for the land premium. As a result, the MTR decreased its cost of land acquisition and banking, which reduced its financial risk of LVC (Tang *et al.*, 2004, Suzuki *et al.*, 2015).
- In the Delhi case, the SPV of the DAME needed to pay for the land to use LVC and share its revenue to DMRC. As a result, DAME failed to decrease the cost of using LVC and resulted in a significant financial loss. For example, drawing on DMRC's data from 23/02/2011 to 31/03/2013, the SPV only collected US$2.73 million in gross revenue but was required to pay US$10 million for the use of LVC (Delhi Metro Rail Corporation Ltd., 2013, 2014).

6.2.4 Life-Cycle Process

The life cycle process dimension is validated. All five cases identify technical details of using PPP, LVC and delivering rail infrastructure and collaboration between stakeholders are critical to the project's success.

6.2.5 Governance

Stakeholder engagement and regime are identified as two critical issues needed to govern the URT PPPs with LVC. In addition, the Chinese cases indicate that systemic regimes can support other dimensions of the conceptual framework through a series of regulations for using PPP, developing properties and delivering the rail infrastructure.

Notably, overly optimistic estimates that contribute to the defects of the project have been identified in the cases of this research. In the case of DAME, the transit demand forecast was overly optimistic. As a result, its expected fare and LVC revenue were unable to be achieved, and the SPV experienced financial losses (Chapter 4). In the Guangzhou case, the municipal government had an overly optimistic schedule for the No. 11 Line's PPP underground utility tunnel project to set a tight time frame for its document preparation before the bidding. To meet the tight time frame, the scope and quality of PPP's document preparation had to be reduced, resulting in the underestimation of its cost (Chapter 5).

Although Hong Kong, Guiyang and Wuhan case has not identified the phenomenon of the overly optimistic estimate, it should not be omitted. The reason is that overly optimistic estimates in the delivery of transport infrastructure usually impairs its cost performance (Iyer and Jha, 2005). Thus, it is suggested that overly optimistic estimates should be taken into account and mitigated by effective strategies in project governance (Siemiatycki, 2009; Love *et al.*, 2015). The discussion of mitigating the overly optimistic estimate will be presented in the final PPP and LVC framework for URTs next.

6.3 The Final PPP and LVC Framework

Combining the inter-case comparison above, CF_1 to CF_4 and prevailing theories and knowledge in normative literature, the final PPP and LVC framework is developed. Figure 6.1 presents the final PPP and LVC framework for URTs, which identifies three specific aspects within the context and four dimensions that include critical issues and a series of strategies.

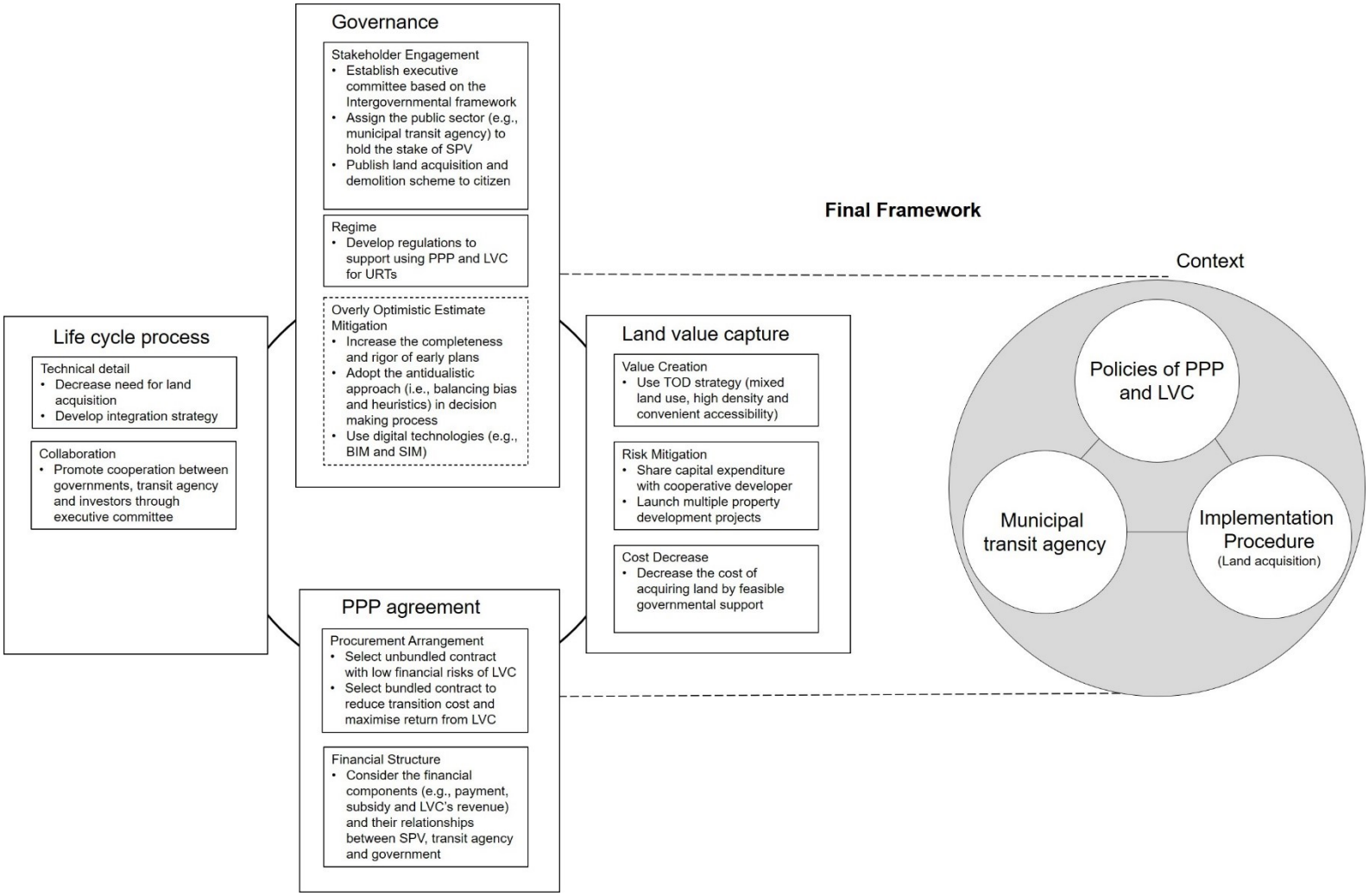


Figure 6.1 The final PPP and LVC framework for URT systems and networks

6.3.1 The Context with Three Specific Aspects

Three specific aspects within the context are the policies of PPP and LVC, the municipal transit agencies, and the implementation procedure with land acquisition. They interact and collectively constitute the backdrop of delivering URTs. The policies of PPP and LVC will shape the process, actors and components for delivering URTs (Chang and Phang, 2017). The municipal transit agencies play a critical role in using PPP and LVC in each city. For example, they can negotiate the agreement with SPV (e.g., Delhi), adopt the land sales and property development (e.g., Guiyang, Guangzhou and Wuhan), and even become the single entity to integrate PPP and LVC in Hong Kong. Land acquisition is the necessary component that can influence URT delivery and the use of LVC (Suzuki *et al.*, 2015; Wang *et al.*, 2019).

6.3.2 Four Dimensions of Project

Four dimensions can further influence the success and failure of a URT project delivered through a PPP and LVC. Each of these dimensions will be described below.

PPP agreements focus on its contract scope (i.e., bundled or unbundled) and the financial structure used to balance the project's revenue and expenditure. Selecting the bundled contract (e.g., joint venture) has the advantage of reducing transaction costs and maximising the returns from an LVC's return, but needs to set clear economic and social goals to protect public interests (Tang *et al.*, 2004; Suzuki *et al.*, 2015; Chang and Phang, 2017; Cruz and Marques, 2012). In comparison, selecting an unbundled contract has the advantage of lowering the investment of the project and reducing the financial risk to the investors (Solino and Vassallo, 2009; Cruz *et al.*, 2015). When selecting an unbundled contract, reducing the financial risk of LVC in the agreement is critical to the project's success. No matter what contract scope of the PPP agreement it takes, the financial components (e.g., payment, subsidy and LVC's revenue) and their relationships between SPV, transit agency and government should be borne in mind to balance the project's revenue and expenditure.

LVC considers achieving the value creation, risk mitigation and cost decrease to ensure its success. There are a series of strategies to achieve value creation, risk mitigation and cost decrease for LVC. For example, using a TOD strategy (mixed land use, high density and convenient accessibility) with LVC can increase its value (Suzuki *et al.*, 2015). Simultaneously, mitigating the risk of using LVC can share its capital expenditure with the cooperative developer and launch multiple real estate projects to balance the revenue and cost of a single one (Transport of London, 2017). Finally, the government can provide land that is at a low price for LVC, which can decrease the cost of using this mechanism (Suzuki *et al.*, 2015).

The life cycle process identifies the technical details that ensure the rail system function well, and its influence on the value of surrounding property and land is needed. In relation to this, collaboration is critical to the success of PPP and the use of LVC. Valuable strategies have been identified to achieve these aims. For example, developing an integration strategy to collaborate the delivery of rail infrastructure and property development and decreasing the need for land acquisition in the planning and design stage can ensure their construction safety and avoid time and cost overrun. Meanwhile, effective collaboration between municipal governments, municipal transit agencies, and investors can be promoted through executive committees that include these institutions' staff.

Governance focuses on accountability, control and the management of the URT, PPP and LVC, which contains the stakeholder engagement, regime and overly optimistic estimate mitigation. First, stakeholder engagement can create values to be shared and simulate collaboration (Love *et al.*, 2020a). It can be achieved by establishing the intergovernmental framework, assigning the public sector to hold the stake of SPV, and publishing a scheme that can contact citizens and protect their rights in the land acquisition process. Then, the regime should incorporate legal regulations and policies to regulate and support the operation of a PPP and its interactions with LVC.

In addition, the overly optimistic estimates in the URT delivery through PPP and LVC can be curbed in the dimension of governance through several strategies (Siemiatycki, 2009; Love *et al.,* 2015; Love *et al.*, 2021). For example, policymakers can increase

the completeness and rigour of early plans to avoid overly optimistic estimates. Meanwhile, policymakers can use digital technologies (e.g., BIM and SIM) to improve the project's delivery process and information sharing to increase the accuracy of estimation. Moreover, adopting the "antidualistic" approach (i.e., balancing bias and heuristics) in the decision-making process is recommended to improve the understanding of risk, uncertainty and estimation accuracy to reduce optimism bias for estimates.

6.4 Systemic Model of LVC

The final framework has identified that a successful project should consider value creation, risk mitigation and cost decrease in the dimension of LVC. However, how value creation, risk mitigation and cost decrease connect to each other and collectively contribute to the LVC strategy development needs to be further explored. To address this problem, this section first identifies the three associated challenges to using LVC effectively. Based on these three associated challenges, it is identified that there needs an exploration into the interdependency between the knowledge threads of LVC. With this in mind, the causal loop diagram (CLD) is developed to examine the primary constituents that influence the integration of LVC for URT procurement, drawing from the experience of Guiyang, Guangzhou and Wuhan, and developing a systemic model. The systemic model thus illustrates the interdependency between its constituents, supporting the final PPP and LVC framework.

6.4.1 Associated Challenges of LVC Knowledge and Its Critical Gap

The contextual backdrop that shows the relationship between the threads of LVC knowledge and their associated challenge and the critical gap is presented in Figure 6.2. The threads of LVC knowledge have been identified in Chapter 2. They are (1) its impact on land/property price by URT systems; (2) the use of instruments for generating income (i.e., tax or fee-based and development-based); and (3) the development of accessibility-oriented frameworks in conjunction with the identification of factors contributing to its success. After re-examining the literature that will be presented below, the associated challenges to these three knowledge threads of LVC are identified. They are (1) uncertainty with the estimation of land

values; (2) inequitable outcomes that come from the implementation tax or fee and development-based LVC; and (3) ambiguity between the theory of accessibility-oriented framework and critical success factor, and the practice of LVC.

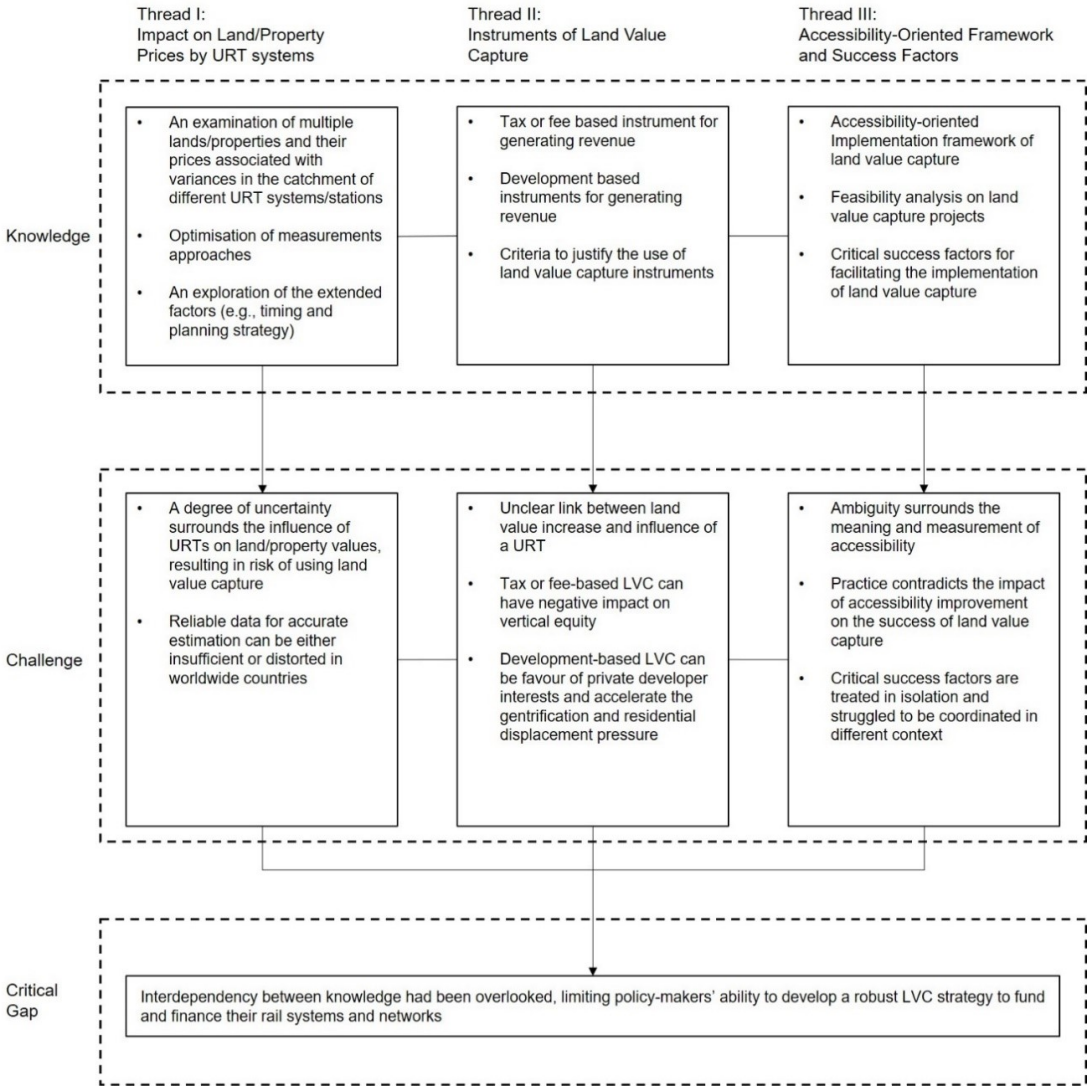


Figure 6.2. The contextual backdrop of LVC

Associated Challenge I: Uncertainty with the Estimation of Land Values

Chapter 2 indicates that a significant number of studies have estimated the impact of URT systems on land/property prices. However, accurately estimating a URT's influence on land/property values is still a challenge due to the uncertainty and complexity associated with its measurement (i.e., too many factors[17]) and noise in the data used (i.e., unavailable and/or incomplete land value and cadastral data (geo-referenced)) (Mohammad *et al.*, 2013; Higgins and Kanaroglou, 2016; Transport for London, 2017; Buensuceso and Purisima, 2018; Sharma and Newman, 2018b; Mathur, 2019).

Associated Challenge II: Inequitable Outcomes of Using LVC

Chapter 2 reveals that jurisdictions worldwide have successfully used tax or fee-based and development-based LVC to capture the increased value of land/properties. Despite the economic advantages of using LVC, it also has disadvantages. In the case of tax or fee-based LVC, it often fails to demonstrate a link between increases in land values due to proximity to a railway station and the revenue captured from taxpayers (Suzuki *et al.*, 2015; Terrill, 2017). Furthermore, tax or fee-based LVC can also negatively impact vertical equity; that is, the distribution of resources between individuals with differences in need and the ability to pay. A case in point is Gold Coast's LRT (Australia). A tax or fee-based LVC approach was employed, and a high levy was passed on to low-income households. The upshot is a mismatch in tax payments between different income groups (Yen *et al.*, 2020).

Development-based LVC requires public and private sectors to engage in lengthy and high-transaction-cost negotiations to agree with uplifts in land value, land use adjustments, and revenue sharing (Zhao *et al.*, 2012b; Suzuki *et al.*, 2015). However, the public sector usually does not have transparent standards or clear analytical frameworks that can be drawn upon to evaluate how much value should be created, captured and shared with private partners (Kim, 2020). Asymmetric outcomes can arise from negotiations resulting in favour of the private developer (McAllister, 2017).

[17] Such factors including the type of rail, accessibility to roads, distance to stations, geographical location, the buoyancy of the real estate market and even the method of measurement (Mohammad *et al.*, 2013; Transport for London, 2017). Unobserved factors and can also affect the estimation of URT's influence on land/property values (Higgins and Kanaroglou, 2016)

Additionally, development inequity can make it challenging to build a sense of community amongst property owners and residents and provide affordable housing. For example, development-based LVC often aims to increase the floor area ratio (FAR) to boost profit levels of development-based LVC, which may also accelerate gentrification and result in residential displacement (Wong, 2018; Aveline-Dubach and Blandeau, 2019; Davis, 2021).

Associated Challenge III: Ambiguity between Theory and Practice

Chapter 2 notes that, in theory, accessibility-oriented frameworks and CSFs provide policymakers with a roadmap to implement LVC. However, a different story unfolds in practice. A great deal of ambiguity surrounds the meaning and measurement of accessibility. It is often assumed to be akin to mobility[18], but these concepts are different, and there is no standard approach to calculating its effectiveness (Handy, 2020). Furthermore, empirical evidence indicates that the success of LVC is not reliant upon improving accessibility to a URT station, which has resulted in the questioning of the very foundations of an accessibility-oriented framework (Fischer, 2019). In the case of Kansas City (US), for example, its streetcar project was reported to do little to improve accessibility but still contributed to the success of LVC (Fischer, 2019). The local officials believed their LVC succeeded as their streetcar investment was purposely placed in the city's spatial development priority area. It then attracted real estate investors and associated development activities, which resulted in uplifts in land value.

Moreover, it is widely understood that CSFs interact with one another but are treated in isolation more often than not (Liu *et al.*, 2014). Success factors should not be treated as being independent – no one factor can influence the success of LVC (Liu *et al.*, 2019). Determining how CSFs interact with each other for LVC implementation remains unclear (Mathur, 2019; Mathur and Gatdula, 2020). Thus, policymakers have struggled to understand, learn and transfer practices to improve the performance of LVC from different contexts. For example, the transit agency of Delhi Metro acquired significant income from property development. However, it failed to reach the expected income projections through the same approach (Mathur, 2019).

[18] Mobility is referred to as the ability to move or be moved (Handy, 2020)

Critical Gap to the Adoption of LVC

The knowledge threads of LVC in the context of URT systems and networks are summarised in Chapter 2, and their associated challenges are presented in this section above. However, it is noted that an exploration into the interdependency between the knowledge threads of LVC has not been given the credence they deserve by the transport community. After all, they can influence the failure and success of LVC. The nature of the interdependency between the constituents of LVC remains unclear, rendering it difficult for policymakers to develop a robust LVC strategy (Suzuki *et al.*, 2015; Salon *et al.*, 2017; Kim, 2020). It is necessary to fill this critical gap as there is a need to examine the relationship between LVC and URT procurement systemically. Understanding the dynamics underpinning these relationships provides a platform for policymakers to deliver effective rail services to their customers.

6.4.2 Using Causal Loop Diagram

The interdependency between the constituents of LVC with URTs was examined using a series of CLDs. A CLD is a core tool of system thinking, which can explicitly depict the direction and type of causality between variables and reveals how each one can affect an outcome (Sterman, 2000, 2001; Goh *et al.*, 2012; Egilmez and Tatari, 2012; Mai and Smith, 2015). Figure 6.3 depicts the analysis and validation process for this systemic model with collected primary and secondary data presented in Chapter 3.

The collected primary and secondary data is used to create a series of CLDs for the policy, planning, finance and project management sub-systems that influence the functioning and economic viability of using LVC to support URT projects. Each sub-system examined identifies the variables and causal relations that affect the decisions to implement and maintain the viability of LVC.

Each sub-system was also combined to develop a systemic CLD to demonstrate the wide range of issues that must be considered to engage with LVC and sustain a URT successfully. The analysis of the systemic relationships using CLDs was presented, and a narrative to explain their meaning (e.g., contextual information, empirical evidence and explanations) was provided. In doing so, the researcher summarises each

of the CLDs, describes their critical characteristics (e.g., behaviours, meanings and challenges), and provides respondents' insights.

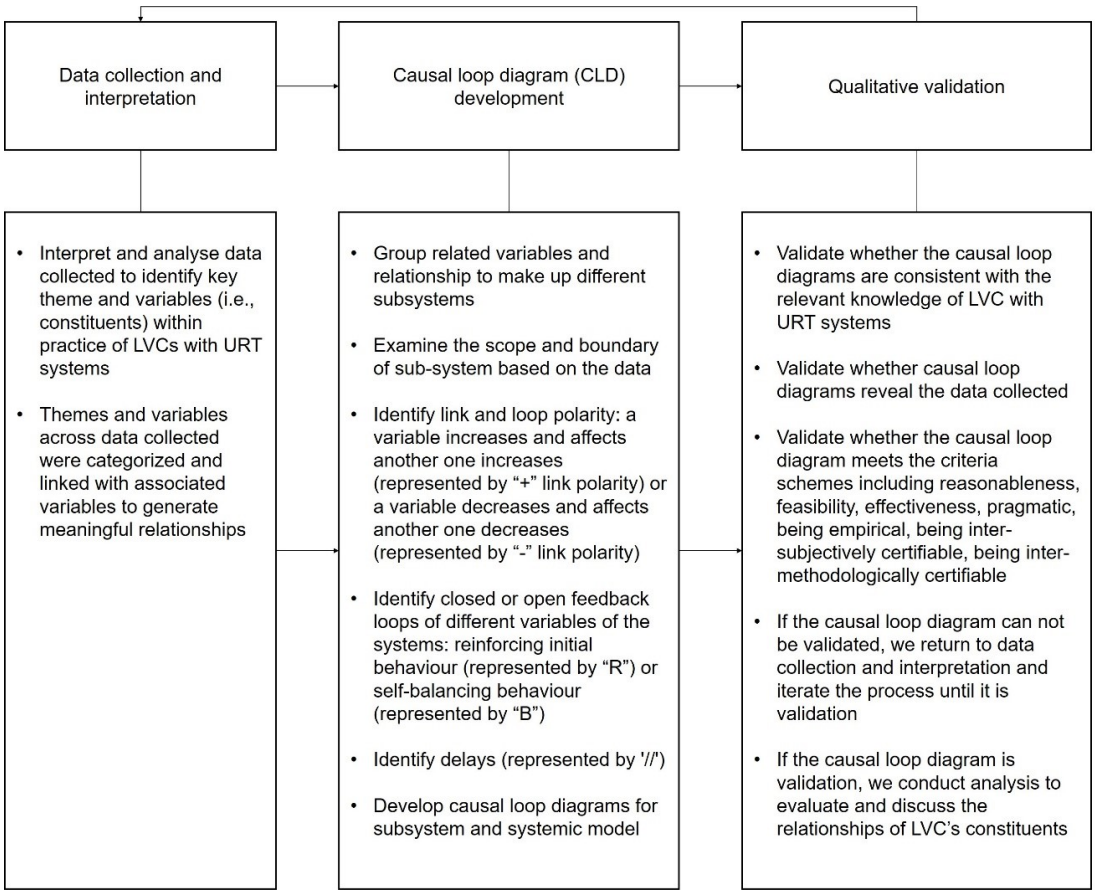


Figure 6.3 Data analysis and validation process for CLD

6.4.3 Policy System

Figure 6.4 encapsulates the underlying policy-related variables identified from the interviews and grey literature that influence the effective use of LVC. Here three main causal loops prevail: (1) LVC strategy (B1); (2) institutional collaboration (B2); and (3) adjustments of land use (B3). Among these variables, the acquisition of government support is pivotal to the involvement of stakeholders. During an interview with a senior manager from the transit agency stated that:

> "All our actions [of LVC] need to be carried out under the relevant policy's guidance and permission [refer to central and local governments' policies in Table 5.2, 5.3 and 5.4]. Without these kinds of supports from the government, we [transit agencies] think that there will be legal risks to use LVC."

As noted in Loop B1, the government developed strategies to support the use of LVC by enabling transit agencies to obtain land at lower prices. The cost of land acquisition will fundamentally contribute to the viability of LVC. Put simply, if the cost of the land is too high, then the financial contribution of LVC to URT's operations will be minimal (Sun *et al.*, 2017). As Chapter 5 noted previously, transit agencies can utilise several strategies to acquire land at a lower price than its market valuation to overcome this issue. Adopting such an LVC strategy provides local governments with the impetus to bolster development around stations and thus ensure the long-term economic viability of transit agencies.

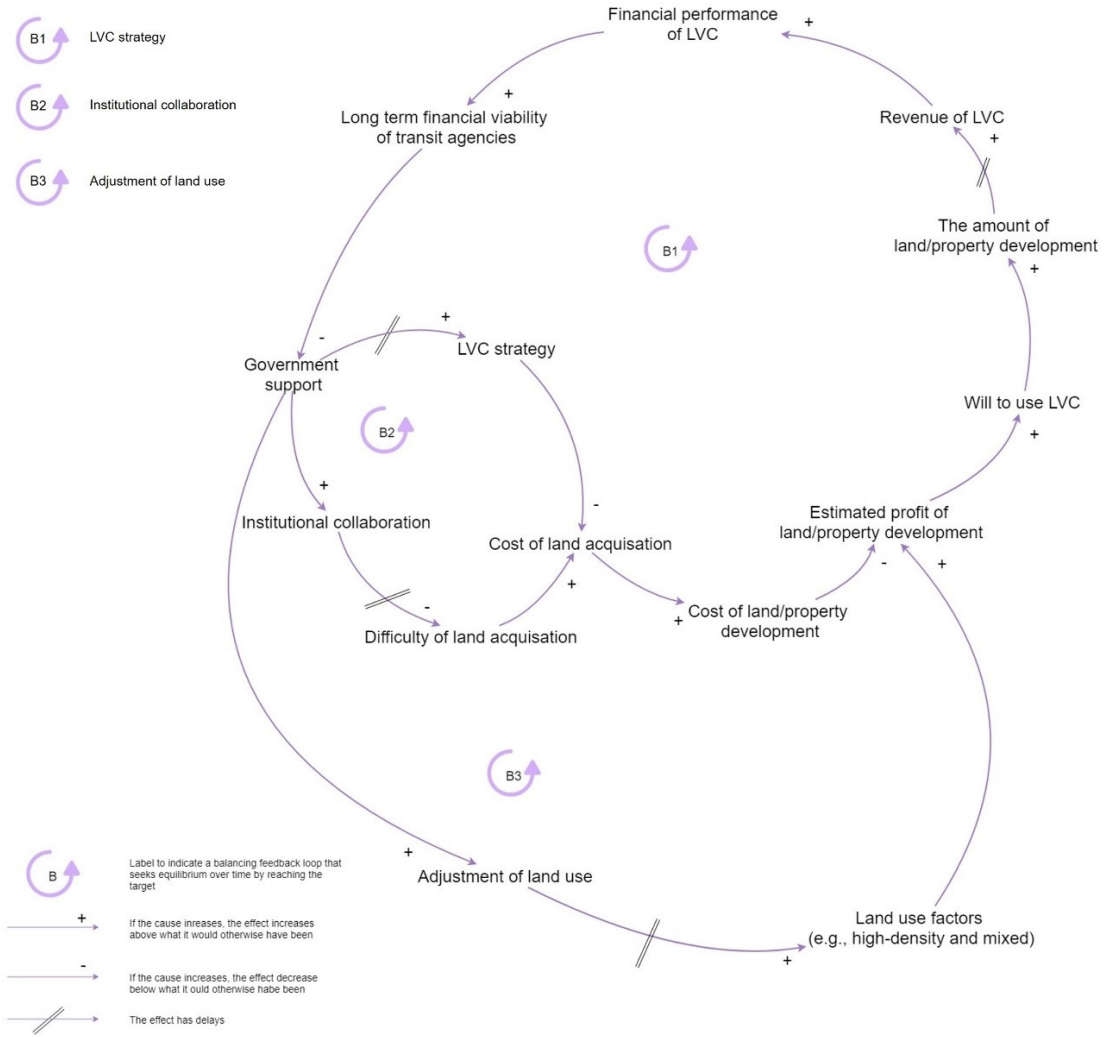


Figure 6.4 A CLD for the policy system

The governments in the cities that have been examined emphasise cooperation between stakeholders (e.g., transit agencies and government agencies) to ensure the land can be effectively acquired to reduce the overall transactions costs associated with implementing an LVC strategy (Loop B2). Reinforcing this point, a land agency's project manager stated:

> "Land acquisition needs the coordination of multiple government agencies such as transit agencies, land reserve departments, and other institutions. If issues such as unclear property rights in land expropriation arise, this is reported to our administrative agency. They will then transfer this issue to the responsible department and wait for them to solve it."

Each of the city's governments can provide land use adjustments around URT (e.g., mixed and high density) stations to realise the benefits (e.g., increased income) of LVC for their transit agencies (Loop B3). For example, in the Qingshuiwan project in Guiyang, the land had been initially approved to house a hospital. However, adjustments to the project's land use resulted in reallocating it to high-FAR residential and commercial zones and generating higher profits (The World Bank, 2020a). Changing the intended use of land, which had been zoned under a master plan for a dedicated purpose, can take a considerable amount of time as various agencies are required to approve the amendment. Echoing this point, a project manager from the transit agency stated:

> "Even though the transit agencies require land-use adjustments, it may not be approved due to the restriction of the city's master plan. Each government agency involved with this issue has its tasks and scope of work to perform (e.g., examining whether land-use adjustment meets each agency's concern). With this in mind, extensive coordination will be required to complete the adjustments of land use, which will result in delays."

6.4.4 Planning System

Figure 6.5 identifies the primary causal relations within the planning system unearthed during the inquiry line. Four main causal loops are recognised to exist: (1) the effect of supportive urban planning environment (R1); (2) self-enhanced accessibility (R2.1); (3) the effect of accessibility improvements (R2.2); and the effect of URT projects on the ability to enact development activities (R3).

A supportive urban planning policy is critical for enacting LVC (Mathur and Smith, 2013). These findings align with the extant literature and are presented in Loop R1, where supportive urban planning (e.g., TOD strategy) can be used to ameliorate land use, accessibility and generate uplifts in land value (Cervero and Murakami, 2009; Levinson and Istrate, 2011; Lyu *et al.*, 2019). A senior urban planner explaining the challenges associated with implementing a TOD strategy made the following comment:

> "In some cities (e.g., Guangzhou), the development of TOD strategy was necessary for the transit agency to implement LVC in URT projects….. However, implementing an effective TOD strategy may be limited by the conditions of the environment that surrounds stations. For example, owners of existing buildings may be reluctant to work with us [urban planners] to coordinate land use around stations, which could hinder a TOD strategy."

Then it is shown that accessibility plays an influential role in implementing LVC (Loop R2.1 and R2.2). In particular, it is observed that accessibility aligns itself with self-enhancement characteristics in Loop R2.1 (Levinson and Istrate, 2011). In this loop, accessibility created by the URT projects can gradually increase the transit demand of commuters and then expand the rail's capacity. In Loop R2.2, it can be seen that an effective transport planning policy can increase transit capacity through URT projects and improve accessibility to increase land values (Medda, 2012).

Additionally, it is also observed that transport planning policy improves the accessibility of URT projects and economic development and stimulates uplifts in land value (Wu, 2015; King and Fischer, 2016). It is shown in Loop R3 that when a railway station is constructed and operates in a given location, there is a growing perception

that significant financial investment will occur (Helling, 1997). Thus, firms and households may be more attracted to this location, which may, in turn, contribute to uplifts in land value (Fischer, 2019). In support of this view, a transport engineer who had participated in multiple URT projects stated:

> "The transport planning policy for URT projects needs to align itself with various government agencies' goals such as reducing traffic congestion, changing population distribution and promoting economic development. In particular, promoting economic development and providing social mobility are the primary goals of URT projects. Once the government plans to construct a URT project in a specific area, then there will be an investment and a real estate boom."

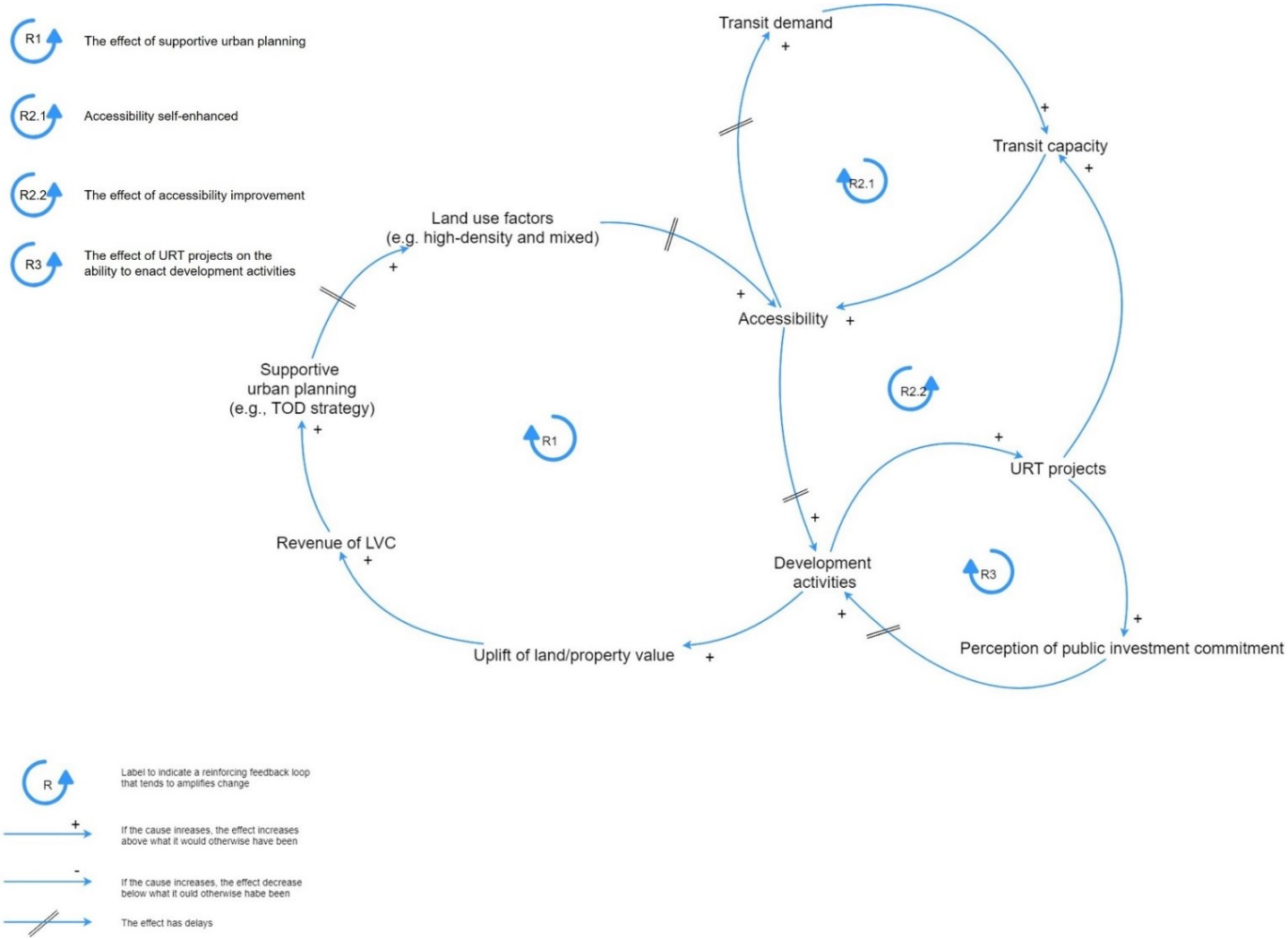


Figure 6.5 A CLD for the planning system

6.4.5 Finance System

There are six causal loops embedded in the finance system, as noted in Figure 6.6, that influence the viability of LVC: (1) financial performance (Loop R4); (2) financial risk (Loop B4); (3) sharing of financial risks (Loop R5.1); (4) sharing of technical needs (Loop R5.2); (5) transit agencies' drive for low-price land (Loop R6); and (6) a preference for acquiring land in suburban areas (Loop R7).

It can be seen in Loop R4 that the driving forces to adopt LVC and the subsequent positive financial contributions result in it becoming a preferred strategy for long-term revenue generation. This loop constitutes the main reason for transit agencies to use LVC. Notably, an inability to sell or let property developments can cause delays in revenue generation (Chapter 4). A consulting engineer further explained the uncertainty associated with LVC's financial performance by making the following comment:

> "In the project's initiating and planning stage, its [LVC's] cost, revenue and profit are based on estimation...Since they are both estimated, there generates uncertainty [in their actual level]. The [actual] revenue may be affected by, for example, the market of the real estate, and the [actual] cost may be affected by the cost of land acquisition. As a result, this will cause uncertainty [in actual profit of LVC] and affect the financial condition of a transit agency."

Based on the uncertainty associated with LVC, additional financial risks are borne by transit agencies (Loop B4). When transit agencies implement an LVC strategy (e.g., property development), there is a likelihood of a mismatch in cash flow between cost and revenue to materialise, resulting in further financial shortfalls (Transport for London, 2017). It can be observed in Loop R5.1 that transit agencies aim to cooperate with stakeholders (e.g., property developers) to share the financial risks of LVC, raise capital for land/property development and obtain technical expertise (Loop R.5.2). Affirming this position, a financial expert from a transit agency stated:

> "After the increasing amount of land/property development, there could be a shortfall of capital and staff. At this point, we [transit agencies] struggle to do property development by ourselves. We are not very good at property development. In recent years, we have been gradually cooperating with them."

It has been repeatedly shown that transit agencies aim to obtain land at a low price to maximise property/land development profit, reinforced in Loop R6. During the semi-structured interviews, it was frequently noted that transit agencies had a preference to acquire greenfield sites in suburbs as there is greater flexibility for land use and property development and, therefore, can increase profit margins (Loop R7).

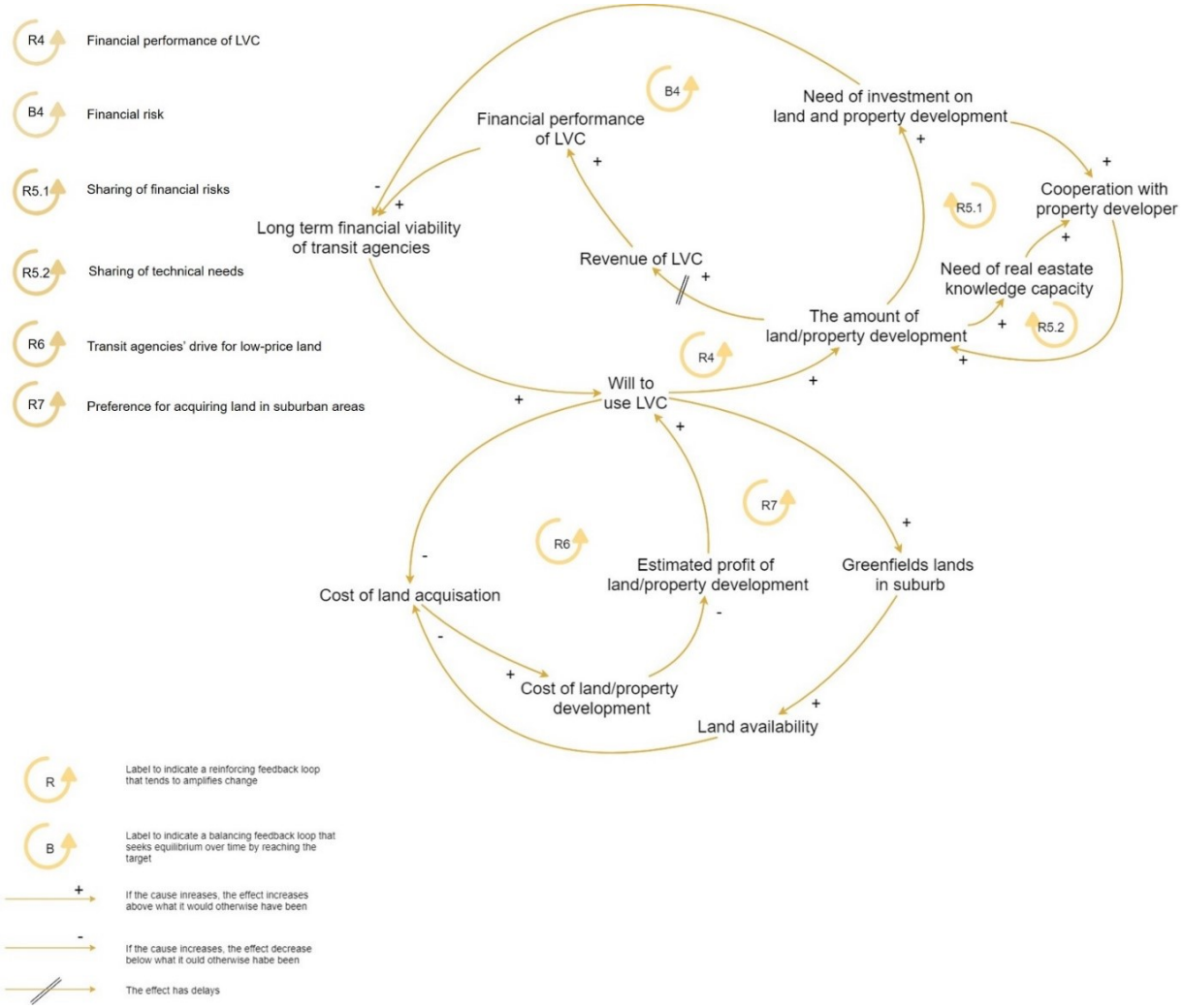


Figure 6.6. A CLD of the finance system

6.4.6 Project Management System

In Figure 6.7, it is presented that the underlying causal loops that were found to materialise from the interviews within the project management system: (1) an integrated strategy for ensuring the feasibility of the URT and LVC (Loop R8); (2) ensuring safety during construction (Loop B6); and (3) work with state-owned enterprises (SOEs) (Loop B7).

Managing URT infrastructure and property development is a complex and challenging task. Therefore, they need to be effectively integrated to ensure a project's economic viability. Transit agencies in China are cognisant of the complexity of delivering and managing a URT and associated property developments and therefore tend to develop an integration strategy (Loop R8). Such a strategy aims to seamlessly integrate the project management process (including design, building, finance, operation and maintenance) of a URT with property development and ensure they do not hinder each other.

Safety is another issue that needs attention as part of an integration strategy (Loop B6). For example, developers often require their developments to be constructed as quickly as possible to earn income from their assets and maximise profit. As a result, this places pressure on the transit agency to deliver and ensure the URT is operational according to a pre-determined schedule. Simultaneously constructing the URT and the developments (e.g., shopping centres, housing and offices) places pressure on safety (Carter and Smith, 2006; Transport Safety Victoria, 2012; Yan *et al.*, 2019). A project manager from a transit agency stated:

> "We are cautious when we cooperate with property developers as some focus on solely getting the development constructed as quickly as possible (including sales). Focusing only on the developments speed of construction can negatively affect our original rail transit construction plan and cause safety hazards. If not necessary, we do not want to take this risk."

Transit agencies can work closely with developers such as SOEs to reduce the complexity of managing a URT and property development (Loop B7). The SOEs in China tend to support the local government and play a pivotal role in property development projects associated with URT as they can readily adapt to the local business conditions (Yang *et al.*, 2020b, The World Bank, 2020b). In particular, SOEs can enhance the negotiation process with transit agencies as both are regulated by the government and familiar with each other's aims. In support of this view, a project manager of a transit agency made the following comment:

> "SOEs and we [transit agencies] are normally supervised by the same local government and share a similar context, including workplace culture, mission, vision and regulation. For example, safety is a priority for both of us. Thus, when negotiating with SOEs regarding safety issues to coordinate URT construction and property development, we make an agreement easy. While it can be a tough process to negotiate with private developers on this issue as their primary concern is making a profit."

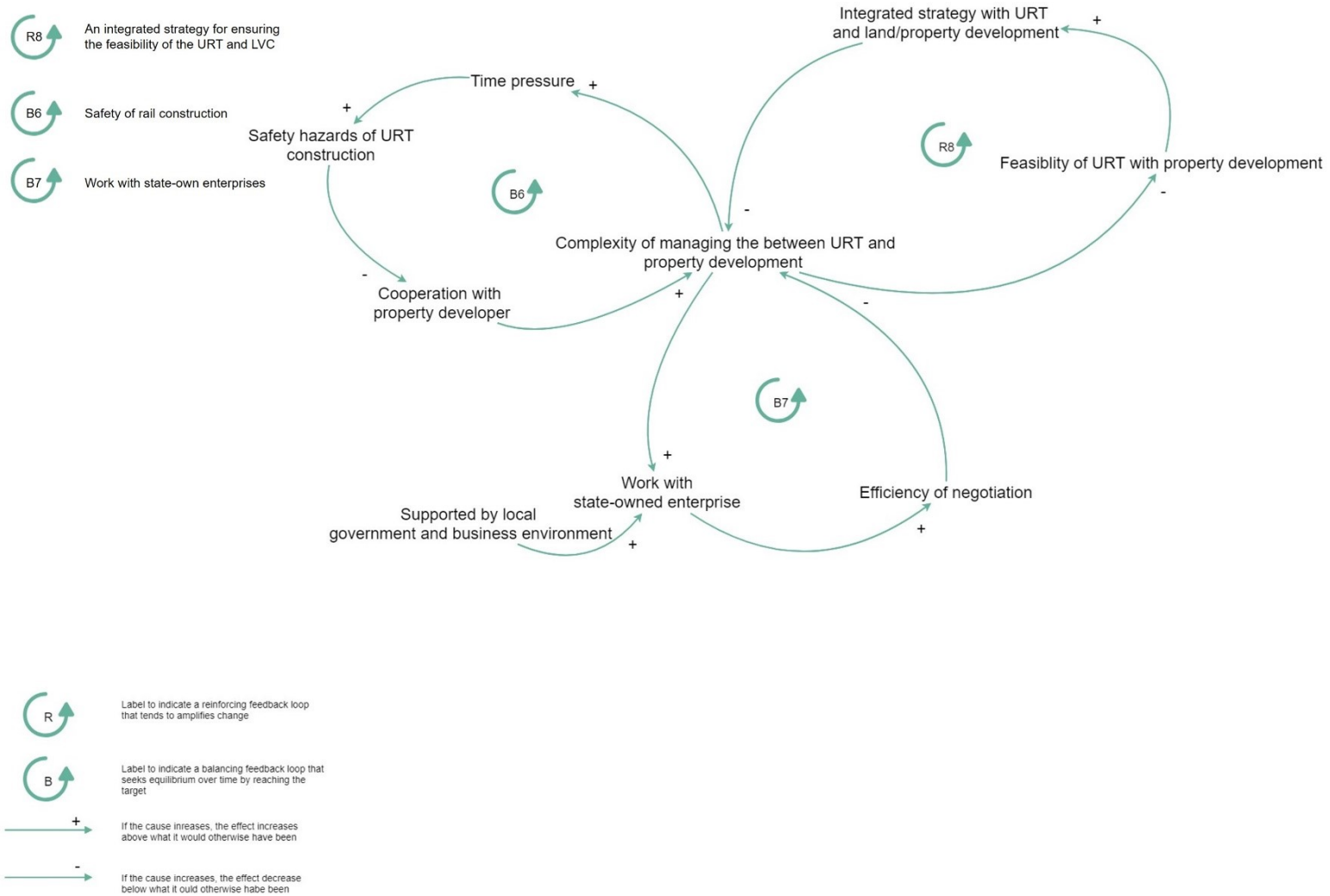


Figure 6.7 A CLD for the project management system

6.4.7 A Systemic Model of LVC to Support the Final Framework

Figure 6.8 presents the systemic model for implementing LVC to support URT, comprising four sub-systems. The implications of the systemic model are:

- The finance system within the systemic model acts as a medium to connect the other three sub-systems. For instance, a change in the planning system (e.g., decreasing uplifts of land/property value by URT systems) can adversely impact on finance system, which can have cascading influences on other sub-systems;
- Change in a variable can generate either positive or negative impacts on different sub-systems. For example, decreasing the acquirement of greenfield lands in the suburb may reduce the revenue of LVC, which can impair the performance of the finance system and the use of TOD in the planning system. While it may encourage the policy system to provide more substantial government support to improve the LVC; and
- Improving the performance of any sub-system needs the support from other three sub-systems. For example, improving the financial performance will require positive changes in the policy, planning and project management (e.g., stronger government support, higher uplift of the land value and better cooperation with developers) to provide a robust foundation.

The systemic model examines the interactive relationships between each knowledge thread and their collective influence on the performance of LVC. Take the "adjustment of land use" (Loop B3) and "the effect of supportive urban planning" (Loop R1) as an example. When the "land-use factors" improve, Loop B3 and R1 can positively affect the "revenue of LVC". This interactive relationship is in accord with the extant knowledge that zoning power can facilitate high-density and mixed land use within the TOD strategy, which would improve accessibility, uplift land value, and increase property development revenue (Li and Huang, 2020; Mathur and Gatdula, 2020). However, if local governments think that transit agencies have received sufficient revenue from LVC, they may decrease the support and then reject the improvement of "land use factors". As a result, Loop B3 and R1 tend to reduce the "revenue of LVC

collectively". At this point, the "revenue of LVC" is not necessarily reduced as other CLDs (e.g., Loop B1, B2, R6 and R7) within the systemic model can support it.

As shown in Figure 6.9, this systemic model demonstrates how the constituents of LVC can optimise revenue, cost, and risk for the final framework. The finance system is the foci of the systemic model with the "cost of land acquisition", "estimated profit of land/property development", "revenue of LVC' and "cooperation with property developer" links the three sub-systems. The collaborative process between the government agencies, transit agencies, and SOEs results in several sub-systems being brought together to stimulate the effectiveness of the development-based instruments (Loop B1), with loops such as accessibility-oriented/economic-development ones being critical (R2.2 and R3). As a result, the LVC strategy can reduce and manage the risk and uncertainties that influence URT on land/property value and enable profit generation.

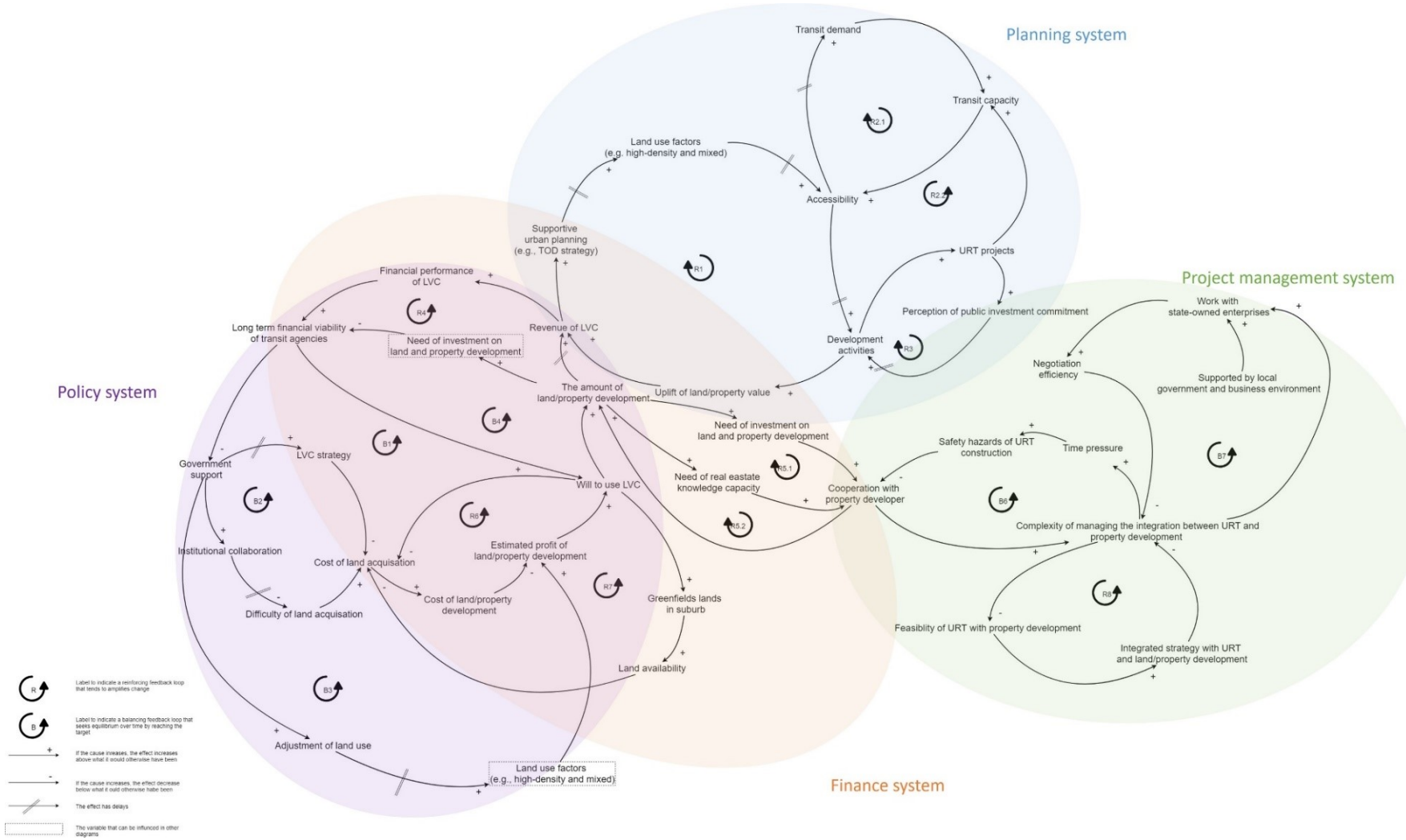


Figure 6.8 A systemic model for implementing LVC to support URT

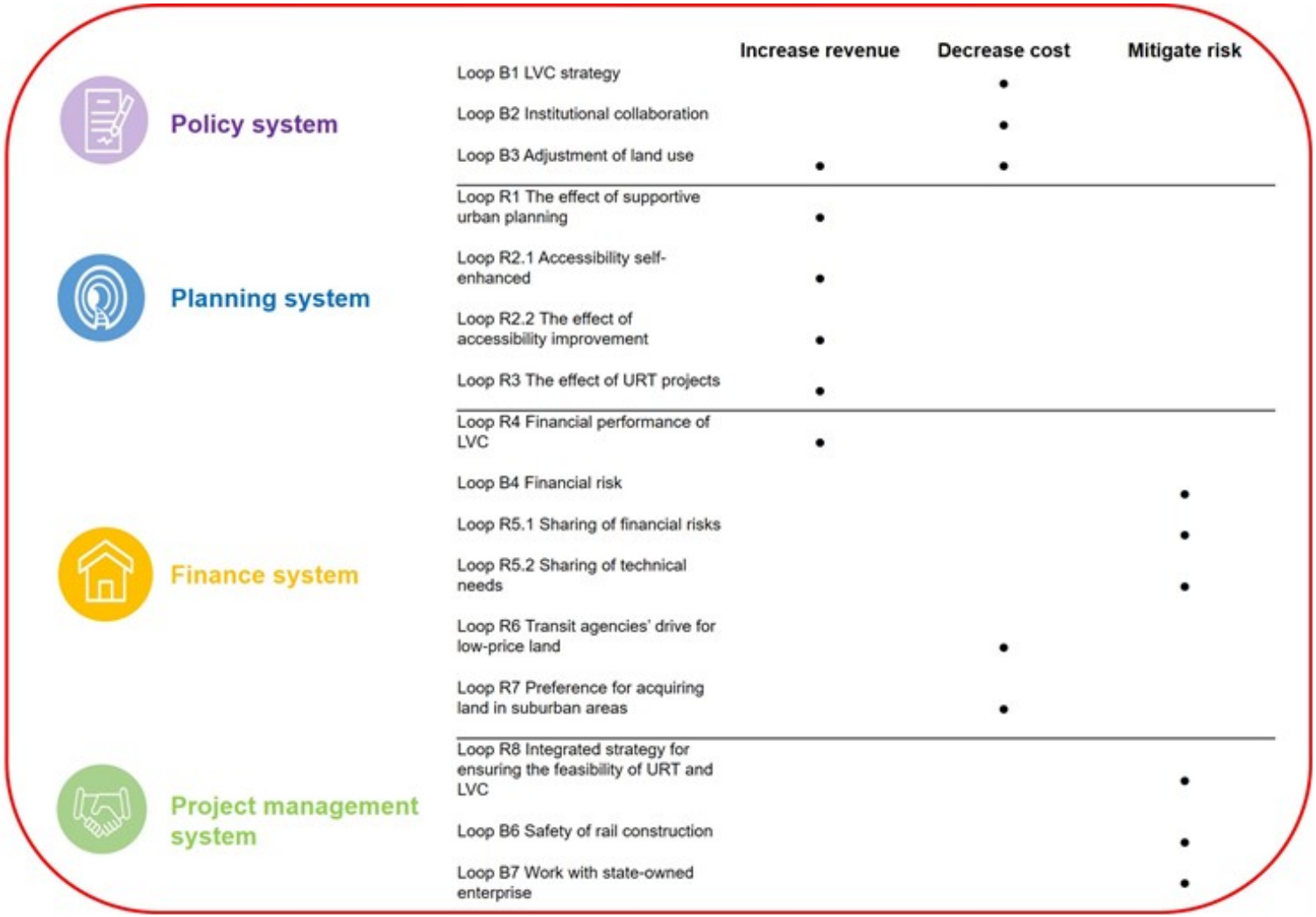


Figure 6.9 The balancing between increasing revenue, decreasing cost and mitigating risk in the systemic model

6.5 Implications for Policymaker and Research

The implications of this research for policymakers, researchers and alike are now examined and focus on seven themes: (1) applicability of the final PPP and LVC framework; (2) transit agencies governance; (3) ineffective TOD; (4) decrease cost and risk mitigation strategies for LVC; (5) selection of bundled or unbundled contract; (6) optimistic forecasts; and (7) the negative influence of URT's on the environment.

6.5.1 Applicability of the Final PPP and LVC Framework

The final PPP and LVC framework respond to the need for a robust and generic model that can assist decision-makers in effectively using the delivery of PPP and LVC to procure URTs (Chang and Phang, 2017; Sharma and Newman, 2018a). Indeed, it provides policymakers and the academic community with threefold contributions to the delivery of URTs through PPP and LVC.

The first contribution is that the final framework can help policymakers and academics have a holistic understanding of delivering URT systems and networks through PPP and LVC. Extant studies on URT PPP with LVC focus on examining the specific issues associated with the strategies, policies and problems and presenting insular experience (Luan *et al.*, 2014, Suzuki *et al.*, 2015; Chang and Phang, 2017; Sinha, 2021). To overcome the limitation of insular knowledge for URT PPP with LVC, this final framework is developed and validated across five cases in this study. Hence, this final framework presents a holistic knowledge of using PPP and LVC to deliver URTs, which can help policymakers and academics identify the issues that can contribute to its success, the relationships between these issues, and the viable strategies.

The second contribution is final framework can be a helpful tool for policymakers and academics to learn and analyse the extant experience of URT PPPs with LVC efficiently. The experience of URT PPPs with LVC can provide much information and be analysed by varied theoretical perspectives. For instance, the experience of Hong Kong MTR to deliver metro with LVC has been examined by transaction cost, growth coalition, and differential land rent (Chang and Phang, 2017, Loo *et al.*, 2018; Aveline-Dubach and Blandeau, 2019). For this matter, an appropriate theoretical framework is vital to policymakers and academics as it can focus on identifying information that is

highly related to their aims, which makes the learning and analysis process more efficient. With this in mind, the final framework is a valuable tool for policymakers and academics to learn and analyse the delivery of URT PPPs with LVC. It is specifically developed to improve the decision-making on this topic and has been validated through five case studies in this research.

The third contribution is that the final framework can provide policymakers with adaptable knowledge to (re) calibrate their policy to use PPP and LVC to deliver URT systems and networks effectively. The extant studies usually provide or recommend a specific model to use PPP and LVC for URTs (Chang and Phang, 2017; Newman *et al.*, 2018). However, the worldwide jurisdictions have significant differences in multiple aspects (e.g., public policies on PPP and LVC, transit agencies' role, population, economy, and land ownership). If policymakers aim to use PPP and LVC for URTs efficiently, they need to develop flexible policies rather than imitate the strategies or models from other experiences.

Developing flexible policies can be achieved by the final framework through its three specific aspects within the context and four dimensions of the project. The three aspects within context can help policymakers identify the basis of using PPP and LVC for URTs and figure out what they can do for this delivery. The four dimensions determine what issues can contribute to the project's success and interactive relationships and provide viable strategies, which can be a robust reference for policymakers. For example, when policymakers select procurement arrangements, the final framework can provide multiple options (i.e., bundled contract or unbundled contract) and discuss their advantages, weakness and improvement strategies to respond to the different contexts.

6.5.2 Transit Agencies Governance

In this study, the transit agencies perform a crucial role in delivering URT PPPs with LVC across Hong Kong and three Chinese cases. In the case of Hong Kong, the MTR is a joint venture that integrates PPP and LVC to reduce the transaction cost and maximise the return from real estate development for delivering URT systems and

networks. In the case of Guangzhou, Guiyang and Wuhan, the municipal transit agencies can use LVC to indirectly provide revenue to URT PPPs and monitor SPV's activities to decrease information asymmetry.

In these cases, the policies of PPP and LVC are the critical factor in determining transit agencies' role. For example, policies in Hong Kong allow the MTR to be privatised and have exclusive rights to develop land around the station, paving the foundation to use PPP and LVC in an integrated way. Similarly, the policies of China's governments provide support to the municipal transit agencies to help them use LVC and assign them to hold a share of SPV's equity to facilitate PPP delivery.

Drawing upon the experience of Hong Kong and three Chinese cities, the policymaker should consider how to calibrate their policies on the transit agencies to help the delivery of URT PPP with LVC more effectively. Transit agencies were reported to consider bracing the entrepreneurship, adopting financial innovation (e.g., LVC and PPP) and pursuing more economic goals that increase revenue rather than only moving commuters (Salon *et al.*, 2017). However, in the entrepreneurial process of transit agencies, whether they can successfully use LVC and PPP to deliver URTs and protect public interests are still unknown. Studies that examined the local government and land and planning authority had identified that institutions usually lack sufficient ability and capacity to ensure PPP project success or share too much of LVC's revenue to the private sector (McAllister, 2017; Artioli, 2021; Kim, 2021). Therefore, it is suggested that future research identify the appropriate policies and strategies to effectively govern transit agencies to improve the use of PPP and LVC for URTs.

6.5.3 Ineffective Transit-Oriented Development

The implementation of LVC to support URT projects is typically aligned with a TOD strategy; both can complement each other (Mathur and Smith, 2012; Thomas and Bertolini, 2017; Sahu, 2018; Mathur, 2019; Renne and Appleyard, 2019; Wang *et al.*, 2019; Ibraeva *et al.*, 2020). While the selected cases in this research support this view, it is revealed that selecting greenfield lands in suburban locations to support LVC with TOD can enable transit agencies to maximise their profit margins (Loop R7 in the

systemic model of LVC). Consequently, the pursuit of profit that drives the suburban preference within the use of development-based LVC may negatively influence the effectiveness of a TOD strategy's goal to mitigate urban sprawl. It is raised and reinforced an important issue - urban sprawl can result in inequity for residents regarding access to employment opportunities and public facilities (Wei and Ewing, 2018). Several studies have identified problems associated with the inequalities that manifest from development-based LVC (e.g., McAllister, 2017; Aveline-Dubach and Blandeau, 2019; Kim, 2020; Artioli, 2021; Davis, 2021). Thus, there is a need to examine the effectiveness of TOD in the context of suburbia and its impact on urban sprawl as a consequence of development-based LVC.

To this end, two issues come to mind here: Firstly, a TOD's success relies on high density and populations around the railway stations. However, a new station located in suburbia does not necessarily translate into increased population and commuters to support a TOD strategy. Thus, a TOD strategy's effectiveness cannot be guaranteed (Yang *et al.*, 2016). And secondly, a TOD strategy is often linked to property development and infrastructure funding. It can support an LVC mechanism by raising the government's capital and acquiring land near the URT station, converted into real estate. But when a TOD plan is implemented in suburbia, it may simply become an instrument to facilitate the area's growth rather than a tool for curbing its urban sprawl (Shen and Wu, 2019).

Policymakers can encourage their transit agencies to implement development-based LVC juxtaposed with TOD in high-density urban areas around stations to mitigate the "preference for acquiring land in suburban areas" (Loop R7 in the systemic model of LVC). While suggestions to combine LVC and TOD in high-density urban areas have been made in the literature, there is a lack of empirical research to support its use in practice (Ibraeva *et al.*, 2020). Thus, it is suggested that future empirical research examine the relationship between LVC and TOD in high-density urban areas.

6.5.4 Decrease Cost and Risk Mitigation Strategies for LVC

As shown in Section 6.4.7, the systemic model demonstrates that an effective LVC strategy can be achieved through revenue increase (i.e., value creation), cost decrease, and risk mitigation. However, there is an overwhelming tendency for the LVC literature to focus on revenue generation. Therefore, less attention is paid to decreasing costs and mitigating risks (e.g., Salon *et al.*, 2017; Mathur, 2019; Artioli, 2021). In the cases that have been examined, the transit agencies purchased land at a lower than the expected market value with support from the local government to decrease their costs and risk. However, in the case of the regeneration of Kings Cross (London), the transit agency did not need to purchase land as they already owned it, which helped significantly decrease their costs and financial risks (Suzuki *et al.*, 2015). The transit agencies in the selected cases collaborated with SOEs to implement LVC and ensure the economic viability of their URT. Nonetheless, outside of China, it has been seen that greater emphasis is on involving the private sector in funding and financing rail infrastructure systems and networks through the use of LVC (Newman *et al.*, 2018; Noring, 2019; Sharma and Newman, 2020).

6.5.5 Selection of Bundled or Unbundled Contract

Selecting which contract scope (i.e., bundled or unbundled) is best to deliver URT systems and networks through PPP and LVC is inconclusive in this research. Thus, there is a need to determine the criteria for using a bundled or unbundled contract in future. While there has been widespread discussion surrounding their advantages and disadvantages (Siemiatycki, 2006; Phang, 2007; Chang, 2013; Hong, 2016; Chang and Phang, 2017), studies have been unable to provide policymakers with a robust framework for selecting the optimal contract structure for their delivery. To address this issue, it is suggested to undertake a comparative study that can derive lessons learned by understanding the nuances and context of their delivery (e.g., types of contracts, modes of URT, implementation context and performance). As each case of transport PPP is unique, Roumboutsos (2015) has suggested that a unified standard for classifying and comparing projects' characteristics is required. Thus, it is recommended that such a classification be developed to compare and contrast URT

PPPs to identify best-practice and engender their performance improvement in future research.

6.5.6 Optimistic Forecast

The Delhi case explicitly brings to the fore issue that optimistic forecasts can result in financial failure. Optimistic transit demand forecasts are a leitmotiv with transport projects, and it is an issue that has received a considerable amount of attention (e.g., Sclar, 2001; Flyvbjerg, 2005; Siemiatycki, 2009; Li and Hensher, 2010). For the DAME project, the optimistic transit demand forecast impaired the revenue of the LVC. If LVC is used as a finance and/or funding mechanism, greater certainty around patronage forecasts will be required. While sophisticated forecasting models[19] exist, they cannot consider the effects of policy ideas, such as high-density or TOD and region-wide rail investment. Thus, forecasting needs to consider the accuracy of patronage and a broad range of circumstances (e.g., land use and how it interacts with transport). It needs to be acknowledged that transport systems have many users with varying objectives, which generate different costs to the URT systems (Salon, 2014; Salon *et al.*, 2017; Sharam and Newman, 2017; NESC, 2018). Therefore, it is suggested that future research needs to understand travel behaviour and how people will respond to different types of incentives linked with the LVC mechanism. Another pertinent issue that needs to be considered is the accessibility to the URT. Placing stations where user needs (e.g., the proximity of residential to retail developments) are met will enable benefits to assess better.

6.5.7 Negative Impact of the URT on Environment

A URT can negatively impact (e.g., interrupting economic activities and damaging cultural heritage) people's environment and social well-being throughout their life-cycle (Pulido *et al.*, 2018). These negative impacts can take the form of protests and even lawsuits (Carpintero and Petersen, 2015). To accommodate concerns from the

[19] The standard travel-forecasting model is the four-step method. Inputs are; (1) demographic and economic inputs; (2) location of homes and businesses; and (3) description of the transportation system. The four steps are; (1) number of trips; (2) origin and destination of each trip; (3) mode choice; and (4) time of day and route choice.

public (e.g., due to environmental concerns), the route selection for a URT may be amended. However, this may potentially jeopardise its financial viability (Carpintero and Siemiatycki, 2016). The International Finance Corporation (2015), for example, has developed an Environmental and Social Management Systems (ESMS), which contains a set of policies, procedures, and processes that can be used to manage environmental and social impacts and disputes that may emerge during the delivery of an asset. Pulido *et al.* (2018) recommended that the ESMS be applied to urban rail projects. This researcher concurs with this suggestion. However, in the context of PPPs, issues associated with governance will also need to be accommodated. For example, the ESMS emphasises the management of negative impacts that may arise during construction but provides insufficient attention to risks that can materialise during a rail project's operation and maintenance.

6.6 Chapter Summary

This chapter compares the five cases examined in this research. It then produces a final framework that policymakers can draw upon to help policymakers ensure the success of their URTs delivered using a PPP and supported by LVC successfully. A systemic model of LVC strategy is developed to support the final framework. Furthermore, the implication of seven research findings (e.g., the applicability of the final framework, transit agencies governance, and ineffective TOD) in this study to policymakers and researchers are also presented.

CHAPTER 7 CONCLUSION AND RECOMMENDATIONS

7.1 Chapter Introduction

The research presented in this thesis aims to contribute to knowledge by providing the understanding needed to integrate PPP and LVC for successfully delivering URTs. Under the auspices of an interpretive lens, based on the experiences of Hong Kong, Delhi, Guiyang, Guangzhou and Wuhan, a structured case study approach is used to develop a generic framework that can help policymakers successfully use PPP and LVC. The findings and outcomes derived and generalised from the previous chapters of this thesis, the policy recommendations stemming from this research, and the promising directions for future research are summarised and reported in this chapter.

7.2 URT PPPs with LVC

The background and the necessity for the research were examined in Chapter 1. As addressed and emphasised throughout this thesis, the primary aim of this research was to develop a generic framework based on the empirical evidence and current theories to help policymakers successfully use PPP and LVC to deliver URT systems and networks. To achieve this primary research aim, specific objectives including the development of the conceptual frameworks and the generation of the generic framework underpinned by the systemic model were identified. In addition, the structure of this thesis, its significance and contributions were explicitly described in Chapter 1. Overall, this research is theoretically and practically significant because it fills the current gap in the body of knowledge of using PPP and LVC in an integrated manner to deliver URTs. This research is the first to provide policymakers with a holistic understanding and generic framework that can be drawn upon to successfully procure a URT using a PPP that is supported by LVC.

After introducing the nature of the research, the review of normative literature was presented in Chapter 2, covering issues regarding the research of URT PPPs, LVC and their practice. The literature review confirmed the importance, necessity and significance of the study. It also revealed that only a limited number of studies had explored the important role of LVC in supporting PPPs, and there was a need to develop a robust framework that policymakers can draw upon to deliver URTs successfully.

7.3 Methodology

The limited number of studies examining URT PPPs with LVC revealed that the extant knowledge for this research question was insufficient to formulate the testable hypothesis. These studies also indicated that the access to objective data to understand the use of PPP and LVC for rail infrastructure was limited, but subjective data had been successfully adopted for the research. As a result, an interpretive qualitative research method was adopted to address the proposed research question, as was presented in Chapter 3. The research design was based on a structured cased study, which used a series of research cycles to develop conceptual frameworks. Each research cycle of the structured case was repeated until the final conceptual framework arose. At this point, data saturation occurred, creating conceptual frameworks to explain how URT PPPs with LVC succeed, representing a good picture of practice and the end of research process. With this research design, the unit of analysis, case selection, data collection strategy and content analysis were sequentially justified and described in Chapter 3. Overall, 27 semi-structured interviews and 101 documents were used for the collection of primary and secondary data and the analysis for this research.

7.4 The Initial Conceptual Framework (CF_1)

The initial conceptual framework (CF_1) was developed in Chapter 4, drawing from the antipodal experiences (i.e., success versus failure of PPPs and LVC) of Hong Kong MTR and DAME. A total of 31 publicly-available and critical documentary sources, published between 1999 and 2020, were collected, forming the empirical evidence for analysis and the development of CF_1.

The CF_1 encompasses “what goes right” (success) and “what goes wrong” (failure). The CF_1 identifies four core dimensions with interactive relationships that influence the success and failure of a URT project delivered via a PPP and LVC. The four dimensions of CF_1 are: (1) the nature of the PPP agreement, which focuses on the core relationships and elements of the procurement arrangement; (2) LVC, which emphasises the implementation of this mechanism and the mitigation of its risks; (3) the life-cycle process, which identifies the critical factors needed to ensure rail system functions well and the influence of surrounding property and land; and (3) governance,

which centres on the accountability, control and management of the URT, PPP and LVC. Thus, the CF_1 can provide a setting for policymakers to deeply understand the integration of PPP and LVC to deliver URTs. In addition, the optimistic transit demand and aggressive bidding of the DAME project were presented at the end of Chapter 4.

7.5 CF_2, CF_3, CF_4 and the Final PPP and LVC Framework

Chapter 5 presented the remaining research cycles of the structured case approach based on the experiences of Guiyang, Guangzhou, and Wuhan. A total of 27 semi-structured interviews were conducted between 2019 and 2021, and 70 publicly-available and critical documentary sources published between 2008 and 2021 served as the source of empirical evidence that is essential to produce each CF. In this chapter, the CF_1 was validated and transformed to CF_2 within the Guiyang case. Then, the CF_2 was validated and transformed to CF_3 within the Guangzhou case. The CF_3 was validated and transformed to CF_4 within the Wuhan case.

After comparing and combining the three conceptual frameworks, the final PPP and LVC framework is presented in Chapter 6. The final frameworks comprise three specific aspects within context (i.e., policies of PPP and LVC, the municipal transit agencies, and land acquisition within implementation procedure) and four dimensions of projects (i.e., PPP agreement, LVC, life-cycle process and governance). The three specific aspects within the context are connected and collectively constitute the backdrop of PPP and LVC to procure URTs. The four dimensions of projects can further determine the success and failure of a URT project delivered through a PPP and LVC. To be noted, based on the four dimensions mentioned in CF_1, newer critical issues were added to the final framework. The final framework additionally identifies that a decrease in the cost of land acquisition can contribute to the success of LVC and provides strategies in the dimension of governance to mitigate the overly optimistic estimate.

7.6 The Systemic Model

The LVC dimension of the final framework is supported by a systemic model, which is presented with empirical evidence collected from the Guiyang, Guangzhou and Wuhan cases in Chapter 6. The systemic model examined interdependency between

the constituents of LVC using a series of causal loop diagrams to illustrate the underpinning systemic relationships. The systemic model comprises four sub-systems: (1) policy; (2) planning; (3) finance; and (4) project management. Each of these sub-systems interacts with one another and, therefore, adversely affects the performance of LVC in URT projects. Moreover, the systemic model demonstrates that a successful LVC strategy needs to optimise revenue, cost, and risk. These findings of the systemic model are aligned with the value creation, risk mitigation and cost decrease of the LVC dimension within the final framework. Therefore, it can be concluded that the systemic model underpins the final framework to create a successful LVC strategy to support the URT PPP project.

7.7 Policy Recommendations from the Research

This research reveals a series of practical implications. To be exact, three specific policy recommendations can be learned from the research findings, and they are presented as follows.

7.7.1 Improve Transparency of the Decision-Making Process

The decision-making process on PPP and LVC has been criticised as lacking transparency. Transparency here means that the public is able to access the necessary information about policymaking on delivering rail infrastructure and the use of PPP and LVC. A lack of transparency in using PPP and LVC to deliver rail infrastructure can result in the public failing to protect their interests (Siemiatycki, 2007; Kim, 2020). Thus, improving transparency in the decision-making process has been advocated for the sake of the public interest (Hodge and Coghill, 2007; Siemiatycki, 2007; Hong, 2016).

However, a prevailing challenge is how to obtain a balance between disclosing critical data of URT PPPs to inform the public, ensuring commercial confidentiality, and adhering to legal requirements (Siemiatycki, 2015). With this in mind, it is suggested that governments consider employing a framework of disclosure akin to that developed by The World Bank (2015) to improve transparency throughout the management of an asset's life. The World Bank's (2015) framework was designed as a hierarchical

system to accommodate varying levels of disclosure. The framework can be combined with a jurisdictions' prevailing laws and regulations, the public sector capacity, and URT PPPs' contracts. If a government adopts this framework, it could better provide the disclosure needed to satisfy the public's curiosity and possible concerns and simultaneously protect the commercial confidentiality of bidders.

7.7.2 Set a Regime to Reduce the Political Influence

The final PPP and LVC framework that is developed in this research provides governments and policymakers with a platform to re-calibrate their existing policies and initiate a change process to accommodate a robust approach to delivering and financing their URTs. Amendments to procurement policies take time and need to be a pragmatic process and will require changes to how privatisation, financing, tax regime, and land use are approached. If the truth is told, political interference with changes to procurement policy and a lack of cooperation between agencies has jeopardised the success of URTs being procured using PPPs and LVC (Carpintero and Petersen, 2014; Salon *et al.*, 2017).

In light of such hindrances, policymakers need to make modest tweaks to the procurement policy of URT by setting a regime whereby the value creation mode can reduce the political influence. It is acknowledged that political influence can adversely affect the decision-making process and its success or failure (e.g., whether it goes ahead or not). Moreover, policymakers need to be cognizant that PPPs traditionally can perform poorly when used to deliver URTs, particularly when combined with LVC (Chapter 4). While aware of the risks of using a PPP and LVC, the regime and value-creation approach that has been incorporated into the final framework can contribute to an effective procurement process. A case in point can be found in Copenhagen's (Denmark) city-wide metro system, where national regulations were established to ensure an SPV's yield is "sheltered from political interference" (Noring, 2019, p.125). The regulations mandate that the SPV should continuously optimise its revenue through its private management, placing it in a position to maximise its profit from LVC.

7.7.3 Use Independent Organization to Prepare Technical Documents

Financial losses and cost overruns can result from inaccuracies and mistakes in technical documents (e.g., transit demand forecasts and preliminary feasibility studies). These flawed technical documents could be created by the professional institutions established by the government. At this point, the close connection between professional institutions and governments could be the cause for these mistakes to happen to ensure the project can be implemented. For this matter, it is suggested that policymakers should consider using an independent organisation to create and audit critical technical documents (e.g., forecasts and feasibility studies) for their URT PPPs with LVC projects.

For instance, it is identified that the forecasts of the DAME project prepared by the RITES established by the Government of India were inaccurate. The need and pressure to complete the DAME and ensure it was operational for the Commonwealth Games resulted in the RITES being placed to create and supervise the project's forecast, which might have been used to justify its construction. It would appear that there was a political drive to ensure this project went ahead. For this matter, there needs to be political independence when preparing transit demand forecasts in PPPs (Carpintero and Petersen, 2014). To reduce the likelihood of this issue, the technical documents should be prepared by an independent organisation (Siemiatycki, 2009).

7.8 Future Research

Before this research was undertaken, studies had seldomly investigated how to use PPP and LVC to support URT systems and networks in an integrated manner effectively. Therefore, this research has contributed to the creation of new knowledge by developing a generic framework to help policymakers use PPP and LVC to deliver URTs. While the developed framework contributes to the normative literature, opportunities for future research prevail due to its development.

Further research needs to expand the scope of this study to examine the nuances of this generic framework and improve its applicability. The more in-depth relationship within the four dimensions within the developed framework requires more empirical and theoretical inquiry to enhance their ability to contribute to the success of a project.

There is a need to compare the developed framework with other forms of LVC, such as tax or fee-based approaches to determine its validity and reliability, particularly for its application to other cities worldwide. In addition, future research can transfer the generic framework to a practical guideline for the key stakeholders (e.g., policymakers and regulatory authorities) to improve the delivery of rail infrastructures through PPP and LVC.

Additionally, Chapter 6 has discussed research findings for policymakers and academics with suggestions for future studies. These suggestions are summarised and restated:

- Identify the appropriate policies and strategies to govern transit agencies effectively to improve the use of PPP and LVC for URTs;
- Examine the relationship between LVC and TOD in high-density urban areas;
- Explore the strategies to decrease costs and mitigate risks in the use of LVC;
- Determine the criteria for using a bundled or unbundled contract to identify best-practice of URT PPPs with LVC and engender their performance improvement;
- Acquire an understanding of travel behaviour and how people will respond to different types of incentives that are linked with the LVC mechanism; and
- Develop an environmental and social management system to use PPP and LVC to deliver URTs.

7.9 Chapter Summary

This chapter has summarised and reported the findings derived from the previous chapters of this research. Further, a series of policy recommendations have been drawn from the research findings and provided for the policymaker, including: (1) improving transparency in the decision-making process of URT PPPs with LVC; (2) setting a regime to reduce political influence; and (3) using independent organisations to prepare technical documents. More importantly, this chapter also recommended several future research opportunities to study URT PPPs with LVC. For example, future research should expand the scope of this research to examine the nuances of the developed framework and explore the strategies that can decrease costs and mitigate risks in the use of LVC.

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APPENDICES

Appendix A: Core Articles for Systematic Review

The list of core articles for systematic review

Year	Number	Author/Title/Journal	LCS[a]	GCS[b]	LCR[c]
1995	1	Lesley, L. Public and private funding in new urban public transport *Public Money and Management*, 1995, 15(4), 61-64	0	0	0
2002	2	Shaoul, J. A financial appraisal of the London underground public-private partnership *Public Money and Management*, 2002, 22(2), 53-60	1	23	0
2006	3	Siemiatycki, M. Implications of private-public partnerships on the development of urban public transit infrastructure – The case of Vancouver, Canada *Journal of Planning Education and Research*, 2006, 26(2), 137-151	6	30	0
2007	4	Phang, S. Y. Urban rail transit PPPs: Survey and risk assessment of recent strategies *Transport Policy*, 2007, 14(3), 214-231	9	37	0
	5	Hodge, G. A., and Coghill, K. Accountability in the privatized state *Governance: An International Journal of Policy Administration and Institutions*, 2007, 20(4), 675-702	0	43	0
	6	Siemiatycki, M. What's the secret? Confidentiality in planning infrastructure using public/private partnerships *Journal of The American Planning Association*, 2007, 73(4), 388-403	0	28	1

2009	7	Solino, A. S., and Vassallo, J. M. Using public-private partnerships to expand subways: Madrid-Barajas international airport case study *ASCE Journal of Management in Engineering*, 2009, 25(1), 21-28	2	19	0
	8	Kiggundu, A. Financing public transport systems in Kuala Lumpur, Malaysia: challenges and prospects *Transportation*, 2009, 36(3), 275-294	0	3	0
2010	9	de Jong, M., Mu, R., Stead, D., Ma, Y. C., and Xi, B. Introducing public-private partnerships for metropolitan subways in China: what is the evidence? *Journal of Transport Geography*, 2010, 18(2), 301-313	0	42	1
2012	10	Brandao, L. E., Bastian-Pinto, C., Gomes, L. L., and Labes, M. Government supports in public-private partnership contracts: Metro line 4 of the Sao Paulo subway system *ASCE Journal of Infrastructure Systems*, 2012, 10.1061/(asce)is.1943-555x.0000095	1	8	0
2013	11	Bray, D., and Sayeg, P. Private sector involvement in urban rail: Experience and lessons from South East Asia *Research in Transportation Economics*, 2013, 39(1), 191-201	0	0	1
	12	Gordon, C., Mulley, C., Stevens, N., and Daniels, R. How optimal was the Sydney Metro contract? Comparison with international best practice *Research in Transportation Economics*, 2013, 39(1), 239-246	0	3	0
	13	Gordon, C., Mulley, C., Stevens, N., and Daniels, R. Public-private contracting and incentives for public transport: Can anything be learned from the Sydney Metro experience? *Transport Policy*, 2013, 27, 73-84	0	5	0
	14	Cruz, C. O., and Marques, R. C. Endogenous determinants for renegotiating concessions: Evidence from local infrastructure	1	21	0

		Local Government Studies, 2013, 39(3), 352-374			
	15	Chang, Z. Public-private partnerships in China: A case of the Beijing No.4 Metro line *Transport Policy*, 2013, 30, 153-160	3	10	1
2014	16	Luan, X. F., Lin, X. B., McGuinness, E., and Yang, J. W. Emerging public-private partnerships in China's rail mass transit case of Shenzhen *Transportation Research Record*, 2014, 2450, 127-135	0	2	1
	17	Carpintero, S., and Petersen, O. H. PPP projects in transport: evidence from light rail projects in Spain *Public Money and Management*, 2014, 34(1), 43-50	3	8	1
	18	Tserng, H. P., Ho, S. P., Chou, J. S., and Lin, C. Proactive measure of governmental debt guarantees to facilitate public-private partnerships project *ASCE Journal of Civil Engineering and Management*, 2014, 20(4), 548-560	0	5	1
2015	19	Bon, B. A new megaproject model and a new funding model. Travelling concepts and local adaptations around the Delhi metro *Habitat International*, 2015, 45, 223-230	0	1	0
	20	Cruz, C. O., Marques, R. C., and Pereira, I. Alternative contractual arrangements for urban light rail systems: lessons from two case studies ASCE Journal of Construction Engineering and Management, 2015, 141(3), 05014017	0	2	2
	21	Carpintero, S., and Petersen, O. H. Bundling and unbundling in public-private partnerships: Implications for risk sharing in urban transport projects *Project Management Journal*, 2015, 46(4), 35-46	0	7	2
	22	Fombad, M. C.	0	0	0

		Governance in public-private partnerships in South Africa: Some lessons from the Gautrain *Journal of Southern African Studies*, 2015, 41(6), 1199-1217			
2016	23	Ramos-Santiago, L. E., Brown, J. R., and Nixon, H. Streetcar resurgence in the United States transit strategy, growth machine tactic, or some of both? *Transportation Research Record*, 2016, 2540, 30-38	0	0	1
	24	Cohen, R., and Boast, T. Governance of public-private partnerships and infrastructure delivery: Case of the Milan, Italy, Metro Line M4 *Transportation Research Record*, 2016, 2597, 37-43	0	0	0
	25	Alpkokin, P., Kiremitci, S. T., Black, J. A., and Cetinavci, S. LRT and street tram policies and implementation in Turkish Cities *Journal of Transport Geography*, 2016, 54, 476-487	0	2	3
	26	Carpintero, S., and Siemiatycki, M. The politics of delivering light rail transit projects through public-private partnerships in Spain: A case study approach *Transport Policy*, 2016, 49, 159-167	0	0	3
	27	Hong, S. When does a public-private partnership (PPP) lead to inefficient cost management? Evidence from South Korea's urban rail system *Public Money and Management*, 2016, 36(6), 447-454	1	3	3
2017	28	Ke, Y., Hao, W., Ding, H., and Wang, Y. Factors influencing the private involvement in urban rail public-private partnership projects in China *Construction Economics and Building*, 2017, 17(1), 90-106	0	0	1
	29	Sturup, S. Swimming or Drowning in the Depths of Partnership	0	0	1

	Australian Journal of Public Administration, 2017, 76(3), 288-300			
30	Feng, K., Xiong, W., Wang, S.Q., Wu, C. L., and Xue, Y. G. Optimizing an equity capital structure model for public-private partnership projects involved with public funds *ASCE Journal of Construction Engineering and Management*, 2017, 143(9), 10.1061/(asce)co.1943-7862.0001349	0	0	1
31	Chang, Z., Phang, S. Y. Urban rail transit PPPs: Lessons from East Asian cities *Transportation Research Part A: Policy and Practice*, 2017, 105, 106-122	0	0	3

[a]LCS = Local Citation Score: Number of citations to the paper from within the 31 collections

[b]GCS = Global Citation Score: Number of citations to the paper from all sources, as reported in Web of Science when the data was downloaded

[c]LCR: Local Cited References: Number of records in 31 collections that are cited by the paper

Appendix B: Semi-structured Interview Question Protocol

The semi-structured interview question protocol

1.0 Target Population

The target population of the interviews were practitioners and government staff who have experience in URT PPPs and stakeholders who are influenced by the Urban Rail Transit Public-Private Partnerships (URT PPPs) delivery. Specifically, they are:

1) Staff in public authorities who engaged in the decision-making process of URT PPPs
2) Project director, manager, consultants and engineers who are taken in the URT PPPs projects
3) Property developers, landowners and residents who were influenced by the URT PPPs when it employs Land Value Capture (LVC)

2.0 Interview Questions

2.1 Delivery Dimension

1. Can you give some background about the PPP delivery used in this URT project?
   - Do you consider the PPP used in this URT project is the most appropriate delivery method?
   - Do you have any suggestions for optimizing the PPP used in these URT projects?
2. Can you describe the project structure used in this URT PPP?
   - Do you consider the contract strategy used in this URT PPPs is the most appropriate approach?
   - What are thoughts you have on the bundled or unbundled contract of PPP used in these URT projects?
   - Have you ever thought about using the joint venture structure in these URT PPPs
3. Can you describe the financial model used in this URT PPP?
   - Do you consider the financial model used in this URT PPPs is the most appropriate approach?
   - Do you consider the capital and operating expenditure of this URT PPP is reasonable?
   - Have you ever considered any methods to improve the expenditure of this URT PPP?
   - Have you ever considered other innovative finance or funding method for this URT PPP?

2.2 Project Dimension

1. Can you give some background about the construction and operation of this URT PPPs project?
   - Do you consider the construction and operation of this URT PPPs project will influence the value of surrounding property and land?
   - Which factor of the construction and operation in URT PPPs projects is the most important to affect the value of surrounding property and land?
2. Can you give some background about the specific circumstance (population, economy and traffic condition) associated with this URT PPP?
   - Do you consider that the demand forecast and ridership have highly relied on the specific circumstance?
   - Which factor do you think is the most important one for improving the ridership of this URT PPP?

2.3 Governance Dimension

1. Can you give some background about key government policies associated with this URT PPP?
   - Which policy/regulation do you think has the most significant impact on the decision-making process of URT PPPs?
   - What kind of aspects do you think that the public sector was needed to improve for more effectively regulating the URT PPPs?
2. What do you think about the planning and design of this URT PPP?
   - Do you consider the urban planning associated with this URT PPP project is the appropriate one?
   - What are the thoughts you have on employing the transit-oriented development (TOD) principle with this URT PPP?

2.4 Land Value Capture Dimension

1. What are the thoughts you have on using land value capture (LVC) in this URT PPP?
   - Do you consider using LVC could bring both financial and social benefits (especially about the justice issues) in this URT PPP?
   - Do you consider that employing LVC could have a negative effect on this URT PPP?

2. Which criteria is the most important one for choosing types of LVC mechanism (Tax or fee-based LVC or development-based LVC) in URT PPPs?

- What kind of population should be charged if this URT PPP used the tax-fee based LVC?
- What kind of properties (e.g., station, residence, retail or office) should be developed if this URT PPP used the development based LVC?

3. How do you think about the risk management of the LVC mechanism in this URT PPP?

- What are thoughts you have on transferring the risk of property development to the real estate company?
- Do you consider the external stakeholders like the local community and landowner have an obvious impact on the LVC performance of this URT PPP?

3.0 Glossary

Bundled Contract. The bundled contract indicates that the project is implemented on the basis of one PPP agreement with a single private sector partner. In this situation, the private sector partner generally assumes responsibility for the construction of civil infrastructure, mechanical and electrical work, procurement of rolling stock, and operation of the system

Capital Expenditure (CAPEX). The capital expenditure refers to the initial construction costs of the infrastructure plus any expenditure on the constructed PPP assets that is not an operating expenditure.

Development-Based LVC. The development based LVC indicates that capturing the viable increase in the value of land is manipulated through the direct transaction of properties where they are increased by public regulatory decision or infrastructure investment.

Financial Model. The financial model refers to the information that incorporates, for the duration of the contract, all the investments, revenues, costs, and compensation (including grants, service payments and subsidies).

Joint Venture. The joint venture is also widely used to refer to “mixed equity companies” or “empresas mixtas”.

Land Value Capture (LVC). The land value capture is defined as the mobilization for the community at large some or all of the land value increments (unearned income) generated by actions other than the landowners such as public investments in infrastructure or administrative changes in land use norms and regulations.

Operating Expenditure (OPEX). The operating expenditure refers to costs for operating the infrastructure asset after construction delivery.

Project Structure. The project structure refers to the architecture of contract relationships and cash flows that govern the development and life of the project.

Public Private Partnership (PPPs). PPPs refer to a long-term contract between a private party and a government entity for providing a public asset or service, in which the private party bears significant risk and management responsibility, and remuneration is linked to performance. PPPs typically include various models, like design-build-finance-operate-maintain (DBFOM), operations and maintenance (O&M) contract and joint venture.

Social Benefits. Social benefits refer to the increase in the welfare of a society that is derived from a particular course of action.

Special Purpose Vehicle (SPV). The special purpose vehicle refers to an entity created to undertake a single task or project in order to protect the shareholders with limited liability, often used for limited or non-recourse financing.

Tax or fee-Based LVC. The tax or fee-based LVC indicates that capturing the viable increase in the value of land is manipulated through various tax or fee instruments to extract surplus from property owners.

Transit-Oriented Development (TOD). Transit-oriented development refers to a type of urban development that maximizes the amount of residential, business and leisure space within walking distance of public transport

Unbundled Contract. The unbundled contract indicates that the project is split into various contracts (e.g., PPP agreement), each addressing one project component or a combination of them: (1) construction of civil works, (2) electromechanical equipment, (3) procurement of rolling stock, and (4) O&M of the system

Appendix C: Critical Documents for Hong Kong and Delhi Cases

The list of critical documents that are used to analyse Hong Kong and Delhi cases

Number	Critical Document	Type	Delhi	Hong Kong
N1	MTR Privatisation Share Offer Global Offering by The Financial Secretary Incorporated on behalf of the Government of the Hong Kong Special Administrative Region (MTR Corporation Ltd., 2000)	Official Document		●
N2	2015 Annual Results (MTR Corporation Ltd., 2016)	Official Document		●
N3	2017 Annual Results (MTR Corporation Ltd., 2018)	Official Document		●
N4	2019 Annual Results (MTR Corporation Ltd., 2020)	Official Document		●
N5	Airport Metro Express Line Concession Agreement (Delhi Metro Rail Corporation Ltd., 2008)	Official Document	●	
N6	Annual Report 2012-2013 on the Reliance (Reliance Infrastructure, 2013)	Official Document	●	
N7	Report No. 13 of 2013 - Compliance Audit on Observations of Union Government, Commercial, Chapter 15 Ministry of Urban Development. (Comptroller and Auditor General of India, 2013)	Government Document	●	
N8	Mass Transit Railway Bill (Hong Kong Legislative Council, 1999)	Government Document		●
N9	Rajya Sabha Unstarred Question No.1709, Answered on 06.02.2014, Ministry of Urban Development (Council of States, 2014)	Government Document	●	

N10	Rajya Sabha Unstarred Question No.2163, Answered on 29.08.2013, Ministry of Urban Development (Council of States, 2013)	Government Document	●	
N11	LCQ20: Attendances of government officials at MTR Corporation Limited Board meetings (Transport and Housing Bureau, 2019)	Government Document		●
N12	Union Audit Reports, "Implementation of Phase I of Delhi Mass Rapid Transit System by Delhi Metro Rail Corporation Limited (Comptroller and Auditor General of India, 2008)	Government Document	●	
N13	Can land value capture make PPP's competitive in fares? A Mumbai case study (Sharma and Newman, 2018a)	Academic Publication	●	
N14	Cleaner-Energy Investments: Cases and Teaching Notes (Sunderasan, 2016)	Academic Publication	●	
N15	Delhi airport metro fiasco: What can be done to redeem the project? (Pratap, 2013)	Academic Publication	●	
N16	Delhi Airport Metro: PPP in Distress (Sinha, 2015)	Academic Publication	●	
N17	Financing Transit-Oriented Development with Land Values: Adapting Land Value Capture in Developing Countries (Suzuki *et al.*, 2015)	Academic Publication	●	●
N18	Study of the Integrated Rail-Property Development Model in Hong Kong (Tang *et al.* 2004)	Academic Publication		●
N19	Leveraging property values for metro railway development in Hong Kong: Experience and lessons (Tang, 2017)	Academic Publication		●
N20	Rail and property development in Hong Kong: Experiences and extensions (Cervero and Murakami, 2009)	Academic Publication		●

N21	The political economy of transit value capture: The changing business model of the MTRC in Hong Kong (Aveline-Dubach and Blandeau, 2019)	Academic Publication		●
N22	Urban rail transit PPPs: Lessons from East Asian cities (Chang and Phang, 2017)	Academic Publication		●
N23	Urban rail transit PPPs: Survey and risk assessment of recent strategies (Phang, 2007)	Academic Publication		●
N24	Land Value Capture: Final Report (Transport for London, 2017)	Expert Report		●
N25	Study on Urban Transport Sector in India (JICA *et al.,* 2013)	Expert Report	●	
N26	2011 The Rating Rational of Delhi Airport Metro Express Private Limited (ICRA, 2011)	Expert Report	●	
N27	The Urban Rail Development Handbook (Pulido *et al.*,2018)	Expert Report	●	●
N28	What Price Value Capture? (Terrill, 2017)	Expert Report	●	●
N29	Delhi Airport Metro Line debacle: The way forward （Das, 2013)	Newspaper	●	
N30	End of the line? (Dutta, 2012)	Newspaper	●	
N31	Fissures between Delhi Metro and Anil Ambani group pose firm questions about the PPP model (Raja *et al.*, 2012)	Newspaper	●	

Appendix D: Critical Documents for Guiyang, Guangzhou and Wuhan Cases

The list of critical documents that are used to analyse Guiyang, Guangzhou and Wuhan cases

Number	Critical Document	Type	Guiyang	Guangzhou	Wuhan
N1	Announcement of Winning the Bid of No. 11 Line's Civil Work and Underground Utility Tunnel (in Chinese) (China Railway Group Limited, 2016)	Official Document		●	
N2	PPP Agreement of No. 12 Line (in Chinese) (China Central Government Procurement, 2020)	Official Document			●
N3	The Land Acquisition Announcement for No. 12 Line in Wuhan (in Chinese) (Qiaokou District Government, 2020)	Official Document			●
N4	Guangzhou Metro Group Wins the Bidding of Line 11's Chisha Depot Land (in Chinese) (Guangzhou Municipal Planning and Natural Resource Bureau, 2021)	Official Document		●	
N5	Feasibility Study of No.11 Line's Underground Utility Tunnel (in Chinese) (Guangzhou Road Engineering Research Centre, 2018)	Official Document		●	
N6	PPP scheme of No.11 Line's Underground Utility Tunnel (in Chinese) (Guangzhou Road Engineering Research Centre, 2016)	Official Document		●	
N7	The Land Acquisition Announcement for No.11 Line in Guangzhou (in Chinese) (Tianhe District Government, 2018)	Official Document		●	
N8	The Notice of Accelerating the Preparation of No. 11 Line's Underground Utility Tunnel (in Chinese) (Department of Building and Housing, 2016)	Official Document		●	
N9	The Land Acquisition Announcement for Phase One of No. 2 Line in Guiyang (in Chinese) (Nanming District Government, 2015)	Official Document	●		

N10	The Bidding Announcement of Line 2's Sanqiao Station Complex Construction (in Chinese) (Guiyang Public Resource Trading Centre, 2021)	Official Document	●		
N11	PPP Scheme of the First Phase of Guiyang Rail Transit No. 2 Line (in Chinese) (Guiyang URT Company, 2015)	Official Document	●		
N12	PPP Scheme of the Second Phase of Guiyang Rail Transit No. 2 Line (in Chinese) (Guiyang Transportation Commission, 2016)	Official Document	●		
N13	The Design Features of No. 2 Line (in Chinese) (Guiyang URT Company, 2016)	Official Document	●		
N14	2010-2018 China Rail Transit Resources Management Report (in Chinese) (in Chinese) (China Association of Metros, 2020b)	Official Document	●	●	●
N15	2015 Guiyang Metro Co., Ltd. Renewable Corporate Bond Prospectus (in Chinese) (Haitong Securities Company Limited, 2015)	Official Document	●		
N16	2016 Announcement on the Listing of the First Phase of Wuhan Metro Group Co., Ltd. Renewable Corporate Bonds (in Chinese) (Haitong Securities Company Limited, 2016)	Official Document			●
N17	2017 Annual Report of Corporate Bonds (in Chinese) (Wuhan Metro Group Company, 2017)	Official Document			●
N18	2017 Urban Rail Transit Resources Management Annual Report (in Chinese) (China Association of Metros, 2019a)	Official Document	●	●	●
N19	2018 Urban Rail Transit Statistical Yearbook (in Chinese) (China Association of Metros, 2018)	Official Document	●	●	●
N20	2019 Announcement on the Listing of the Third Phase of Guangzhou Metro Group Co., Ltd. Green Bonds (in Chinese) (Guangfa Securities Company Limited, 2019)	Official Document		●	

N21	2013 Annual Report (in Chinese) (Guangzhou Metro Group Company, 2014)	Official Document		●	
N22	2019 Annual Report (in Chinese) (Guangzhou Metro Group Company, 2020)	Official Document		●	
N23	2019 Annual Report of Corporate Bonds (in Chinese) (Wuhan Metro Group Company, 2019)	Official Document			●
N24	2019 Statistics and Analysis Report of Urban Rail Transit (in Chinese) (China Association of Metros, 2020a)	Official Document	●	●	●
N25	2019 Urban Rail Transit Statistical Yearbook (in Chinese) (China Association of Metros, 2019b)	Official Document	●	●	●
N26	2020 Urban Rail Transit Statistical Yearbook (in Chinese) (China Association of Metros, 2020c)	Official Document	●	●	●
N27	2014 Opinions of the State Council on Strengthening the Management of Local Governments' Debts (in Chinese) (State Council of China, 2014a)	Government Document	●	●	●
N28	2014 Guiding Opinions of the State Council on Encouraging Societal Capital Organization to Invest in Innovative and Key Fields (in Chinese) (State Council of China, 2014b)	Government Document	●	●	●
N29	2014 Opinions of the General Office of the State Council on Supporting Railway Construction and Implementing Comprehensive Land Development (in Chinese) (State Council of China, 2014c)	Government Document	●	●	●
N30	2014 Notice on Promoting the Use of Public Private Partnership (in Chinese) (Ministry of Finance, 2014a)	Government Document	●	●	●
N31	2014 Guidelines on the Operation of Public-Private Partnership (Trial) (in Chinese) (Ministry of Finance, 2014b)	Government Document	●	●	●

N32	2015 PPP Project Contract Guidelines (Trial) (in Chinese) (Ministry of Finance, 2015a)	Government Document	●	●	●
N33	2015 Guidelines for Financial Viability of Public-Private Partnership (in Chinese) (Ministry of Finance, 2015b)	Government Document	●	●	●
N34	2015 Notice of the National Development and Reform Commission on Strengthening Urban Rail Transit Planning and Construction Management (in Chinese) (National Development and Reform Commission, 2015b)	Government Document	●	●	●
N35	2017 Notice on Further Regulating the Debt Financing Behaviour of Local Governments (in Chinese) (Ministry of Finance, 2017)	Government Document	●	●	●
N36	2017 Notice on Strengthening the Risk Management in PPP of Centrally Administered State-owned Enterprises (CSOEs) that are Administered by the Central Government (in Chinese) (State-owned Assets Supervision and Administration Commission, 2017)	Government Document	●	●	●
N37	2018 Opinions of the General Office of the State Council on Further Strengthening Urban Rail Transit Planning and Construction Management (in Chinese) (State Council of China, 2018)	Government Document	●	●	●
N38	2017 Notice of the General Office of the Municipal People's Government on the Establishment of Guiyang Urban Rail Transit PPP Project Executive Committee (in Chinese) (Guiyang Government, 2017)	Government Document	●		
N39	2017 Project Implementation Plan of Pilot PPP Projects in Guangzhou (in Chinese) (Guangzhou Government, 2017b)	Government Document		●	
N40	Reply to Municipal Proposal No. 20200211 (in Chinese) (Wuhan Natural Resources and Planning Bureau, 2020)	Government Document			●
N41	Instruction of Public Private Partnership project (in Chinese) (China Central Government Procurement, 2016)	Government Document	●	●	●

N42	Opinions of Wuhan on Promoting the Use of PPP in the Public Service (in Chinese) (Wuhan Government, 2016)	Government Document			●
N43	2016 Notice on Conducting the Pilot Scheme of Supporting Underground Utility Tunnel by the Fund of Central Government (in Chinese) (Ministry of Housing and Urban-Rural Development, 2016)	Government Document		●	
N44	Guangzhou Government Provides more than 16 billion RMB to Support the Construction of Guangzhou Metro for Ten Years (in Chinese) (Department of Finance, 2021)	Government Document		●	
N45	Biography: Xiulan Ye (in Chinese) (Guangzhou Government, 2012)	Government Document		●	
N46	2015 Guiyang City Rail Transit Construction Management Regulation (in Chinese) (Guiyang Government, 2015)	Government Document	●		
N47	2017 Implementation Regulations for the Construction of Guangzhou Rail Transit Station Complex and the Comprehensive Development Land (Trial) (in Chinese) (Guangzhou Government, 2017a)	Government Document		●	
N48	2018 Land Reserve Management Regulation (in Chinese) (Ministry of Land and Resources, 2018)	Government Document	●	●	●
N49	2010 The Master Plan of Wuhan City (2010-2020) (in Chinese) (Wuhan Government, 2010)	Government Document			●
N50	2014 Opinions of Wuhan Municipality on Accelerating the Development of Rail Transit (in Chinese) (Wuhan Government, 2014)	Government Document			●
N51	2016 The National Development and Reform Commission Organised a Seminar on the Innovation of Urban Rail Transit Investment and Financing Mechanisms (in Chinese) (Chinese Central Government, 2016)	Government Document	●	●	●

N52	Introducing public-private partnerships for metropolitan subways in China: what is the evidence (de Jong *et al.,* 2010)	Academic Publication	●	●	●
N53	A financing mode of Urban Rail transit based on land value capture: A case study in Wuhan City (Sun *et al.,* 2017)	Academic Publication			●
N54	Bypassing institutional barriers: New types of transit-oriented development in China (Song *et al.*, 2021)	Academic Publication		●	
N55	Developing metro-based accessibility: Three aspects of China's Rail+Property practice (Yang *et al.,*2020b)	Academic Publication	●	●	●
N56	Effects of transit-oriented development (TOD) on housing prices: A case study in Wuhan, China (Li and Huang, 2020)	Academic Publication			●
N57	Financialisation in the making of the new Wuhan (Luan and Li, 2020)	Academic Publication			●
N58	Impact of bus rapid transit and metro rail on property values in Guangzhou, China (Salon *et al.*, 2014)	Academic Publication		●	
N59	Institutional barriers to financing transit-oriented development in China: Analysing informal land value capture strategies (Wang *et al.*, 2019)	Academic Publication	●	●	●
N60	Analysis of Urban Rail Transit Joint Development Mechanism (in Chinese) (Pan and Wang, 2019)	Academic Publication		●	
N61	Development and applications of common utility tunnels in China (Wang *et al.*, 2018)	Academic Publication		●	
N62	2020 Annual Tracking Rating Report of Guangzhou Metro Group Company (in Chinese) (CCXI, 2020a)	Expert Report		●	
N63	2020 Annual Tracking Rating Report of Guiyang URT Company (in Chinese) (CCXI, 2020b)	Expert Report	●		

N64	2020 Annual Tracking Rating Report of Wuhan Group Company (in Chinese) (CCXI, 2020c)	Expert Report			●
N65	Golden Track Chain: Mass Transit and Land Development Along (in Chinese) (The World Union Properties Consultant, 2017)	Expert Report		●	
N66	Issue 7：Quarterly Newsletter of GEF China Sustainable Cities Integrated Approach Pilot Project (The World Bank, 2020a)	Expert Report	●		
N67	Issue 9：Quarterly Newsletter of GEF China Sustainable Cities Integrated Approach Pilot Project (The World Bank, 2020b)	Expert Report	●		
N68	Value Capture Beyond Public Land Leasing: Funding Transit and Urban Redevelopment in China's Pearl River Delta (Yang *et al.*, 2020a)	Expert Report		●	
N69	Accelerate the Land Acquisition for the NO. 1 and 2 Lines to Boost URT Construction (in Chinese) (Guiyang Daily, 2016)	Newspaper	●		
N70	Specific Funds Will Be Provided to Cities that Are Selected in Pilot Scheme of Underground Utility Tunnel (in Chinese) (Xinhua, 2015)	Newspaper		●	

Appendix E: Coding System and Category

The relationship between coding system and category

Document	Example of Meaning Unit	Code	Category
Delhi Airport Metro Line debacle: The way forward (Das, 2013)	"```````evaluate the technical feasibility of the line, had based its passenger numbers on the development of Aerocity around the Delhi airport``````"	Demand Forecast	Ridership
Implementation of Airport Metro Express Line Project through Public Private Partnership, Chapter XV: Ministry of Urban Development, Report no 13 of 2013 (Comptroller and Auditor General of India, 2013)	"Against ridership of 42500 passengers per day projected ``````actual average ridership during 17 months" "between 5344 and 17794 passengers per day." (p.176)	Performance of ridership	
Study on Urban Transport Sector in India (JICA, 2013)	"``````while the fare has been raised by 50%, ````some users have reportedly complained about the fare increase, which thereby raises concern about the further decrease in ridership... (p.42)	The reason for low ridership	

Airport Metro Express Line Concession Contract (Delhi Metro Rail Corporation Ltd., 2008)	"In addition to the right to charge and collect Fares` `in Commercial Leases and other activities which may yield additional revenues``````" (p.26, Article 7, 7.1)	Components of LVC	Financial Performance
Fissures between Delhi Metro and Anil Ambani group pose firm questions about PPP model (Raja *et al.*, 2012)	"Reliance's projections were built on`````` 75% of its revenue coming from leasing real estate```````"	The ratio of LVC in total revenue	
Rajya Sabha Unstarred Question No.2163, Answered on 29.08.2013, Ministry of Urban Development (Council of States, 2013)	"However, it is agreed that there is a shortfall in revenue collection, mainly from the sources of property development and retail income``````" (p.1, Answerer(c))	Performance of LVC	
Delhi Airport Metro Fiasco: What Can Be Done to Redeem the Project? (Pratap, 2013)	"```````the is losing bidder, “had asked for an annual subsidy of Rs. 346 crores, or an interest-free loan of Rs 1440 crore for a longer term” (p.19)	Information about bidding competitor	Bidding process

Appendix F: Contract Agreement of Delhi Case

The Specific Term about the LVC Mechanism and the Payments in Contract Agreement of Delhi Airport Metro Express

ARTICLE 7

NON-FARE REVENUE

7.1 In addition to the right to charge and collect fares as set forth in Article 6, the Concessionaire shall be entitled to participate in Commercial Leases and other activities which may yield additional revenues to the Concessionaire, subject to the provisions of this Article 7. All such Non Fare Revenue collected by the Concessionaire pursuant hereto shall be deposited in the Escrow Account and appropriated in accordance with the provisions of Article 23. Such activities may include, inter alia, the following:

7.1.1 **Advertisements**

The Concessionaire shall be entitled, subject to all laws and regulations and to obtain all necessary consents, to display visual advertisements inside the rolling stock, the stations, or along the route. Without derogating from the aforesaid, should the Concessionaire wish to display advertisements, including stations, elevated alignment sections and/or tunnels, the Concessionaire shall bear full and sole responsibility for reaching all necessary agreements and obtaining all necessary consents in relation thereto, including the consent of the Municipalities and any other relevant authority. However, display of advertisement within the Airport boundary (either inside the stations or on other structures) is not permitted. Notwithstanding the provisions of Sub-Article 7.1.1 and without derogating from the provisions of Sub-Article 7.3, DMRC may instruct the Concessionaire to remove advertisements which it considers to be abusive or offensive or contrasting the public interest.

7.1.2 **Vending Machines**

The Concessionaire shall be entitled to install and operate vending machines in the un-paid area of the concourse level of New Delhi, Shivaji Stadium, and Dhuala Kaun Stations, subject to the laws and regulations and the provisions of this agreement.

7.1.3 **Communications**

In addition to providing for its own communications needs, the Concessionaire shall be entitled to provide LCX cables and equipment in stations and tunnels for the operation of passenger mobile telephones, and provide a route for cables of commercial communications operators, subject to the provisions of all laws and regulations. The Concessionaire shall bear full and sole responsibility for obtaining all necessary consents for such use, including any necessary licences from any applicable government agency.

7.1.4 **Additional Entrances from Adjacent Property**

(i) The Concessionaire shall be entitled to design and construct, or to allow the design and construction of additional entrances to the stations from adjacent properties, provided however that the Agreement executed for this purpose between the Concessionaire and any third party which holds the appropriate legal rights in the adjacent property shall be subject to the requirements and restrictions on Commercial Leases in Sub-Article 7.1.6.

(ii) The Concessionaire shall bear full and sole responsibility for the compliance of any additional entrances from the adjacent property with all laws and regulations, standards and codes and with the requirements of the applicable planning authority and for obtaining all necessary consents in connection therewith. For the removal of doubt, where the execution of any such additional entrance requires an amendment to the Concessionaire's design the provisions of Sub-Article 10.1 (d) shall apply.

7.1.5 **Retail and Service Outlets**

(i) The Concessionaire shall be entitled to design and construct or to allow the design and construction of, shops kiosks and the like within public areas of New Delhi, Shivaji Station and Dhaula Kun Stations, provided however that the agreement executed for this purpose between the Concessionaire and any third party for any legal rights in such areas shall be subject to the requirements and restrictions on Commercial Leases in Sub-Article 7.1.6.

(ii) The Concessionaire shall bear full and sole responsibility for the continuous compliance of any shops, kiosks and the like within public areas of stations with all laws and regulations, standards and codes, including with the requirements of NFPA 130 and/or any local codes applicable for the emergency evacuation of public areas, and with the requirements of the applicable planning authority and for obtaining all necessary consents in connection therewith. For the removal of doubt, where the execution of any such additional entrance requires an amendment provisions of Sub-Article 10.1(d) shall apply.

7.1.6 **Property Development and Development Rights**

(i) Subject to the limitations of the Site stated in Schedule "A" and/or shown in the layout drawings in Schedule "I", DMRC will allow the Concessionaire right and/or licence to utilize the land over, under and around of the depot and within the stations for property development/commercial exploitation during the concession period with a view to improving the financial viability of the Project. The Concessionaire may construct, or cause or permit to have constructed, at his own cost, buildings and/or built-up areas in addition to the Required Buildings at the specified locations, after first obtaining the approval of DMRC in writing.

All such buildings and/or built-up areas shall follow

relevant building rules and regulations, Airport Authority of India (AAI) and fire safety regulations and all other applicable municipal approvals, statutory laws and regulations. Such development shall be subject to a Commercial Lease for a term not exceeding the remaining term of the Concession Period and shall be in a form and containing such conditions as may be prescribed by DMRC.

(ii) No property developed by the Concessionaire in accordance with this Sub-Article 7.1.6 shall be sold but shall only be let out for rental purpose during the Concession period. Such buildings and/or built up area, with all the attendant facilities, developed by or on behalf of Concessionaire shall be handed over to DMRC at the Termination of the Concession free of encumbrances, and all moneys due or previously paid for the rights to such property beyond the Termination of the Concession Period shall be paid to DMRC, and all Commercial Leases entered into by the Concessionaire shall include provisions to this effect including that of termination prior to or concurrent with the Termination of the Concession.

Appendix G: Contract Selection Criteria of the Bid in Delhi Case

The original text about the selection criteria of the bid

• "The bids were evaluated on the basis of financial and technical criteria (e.g., prior experience in developing, operating or maintaining urban transport system, the minimum net worth of Rs.400 crores, and an average annual turnover of Rs.1200 crore) and the bid of the consortia comprising Reliance Energy Limited (renamed as Reliance Infrastructure Limited) and CAF (Construcciones y Auxiliar de Ferrocarriles, S.A), offering concession fee of Rs.51 crore, was evaluated as the highest bidder" (Comptroller and Auditor General of India, 2013, p175);

• "The agency (i.e., DMRC) invited potential concessionaires to bid based on the amount of subsidy they thought the government would have to supply to make the project viable. The concession would be awarded to the bidder that requested the least amount of viability gap funding from the government" (The World Bank, 2012, p5); and

• "The SPV (i.e., DAMPEL) comprising Reliance Infrastructure Limited and CAF (Construcciones y Auxiliar de Ferrocarriles, S.A), was awarded the 30-year contract in January 2008, on the basis of their highest quote for annual concession fees to be paid to DMRC" (Infrastructure Development Department, 2008, p3–4).

Appendix H: The Definition of Development-based LVC in China

The definition of development based LVC in China

China Association of Metro (2020b) provide the definition, and revenue calculation of the property development, land sales and property rental and management (i.e., development based LVC), and we cite and translate them below:

“(一) 地铁物业开发指标
地铁物业开发业务指会员单位通过在轨道交通沿线开发的地铁车站（车辆段）上盖物业、独立停车场、独立地下商业空间以及其他归属该会员单位物业所产生的土地销售收入及物业开发销售收入的经营活动。地铁物业开发业务指标由两个细化指标组成。
1. 年度物业开发业务总收入（万元）。当年度该会员单位的物业开发总收入，包括土地销售收入及物业开发销售收入。
2. 年度物业开发业务利润（万元）。当年度该会员单位的物业开发销售税前利润（含股权转让收益），包含土地出让税前利润、物业开发投资税前利润（含股权转让收益）、以及物业开发销售税前利润。”
“(1) Land and property development Indicators

Land and property development refers to income generated by sales of land and property development along with the rail line, the parking lot, the underground commercial spaces, and other properties owned by our members*. The land and property development indicators include two detailed indicators:

1. *Annual total income of land sales and property development (10,000 yuan)* refers to the total income from the member’s land and property development sales during the year;

2. *Annual profit of land sales and property development (10,000 yuan)* refers to profit before tax (including income of equity transfer) of land and property development sales during the year. It includes the pre-tax profit of land transfer/sales, property development investment and property development sales.”

“（二）地铁物业租赁及管理业务指标
地铁物业租赁及管理业务指会员单位通过在轨道交通沿线开发的地铁车站（车辆段）上盖物业、独立停车场、独立地下商业空间以及其它属于该会员单位物业所产生的租赁及物业服务收入。地铁物业租赁及管理业务指标由三个细化指标组成。
1. 年度地铁物业租赁及管理业务收入（万元）。 当年度该会员单位的持有商业物业租赁及物业管理收入。
2. 年度地铁物业租赁及管理业务利润（万元）。 当年度该会员单位持有商业物业租赁及物业管理业务税前利润。
3. 年度持有商业物业租赁总面积（万平方米）。当年度该会员单位持有的商业物业租赁总面积（不含展厅商铺，地铁配线空间通道商业面积）。”

“(2) Property Rental and Management Indicators

Property rental and management refer to the income of rental and property service generated by properties along with the rail lines, parking lots, underground commercial spaces and other properties owned by members. The property rental and management indicators include three detailed indicators:

1. *Annual income of property rental and management (10,000 yuan)* refers to the income of members’ commercial property rental and property management during the year.

2. *Annual profit of property rental and management (10,000 yuan)* refers to the pre-tax profit of members’ commercial property rental and management during the year.

3. *Annual total rental area of commercial properties (10,000 square meters)* refers to the total rental area of commercial properties that members have during the year (excluding exhibition halls and space of metro distribution channels).

* All transit agencies who are responsible for delivering URT systems in each city of mainland China are members of the “China Association of Metros”.

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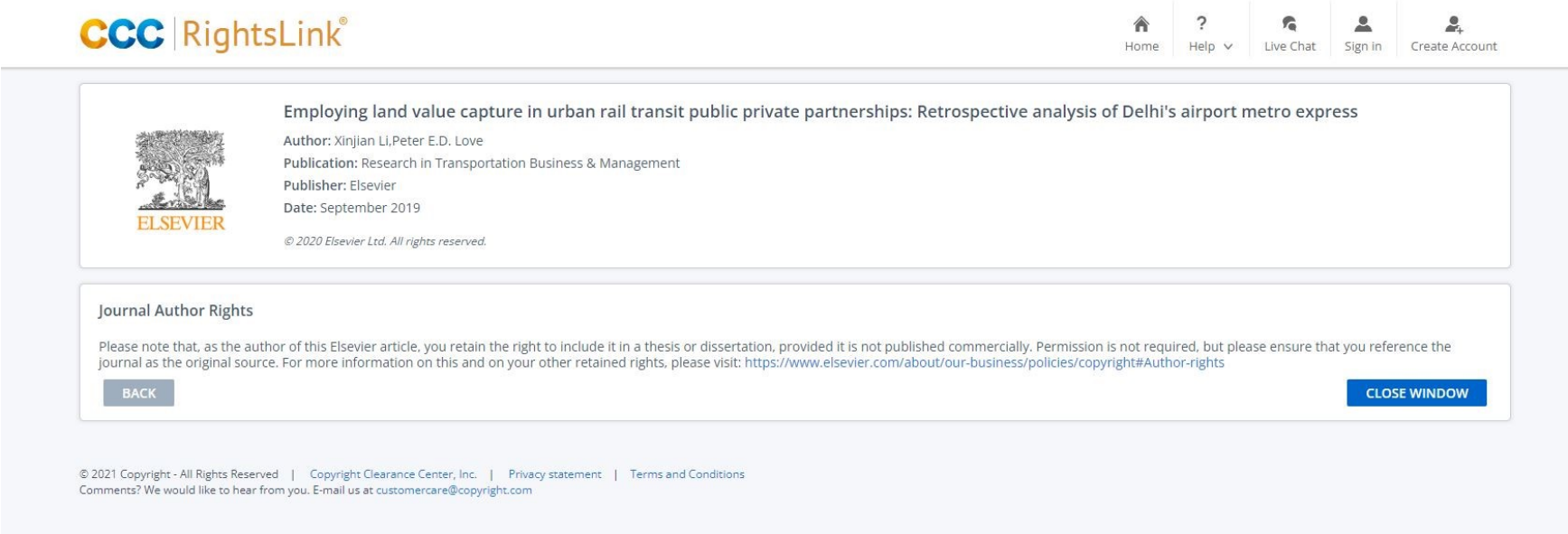

Li, X., and Love, P. E. D. (2019). Employing land value capture in urban rail transit public-private partnerships: Retrospective analysis of Delhi's Airport Metro Express. *Research in Transportation Business and Management*, 32, 100431.

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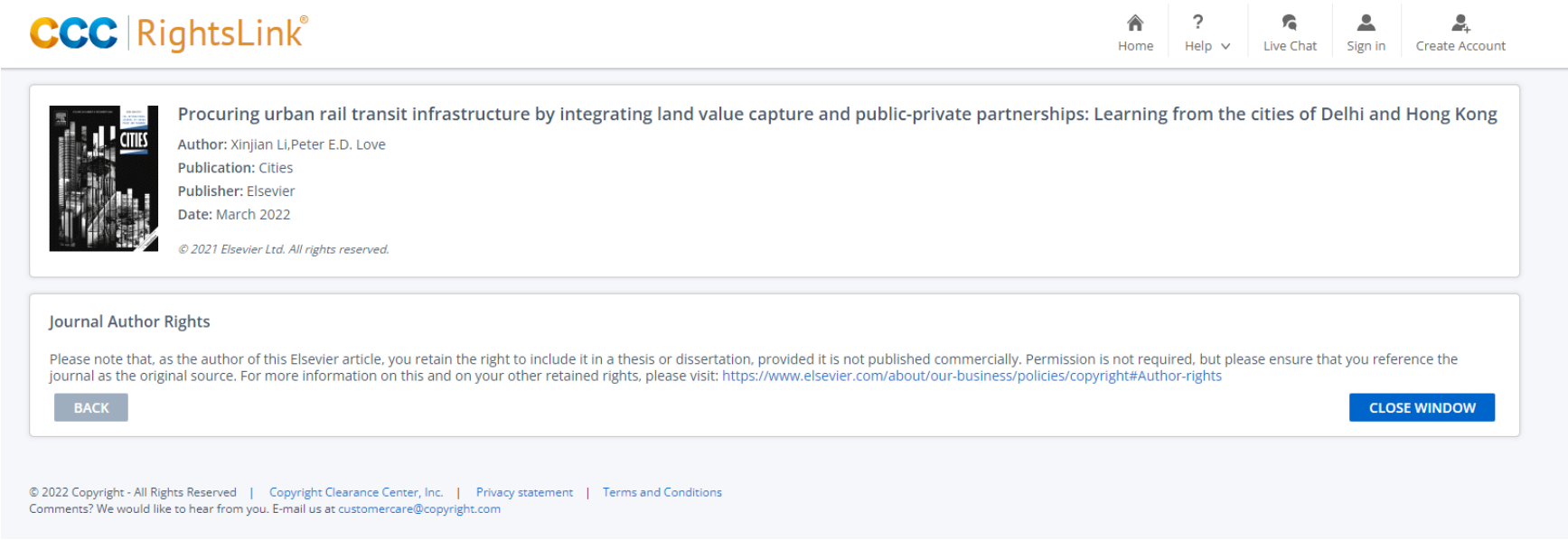
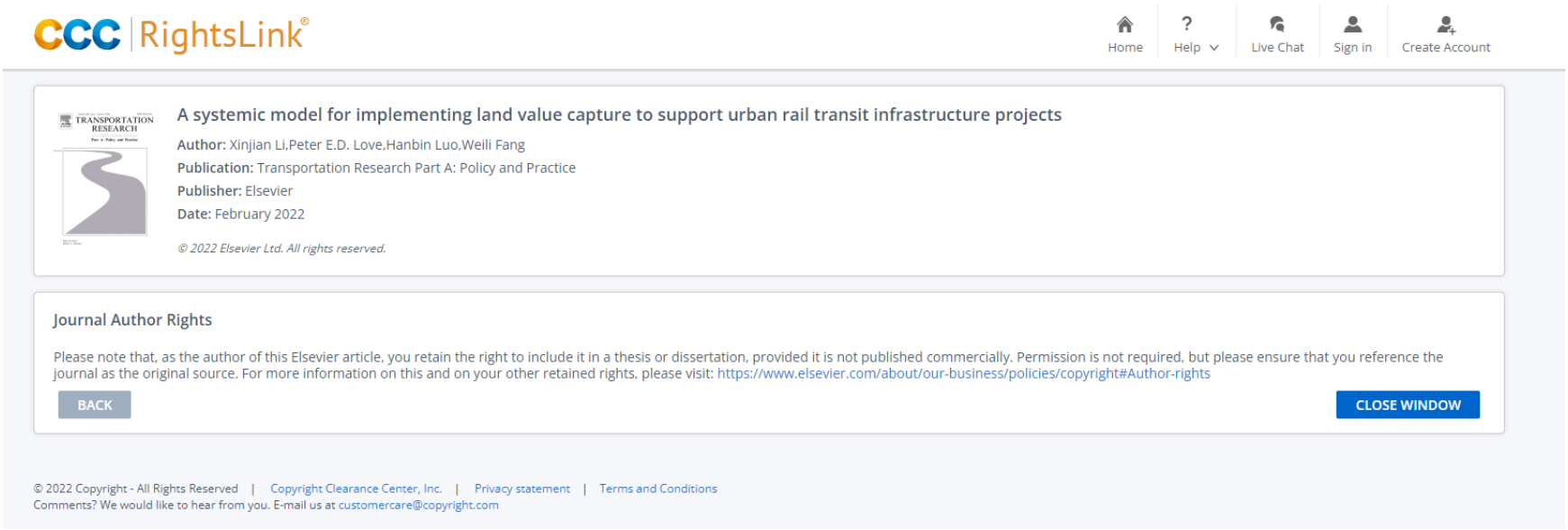


Li, X., and Love, P. E. D. (2022). Procuring urban rail transit infrastructure by integrating land value capture and public-private partnerships: Learning from the cities of Delhi and Hong Kong, *Cities,* 122, 103545.



Li, X., Love, P. E. D., Luo, H., and Fang, W. (2022). A systemic model for implementing land value capture to support urban rail transit infrastructure projects, *Transportation Research Part A: Policy and Practice,* 156, 90-122.

Appendix J: Signed Statements of the Contribution of Co-authors

Signed statements of the contribution of co-authors

To whom it may concern,

I, Xinjian Li, conducted conception, data collection, and analysis and wrote manuscripts of the papers titled as follows. Professor Peter E.D. Love revised and edited the manuscript of these papers and his contribution is less than 20% of each one. Professor Hanbin Luo and Dr Weili Fang provided insights on the conception and data collection of the fourth paper.

1. **Li, X.,** and Love, P. E. D. (2019). Employing land value capture in urban rail transit public-private partnerships: Retrospective analysis of Delhi's Airport Metro Express. *Research in Transportation Business and Management*, 32, 100431.
2. **Li, X.,** and Love, P. E. D. (2020). State-of-the-art review of urban rail transit public-private partnerships. *Journal of Infrastructure Systems*, 10.1061/(ASCE)IS.1943-1555X.0000552.
3. **Li, X.,** and Love, P. E. D. (2022). Procuring urban rail transit infrastructure by integrating land value capture and public-private partnerships: Learning from the cities of Delhi and Hong Kong, *Cities,* 122, 103545.
4. **Li, X.,** Love, P. E. D., Luo, H., and Fang, W. (2022). A systemic model for implementing land value capture to support urban rail transit infrastructure projects, *Transportation Research Part A: Policy and Practice,* 156, 90-122.

(…….……)

I, as a co-author, endorse that this level of contribution by the candidate indicated above is appropriate.

Professor Peter E D Love (…….……); Professor Hanbin Luo (…….……); Dr Weili Fang (…….……).