# Rethinking Value for Money in Public Private Partnerships: a critique, analysis and model for transport infrastructure projects

Jianfeng Zhao

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# Rethinking Value for Money in Public Private Partnerships: a critique, analysis and model for transport infrastructure projects

JIANFENG ZHAO

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## Declaration

I declare that the work contained in this thesis has not been submitted for any other award and that it is all my own work. I also confirm that this work fully acknowledges opinions, ideas and contributions from the work of others.

Any ethical clearance for the research presented in this thesis has been approved. Approval has been sought and granted through the Researcher's submission to Northumbria University's Ethics Online System on 5th January 2020.

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# DEDICATION

*To my dearest parents: Zhou Xin and Zhao Jiayun*

(致我最亲爱的妈妈周鑫和爸爸赵家云)

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Jianfeng

10th July, 2022 on my tiring but always functioning (thankfully) computer

Newcastle

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# LIST OF ABBREVIATIONS

**AHP**: Analytical Hierarchy Process

**BOT**: Build-Operate-Transfer

**CBA**: Cost Benefit Analysis

**C.I.**: Consistency Index

**CONC.**: Concession

**C.R.**: Consistency Ratio

**CSF**: Critical Success Factors

**DBFM**: Design-Build-Finance-Maintain

**DBFMO**: Design-Build-Finance-Maintain-Operate

**DBO**: Design-Build-Operate

**DDCM**: Dynamic Discrete Choice Model

**EIB**: European Investment Bank

**EPEC**: European PPP Expertise Centre

**ESG**: Environmental, Social and Governance

**EU**: European Union

**FHA**: Federal Highway Administration

**HS2**: High Speed 2

**IPA**: Infrastructure and Projects Authority

**MCA**: Multi-Criteria Analysis

**MoF**: Ministry of Finance

**NAO**: National Audit Office

**NHS**: National Health Service

**NPM**: New Public Management

**NPPG**: National PPP Policy and Guidelines

**NPV**: Net Present Value

**NSW**: New South Wales

**OBC**: Outline Business Case

**OECD**: Organisation for Economic Co-operation and Development

**P3**: Public Private Partnership

**PF2**: Private Finance 2

**PFI**: Private Finance Initiative

**PO**: Public Ownership

**PPI**: Private Participation in Infrastructure

**PPPs**: Public Private Partnerships

**PSC**: Public Sector Comparator

**PwC**: PricewaterhouseCoopers

**R.I.**: Random Consistency Index

**SBM**: Shadow Bid Model

**SDR**: Social Discount Rate

**SLR**: Systematic Literature Review

**SOCC**: Social Opportunity Cost of Capital

**SOEs**: State-Owned Enterprises

**SPV**: Special Purpose Vehicle

**SRPT**: Social Rate of Time Preferences

**SWOT**: Strengthens, Weaknesses Opportunities, and Threats

**TCQ**: Time, Cost and Quality

**UK**: United Kingdom

**UN**: United Nations

**US**: the United States

**V*f*M**: Value for Money

# GLOSSARY[1]

## B

**Business case**: Justification for undertaking a project, programme or portfolio, and evaluation of the benefit, cost and risk of alternative options (Project Management Institute, 2021). In the UK, this is often called 'the five case model' in the strategic, economic, commercial, financial, and management dimensions.

## C

**Contracts for Difference**: In the UK, it's a private law contract signed between successful bidding developers of renewable projects (i.e., low-carbon electricity generation) and the Low Carbon Contracts Company, a government-owned company (Department for Business, Energy & Industrial Strategy, 2022). It provides developers of projects with high upfront costs and long lifetimes with direct protection from volatile wholesale prices, and they protect consumers from paying increased support costs when electricity prices are high.

**Competitive neutrality**: The advantages a procurement method has due to ownership. For example, in a traditional public project, tax may be exempt. According to Zwalf (2017), this is to ''ensure the private and public options have no cost advantage over each other''.

**Concession**: A concession is a type of Public Private Partnerships, and gives a concessionaire the long term right to use all utility assets conferred on the concessionaire, including responsibility for operations and some investment.

## D

**Devolved administrations**: In the UK, devolution means that there are separate legislatures and executives in Scotland (Scottish Parliament and Scottish Government), Wales (National Assembly for Wales and Welsh Government) and Northern Ireland (Northern Ireland Executive) (UK Government, 2019). Since 2014, there has also been a process of devolution of powers to local government within England.

## E

**Emergency Recovery Measures Agreements**: It came into force in September 2020 in the UK, and would run for up to 18 months to bring the rail franchising system to an end. In the agreement, management fees for the operators are a maximum of 1.5% of the cost base of the franchise before the COCID-19 pandemic began (Department for Transport, 2020c).

***Ex-ante* value for money assessment**: The decision-making process at the inception stage of a project to determine its procurement approach, i.e., Public Private Partnerships or the traditional route.

***Ex-post* value for money assessment**: The monitoring process of the selected procurement approach to ensure value for money is delivered throughout the project cycle.

**Emphyteutic contract**: A type of real estate contract in which the lessee must improve the property (usually government properties) with construction.

**Excess headway minutes**: The method by which delays experienced by passengers are measured. In the case of Tyne and Wear Metro, the total excess headway minutes for any period is subject to an attribution process resulting to an agreed allocation across the Metro operator, Nexus Rail, Network Rail and Other/ disputed depending on the identified causation.

## G

**Green Book**: Guidance issued by HM Treasury (2020a) on how to appraise policies, programmes and projects.

## I

**Infrastructure**: National Infrastructure consists of those facilities, systems, sites, information, people, networks and processes necessary for a country to function and upon which daily life depends (Cabinet Office, 2017). Transport is one of the 13 critical National Infrastructure sectors.

## M

**Manceps contract**: According to the Oxford Classical Dictionary in the subject of Roman Law, manceps most commonly denotes the successful bidder in an auction of contracts for the sale or leasing of state lands or for public works.

## O

**Opportunity cost:** The costs that reflect the best alternative use a good or service could be put to (HM Treasury, 2020b).

[1] The glossary presented here is the definitions adopted in this research as some may have multiple meanings, such as infrastructure. For brevity purposes, those that have been explained in the Chapters' footnotes are not duplicated here.

**Outline business case**: In the UK, for projects that are over £2 million value of procurement, a three stage business case, including strategic outline case, outline business case, and full business, is required. The purpose of outline business case (HM Treasury, 2022) is to plan the project and to identify the preferred option and arrangements for procurement and the successful delivery of the project.

## P

**Passenger Service Contracts**: In the contact, Great British Railway is the single body to maintain and improve the infrastructure, set fares, sell the tickets and receive the money, plan timetables and run the network, and be fully accountable for these activities. Operators, when bidding, identifies the most efficient way to resource and deliver the specification, and will be paid when trains are on time and there is minimal disruption for passengers (Department for Transport, 2021c).

**Private Finance Initiative**: A long-term contract between a private party and a government entity where the private sector designs, builds, finances and operates a public asset and related services (HM Treasury, 2021b). In the contract, the private party bears the risks associated with construction and maintenance and management responsibility, and remuneration is linked to performance.

**Public expenditure**: Public spending by government departments is planned under intersecting sets of categories, and the main ones include: Departmental Expenditure Limits, Annual Managed Expenditure, capital spending, current/ resource spending, programme spending, and administration spending (House of Commons, 2021).

**Public Private Partnerships**: 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 (World Bank, 2022).

**Public sector comparator**: The cost of the public procurement of the same project (if it is proposed as a Public Private Partnership) (World Bank, 2009).

**Purposive sampling:** Primarily used in qualitative studies, it selects units (e.g., individuals. groups pf individuals, institutions) based on specific purposes associated with answering a research study's questions (Teddlie and Yu, 2007). In this study, purposive sampling was used in the qualitative part to identify experts who have experience in infrastructure procurement.

**Probability sampling:** Primarily used in quantitative studies, it selects a relatively large number of units from a population, or from specific subgroups (strata) of a population, in a random manner where the probability of inclusion for every member of the population is determinable (Teddlie and Yu, 2007). In this study, probability sampling was used in the quantitative part to identify respondents in three clusters (i.e., known figures, Major Projects Association, and LinkedIn).

**Private Finance 2**: The successor to PFI in the UK. Launched in 2012 by HM Treasury (2012), it aimed to bring reform measures such as equity, accelerating delivery, flexible service provision, greater transparency, appropriate risk allocation, future debt finance, and delivering value for money.

## R

**Regulated Asset Base Model**: The UK government plans to use it to finance nuclear projects where a company receives a licence from an economic regulator (i.e., Ofgem) to charge a regulated price to consumers in exchange for providing the infrastructure.

**Rail franchising**: Contracts to operate passenger railway services in the UK are awarded to private train operating companies (or open access operators) for a limited period of time following a detailed bidding and competition process. The degree of revenue risk and commercial freedom for the franchisee may vary in the specific model (Competition and Markets Authority, 2018).

## S

**Sunk cost**: Expenditure or payments already incurred and should be excluded from the appraisal of social value (HM Treasury, 2020b).

**Special purpose vehicle**: A shell company (Demirag *et al*., 2011), normally owned by a consortium, in PPPs that is responsible for sub-contracting (including the contract with the public authority) the finance, design, construction, maintenance and soft services. A typical structure of SPV is available in Figure 3.2.

## T

**The UK Guarantee Scheme**: It is a mean to support private investment in the UK, and offers a government-backed guarantee to help infrastructure projects access debt finance where they have been unable to raise finance in the financial markets (Infrastructure and Projects Authority, 2017).

## V

**Value for Money**: Value is generated in the interaction of the supply side (i.e., governments) and the demand side (i.e., end-users). Value for money consists of traditional value for money and public value for money.

## W

**Whole-of-life cost**: More commonly known as 'whole life cost'. In PPPs, due to the long-term contract, it puts emphasis on the balance between upfront investment costs and ongoing operation and maintenance costs.

# ABSTRACT

Value for Money (V*f*M), as the rationale for the use of Public Private Partnership (PPP), is controversial and often poorly understood by the public sector for their infrastructure projects. This study, therefore, aims to develop a decision-making model for public sector bodies to better understand and assess V*f*M of their transport infrastructure projects. Specifically, four research objectives were formulated, comprising: (1) establishing the state-of-the-art V*f*M assessment practices in global PPP markets and evaluating them in the light of common critical reactions; (2) proposing a new V*f*M concept based on value and stakeholder theories, and developing a comprehensive framework for assessing V*f*M; (3) refining and validating the proposed V*f*M framework; and (4) applying the developed V*f*M assessment model to a real-world infrastructure project.

To address those objectives, under the auspice of a mixed methods research design, semi-structured interviews were first undertaken with 13 highly experienced professionals (with an average of 23-year working experience) with knowledge of infrastructure procurement. The interview results (analysed via a thematic analysis) showed that public V*f*M (i.e., service/ functionality, environment, distribution, resilience, and social inclusion) and traditional V*f*M (i.e., cost, quality, and time) together create a more meaningful concept of V*f*M, which was subsequently refined and further developed into a V*f*M assessment framework that was underpinned by *theories of value* and *stakeholder theory*. Second, using purposive sampling, a questionnaire survey of 31 industry experts who assume extensive experience with infrastructure procurement in the United Kingdom was conducted. The survey data,

which was analysed through Analytical Hierarchy Process, resulted in a quantified relationship between V*f*M assessment variables. Finally, the developed V*f*M assessment model was applied to a real-world transport infrastructure project to examine its V*f*M decision-making and monitoring practices.

By criticising current V*f*M assessment practices, analysing the collected data, and proposing a comprehensive assessment model, this study sets a robust foundation for the public sector to rethink V*f*M in PPPs. As a result, it has made contributions to theory and practice. Theoretically, this study has: (1) expanded the existing V*f*M definition by arguing that traditional V*f*M and public V*f*M together create a more meaningful V*f*M concept; (2) advanced a consistent V*f*M assessment and channelled it into the transport sector; and (3) extended the *ex-ante* V*f*M assessment to include *ex-post* V*f*M assessment by developing a model that can be tailored to suit the procuring body's and the project's needs. In practical terms, it has provided a common language of V*f*M in infrastructure procurement and presented a V*f*M assessment model that can be readily utilised by the public sector for their transport infrastructure projects.

# CHAPTER 1 INTRODUCTION

## 1.1 Background

The development of modern society relies heavily on infrastructure and its services. As the United Kingdom (UK)'s Infrastructure and Projects Authority - IPA (2021a) puts it, "infrastructure connects us to each other and the natural environment, and is the foundation for the services that we depend on." The term 'infrastructure'[2] has been diversely used in the literature on economics. As explained by Sabir and Shamshir (2020), economic infrastructure, such as transport, communication, power and water system can improve the marginal utility of other types of physical capital, whereas social infrastructure (e.g., schools and hospitals) raises the marginal productivity of human capital. It, therefore, becomes vital for governments to provide quality infrastructure and services. For example, the UK has launched a ten-year action plan (2020-2030) to transform infrastructure performance so that it meets ''the wider requirements of society to balance building with the natural environment'' (IPA, 2021a). Yet, according to the United Nations (UN) (2015, p.8), there was a global infrastructure gap, and this gap was around US$ 1.5 trillion in developing countries every year. On this basis, the UN (2015) has explicitly called for 'private investment in infrastructure' and 'public and private blended finance for infrastructure finance'. Following the UN's 2015 data, the Global Infrastructure Hub (2017) estimated that this global infrastructure investment gap would be US$ 15 trillion between 2015 and 2040. The UK Government in its *National Infrastructure Strategy* (HM Treasury,

[2] The definition of infrastructure falls out of the scope of this research, but a wider discussion on this can be found in Buhr (2003) where the author has welcomed the classification of infrastructure into institutional, personal, and material infrastructure. Among them, material infrastructure represents capital goods in the form of transportation, education, and health facilities, equipment of energy and water provision, etc.

2020c) admitted that this gap had led to the declining quality of national infrastructure. As a result, £27 billion (including private investment) would be needed in 2021-22 for its economic infrastructure (HM Treasury, 2020c). In addition to their role in bridging this gap, the Global Infrastructure Hub (2021) subsequently confirmed that private investment also withstood the COVID-19 pandemic shock, which has further limited governments' investment capacity.

One popular form of private participation in infrastructure (PPI)[3] is Public Private Partnerships (PPPs). According to the World Bank (2022), PPPs are broadly defined as "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". They are often considered to be able to contribute to: (1) additional sources of funding and financing; (2) private sector analysis and innovation; (3) private sector incentives and life cycle management; and (4) long-term investment perspective (World Bank, 2022, p.19). With this in mind, governments around the world have been catapulted into PPPs for their infrastructure provisions. The prerequisite for adopting PPPs, however, is that they should provide better value for money (V*f*M) than an arrangement where the costs are borne entirely by the public sector in a traditional procurement approach (Akintoye *et al*., 2003). In practice, this is demonstrated by comparing the net present value of a PPP option with that of a public sector comparator (PSC), which is related to the traditional procurement approach (Chiang *et al*., 2022). However, the PSC comparison is subject to heated criticisms over the selection of a discount rate (Zwalf

[3] The World Bank's PPI database identifies four sub-types of PPI, and they are: (1) management and lease contracts; (2) greenfield projects; (3) brownfields; and (4) divestures. For details regarding their definitions, please refer to https://ppi.worldbank.org/en/methodology/glossary.

*et al*., 2017), risk pricing (Makovsek and Moszoro, 2018), and asymmetric comparison (Yescombe and Farquharson, 2018, p.90), to name a few. Most importantly, as reviewed by the National Audit Office -NAO (2013), the key question – whether benefits associated with PPPs outweigh their additional cost above government borrowing – is not answered. In an extreme case, NAO (2018) reports that the UK had to withdraw this quantitative assessment in 2012 and has still not provided an alternative.

Whereas the UK government is long overdue in releasing a new V*f*M assessment (NAO, 2018, p. 22), its infrastructure is developing at a rapid pace. In 2021, the UK envisaged a £650 billion investment in infrastructure over the next 10 years (IPA, 2021b). Naturally, the questions arise such as "will it involve PPPs or other means of PPI?" and "how is V*f*M ensured?". The answer to the former is perhaps positive because IPA (2021b, p.17) has reported that nearly 50% of the total planned investment from 2021/22 to 2024/25 would come from the private sector. This was reinforced by the establishment of the UK Infrastructure Bank[4] that aims to capitalise on private markets (HM Treasury, 2021a, p.4). Against this backdrop, the lack of a proper V*f*M assessment is accentuated as the government is ultimately held accountable for wise public expenditure. Notably, the UK government is currently using the *Green Book: Central Government Guidance on Appraisal and Evaluation*[5] to apply the long-list and shortlist options appraisals to policies, programmes, and projects. However, this can at best be considered as a 'makeshift' evaluation of PPPs

[4] As stated in HM Treasury's (2021a) policy design for the UK Infrastructure Bank, it is headquartered in Leeds, England, and will mobilise £22 billion of financial capacity to help tackle climate change and support regional and local economic growth.
[5] In the UK, the Green Book applies to all proposals that concern public spending, taxation, changes to regulations, and changes to the use of existing public assets and resources.

as HM Treasury (2020a) itself has concluded that *the Green Book* fails to capture the government's strategic objectives (among other identified problems), and the NAO (2018) has highlighted HM Treasury's inconsistency in V*f*M assessment and failure to update it.

Scholars have also been paying attention to this issue as can be seen in the sheer number of articles published in the field of PPPs. Although the research trends/ interests may change over time, according to the systematic reviews conducted by Ke *et al*., (2009), Cui *et al*., (2018) and Shi *et al*. (2020), V*f*M remains consistently at the core of this topic. Grimsey and Lewis (2005) conducted a comparison of V*f*M assessment approaches over 20 countries, and concluded that: (1) there are alternatives to the PSC comparison and the PSC entails many complexities and ambiguities; and (2) their V*f*M assessments over-emphasise financial factors in the long-term service delivery (i.e., V*f*M is poorly equated with the lowest cost). Focusing on the alternatives, Tsamboulas *et al*. (2013) proposed a framework based on a Multi Criteria Analysis (MCA) to evaluate such impacts as job creation, environmental impacts, and safety and security. DeCorla-Souza *et al*. (2016) suggested the use of benefit cost analysis (more commonly known as cost benefit analysis - CBA) to quantify public benefits (e.g., the accelerated project delivery) in PPPs. More recently, Zhao *et al*. (2022) developed a dynamic discrete choice model (DDCM) to cover cost components, functionality, and other non-financial benefits for a comprehensive V*f*M assessment. Targeting at the financial and non-financial factors, Almarri and Boussabaine (2017) grouped V*f*M indicators into economic, financial, and commercial constructs. Cui *et al*. (2019) confirmed that cost and effectiveness were the fundamental drivers to V*f*M. By contrast, Siemiatycki and Farooqi (2012) found that the transfer of construction

risks to the private sector drove V*f*M results. Santandrea *et al*. (2015), on the other hand, contended that V*f*M was deficient in considering ring-fencing of risks and contractual flexibility. This confusion on V*f*M was then attributed by McKevitt (2015) to stakeholder, measurement, attribution, and stability problems.

At one level, it is fair to say that progress has been made in terms of the methods (e.g., improvements to PSC, MCA, CBA and DDCM) used to assess V*f*M, and an understanding of the V*f*M concept. However, these methods have their own shortcomings. For example, MCA is only applicable when PPPs become the preferred choice, neglecting the evaluation of other options. CBA has been branded as being 'broken' or a 'fallacy' by Flyvbjerg and Bester (2021) in that it is highly inaccurate and biased, and thus seriously distorts resource allocation. Grimsey and Lewis (2005) also mentioned that CBA requires considerable time and resources, making PSC more practical to some extent. Similarly, DDCM relies on information provided from past projects to quantify the non-financial benefits, which, if not accessible, can make any simplified dummy assumptions unrealistic. Furthermore, a universally accepted definition of V*f*M is still not available despite the exploration of its drivers as mentioned above. Or at the very least, the UK's Construction Leadership Council (2018, p.4) calls for "an industry-wide definition of value that takes into account more than capital cost". The situation is further exacerbated by the disconnection between *ex-ante* and *ex-post* V*f*M assessments. Shu *et al*. (2021) have identified the scant nature of research examining whether the anticipated outcomes (e.g., V*f*M) of PPPs have actually materialised. Even in cases where *ex-post* assessments take place, Chung (2016) has argued that such V*f*M evaluation was performed against only the

contractual provisions rather than the said 'optimum combination of cost and quality in meeting the needs of service users'.

## 1.2 Problem Statement

As can be seen from Section 1.1, PPPs are currently beset with an ambiguous understanding of their V*f*M and how it is assessed. This is exacerbated by the fact that private investment continues to play a significant role in infrastructure development in the UK and around the world, and that there is not an updated V*f*M assessment tool in the UK (NAO, 2018). Addressing such gaps requires a line of research that takes into account stakeholders' perception of V*f*M and an assessment model that can aid the public sector to make more informed decisions about their infrastructure delivery. This is important because more often than not the cause of PPP failures can be ascribed to the departure from the defining characteristics (e.g., shared understanding and collaboration between stakeholders) of PPPs (The World Bank, 2022, p.10). For example, the failure of 'Metronet PPPs[6]' in the UK, due to the public sector's negligence, caused The Department for Transport to make £1.7 billion to help pay Metronet's outstanding debt (NAO, 2009). Without such a line of inquiry, similar failures are potentially imminent.

This research, therefore, contributes to the body of knowledge in infrastructure delivery by enhancing an in-depth understanding of V*f*M. In practical terms, it develops a V*f*M assessment model that can not only help the public sector select an

[6] According to NAO (2009), Metronet was a private infrastructure company responsible for the maintenance and upgrade of sections of the London Underground but went into administration in July 2007. The main cause of failure was Metronet's poor corporate governance and leadership. More importantly, NAO (2009, p.8) detected the fundamental problem underlying all the issues was that the public sector bodies involved in the oversight, monitoring and management of the Metronet PPP contracts did not all share a common agenda.

appropriate procurement strategy but also sheds light on V*f*M realisation over the project lifecycle. In short, this present research may not be a silver bullet to all the problems in infrastructure delivery, but certainly is a platform for the public sector to rethink V*f*M and remedy its infrastructure policies.

### 1.3 Rationale of the Research

It may be true, according to Grimsey and Lewis (2005), that PPPs were not (or probably would never be) the dominant method of infrastructure interventions. This was evident in the Organisation for Economic Co-operation and Development (OECD) forum where 18 out of the 20 surveyed member countries spent less than 15% of their total annual capital expenditure through PPPs (OECD, 2012). Nevertheless, in absolute terms, this percentage constitutes a staggering amount that cannot be ignored. In the UK, where the term private finance initiative (PFI) has also been used, PPPs have attracted approximately £56 billion of private sector capital investment in more than 700 infrastructure projects with around 580 contracts still in process (IPA, 2022a). In Australia, according to Infrastructure Partnerships Australia (2022), over 100 PPPs worth more than AUD$100 billion project value have been initiated between 2000 and 2020. Hence, from a pragmatic perspective, having in place an evaluation mechanism is necessary for governments to ensure that existing projects can deliver V*f*M.

One may reasonably argue that PFI has retired in the UK since 2018 following the Budget 2018 (HM Treasury, 2018a). There were two points there. First, the government would continue its commitment to existing PFI contracts. This means that when IPA (2022a) prepares for the expiry of those projects in the next 10 years, it is vital to protect V*f*M as they are providing essential services within the country. Second,

the decision would not affect the use of private finance by self-governing or devolved administrations. As a matter of fact, the Local Government Association (2022) has produced a guide to plan and establish more effective PPPs. However, it is surprising that how to achieve V*f*M is not mentioned in the so-called 'good practice guide' despite the vision to deliver it. In conjunction with the gaps identified above, this research is, thus, of relevance not only to the expiry and transition to future services provision of current projects but also to the development of new forms of private investment[7] into public infrastructure projects.

### 1.4 Research Aim and Objectives

The aim of this research is to develop a decision-making model for public sector bodies to better understand and assess the V*f*M of their transport infrastructure projects. It should be noted here that this assessment of V*f*M relates to the choice between PPPs and traditionally procured projects, as well as their subsequent delivery (see Section 1.5). The following four research objectives have been formulated to address this aim. They include:

i. Establishing the state-of-the-art V*f*M assessment practices in global PPP markets and evaluating them in the light of common critical reactions;
ii. Proposing a new V*f*M concept based on value and stakeholder theories, and developing a comprehensive framework for assessing V*f*M;
iii. Refining and validating the proposed V*f*M framework; and

[7] Currently, private investment in the UK can take the forms of PPPs, Contracts for Difference, the Regulated Asset Base Model, or the UK Guarantees Scheme. As of 17 June 2021, the administration and responsibility for the UK Guarantees Scheme has moved from IPA and HM Treasury to the UK Infrastructure Bank. Please see details at: https://www.gov.uk/guidance/uk-guarantees-scheme.

iv. Applying the developed V*f*M assessment model to a real-world infrastructure project.

## 1.5 Scope of the Research

The scope of this research has three deliberate delimitations, namely: (1) V*f*M applied to the choice between PPPs and the traditional procurement approach; (2) V*f*M assessment that is conducted by the procuring authorities; and (3) V*f*M assessment in the context of transport infrastructure projects.

The first of these indicates that this research is not about the investment decision to determine the 'go or no-go' of the project in question. While V*f*M assessment can form part of the full business case as the investment decision, it happens after the project is deemed feasible, and during consideration of what is the best option to deliver it. Nevertheless, this research attempts to extend this decision-making to include monitoring if V*f*M is materialised over the project lifecycle. According to the service quality model developed by Zeithaml *et al*. (1988), there is often a gap between standards set by those involved at the planning stages of a project (e.g., the V*f*M criterion used at the front end) and the level of service actually delivered (e.g., the *ex-post* V*f*M). Failure to address this gap would adversely impact organisations' measurable benefits in profit, cost savings, and market share. What is more, given the massive opportunity cost and sunk cost infrastructure projects entail, it is important to monitor whether the project has deviated from the expected deliverables, and identify strategies that can keep it on track.

Understanding that V*f*M assessment discussed here is specific to PPPs and the traditional procurement approach also means it is different from the colloquial meaning people use in their daily life. According to PricewaterhouseCoopers - PwC (2021), this everyday use can be easily understood as "not buying more for a good or service than its quality or availability justify". By contrast, in the public sector, or more specifically, for government spending, NAO (2022) assesses V*f*M on the basis of *economy* (i.e., spending less), *efficiency* (i.e., spending well), and *effectiveness* (i.e., spending wisely). Naturally, this sets the basis for assessing V*f*M from a governmental point of view (i.e., the second scope).

The third delimitation is driven by the fact that transport infrastructure projects are a cornerstone of society. This is not to say that social infrastructure, such as schools and hospitals, is not important. On the contrary, this is the area where lots of attention has been paid since the take off of PFI in the UK in 1992. However, different types of infrastructure have unique characteristics. In addition, HM Treasury (2019, p.6) has revealed that Department for Transport shared the fourth largest capital value (around £8 billion) among the current PPP projects. The latest data in the European PPP market has shown that transport was the largest sector both in terms of value and number of projects (European Investment Bank - EIB, 2022). More importantly, rail franchising in the UK has been successively replaced with Emergency Recovery Measures Agreements (Department for Transport, 2020a), and Passenger Service Contracts[8], which encourage greater private sector involvement (Department for Transport, 2021a). Given that they were treated as a 'major change from franchising', it also

[8] According to Department for Transport (2021b), Passenger Service Contracts are based on the concession model used by Transport for London Overground services and many railways around the world. However, The World Bank (2022) states that concession is often used (in law or in common usage) as a specific type of PPP or to describe a wide range of PPP types.

created an opportunity for this research to assess whether they are value-for-money alternatives. Therefore, the focus of this PhD work is on transport infrastructure projects, and any attempt to apply its conclusions to other types of project must be treated with caution.

## 1.6 The Overall Method

That there is a limited understanding of V*f*M assessment was first observed in the existing literature and then confirmed in its practices in global PPP markets. In order to seek a plausible solution and deepen the understanding of the V*f*M concept and its assessment, a framework was proposed by taking stock of *theories of value* (from both the philosophical and economic disciplines) and *stakeholder theory*. The use of theories of value was directly linked to their relevance to 'value' while stakeholder theory offered implications as to who the stakeholders are in V*f*M assessment. The framework was then presented to highly experienced experts with extensive knowledge of infrastructure procurement for validation and further development. This culminated in a V*f*M assessment model that can be used by the public sector to assess and monitor the V*f*M of transport infrastructure projects. For demonstration purposes, the final step in this process was to illustrate a case study of a real-life transport project, upon which the developed model was applied experimentally.

To support this, both qualitative and quantitative strategies were adopted, using semi structured interviews and questionnaire surveys, respectively. To analyse the data collected from secondary (e.g., literature and documents) and primary (e.g., interviews and surveys) sources, a systematic literature review, strengthens, weaknesses opportunities, and threats (SWOT) analysis, comparative analysis, thematic analysis,

analytical hierarchy process (AHP), and an illustrative case study were undertaken. Further details of the methodological choices are provided in Chapter 2.

## 1.7 Thesis Structure

This thesis is divided into eight chapters that collectively explore the way the public sector understands V*f*M, and develop an assessment model so that informed decisions can be made for their transport infrastructure projects to achieve V*f*M. Following this introductory Chapter 1, the remainder of this thesis is organised as follows:

Chapter 2 introduces the research strategy and research design that guide this research followed by a detailed explanation of the methods and data that are used to service the specific research objectives.

Chapters 3 and 4 are literature reviews. In Chapter 3, a comprehensive literature review is conducted to articulate the state-of-the-art of PPPs and V*f*M, and identify research gaps.

Chapter 4 provides an understanding of the practices adopted by governments worldwide to assess V*f*M in terms of PPPs through a comparative study, and reveals the emergent need of a holistic framework.

Chapter 5 addresses the call for a V*f*M assessment model for transport infrastructure projects, and exploratively develops a framework by taking stock of *Theories of Value* and *Stakeholder Theory*.

Chapter 6 refines and validates the proposed framework through qualitative and quantitative data collection and analysis, and in particular, interviews and questionnaire surveys.

Chapter 7 demonstrates the application of the validated model to a real-world transport infrastructure project through an illustrative case study.

Chapter 8 concludes this research by summarising the fulfilment of the research aim and objectives, revisiting the research questions, and making sense of the contributions of this study.

# CHAPTER 2 METHODOLOGY

## 2.1 Chapter Introduction

Chapter 2 begins with the research questions that have impacted the research design of this study. This is followed by an explanation of the three components, namely, philosophical considerations, strategies of inquiry, and research methods that are contained in the research design. In addition, as human participants are involved, ethical considerations are provided. Before arriving at the chapter summary, the research design is evaluated in terms of its reliability and validity.

It should be noted that the foci of this chapter are neither the debate between qualitative research design, quantitative research design, and mixed methods research design nor the superiority of one research design over another. This is not within the scope of this chapter. It has been fully discussed in the existing literature. Instead, based on an understanding of the three designs, this chapter positions itself to a particular design that suits the research questions, explains the rationale, and delves into how this research has been conducted. It is submitted that this research becomes more robust by combing the strengths of several methods to realise the research objectives stated in Chapter 1.

## 2.2 Research Question(s)

It has been shown in Chapter 1 that the existing V*f*M assessment needs improvement given the huge impact of infrastructure interventions. The problem cannot be simply solved with a replacement of terms (e.g., from 'Rail Franchising' to 'Passenger Service Contracts') as is the case in the UK. Otherwise, it can be safely extrapolated that it is

only a matter of time before the same problems happen again. Instead, the transport sector needs to garner an understanding of V*f*M and how it can be assessed so that V*f*M can be delivered to its end-users. In conjunction with the gaps identified in Chapter 1 and Chapter 3, this poses a central research question: '*how should VfM be assessed by the public sector in the context of transport infrastructure projects*?' Naturally, this central research questions can be divided into the following sub-questions:

- *What is the status quo of VfM assessment?*
- *Is there a theoretical lens that can prescribe what should be considered in VfM assessment?*
- *What is the public sector's understanding of VfM assessment?*
- *What is the relationship between the variables in VfM assessment?*
- *How can VfM be better assessed for transport infrastructure projects?*

Formulating research questions in this research was an evolutionary process as it had been expected that there would be new situations that emerge and should be dealt with. For example, although V*f*M assessment is also a feature of purely private sector projects, the central research question was restricted to those involving public sector bodies. Another was that variables in any new V*f*M framework should not be treated as the same because: (1) the public sector may place different emphases on them; and (2) the public sector may not have the capacity to assess them equally, which helped raise the sub-question 4 above. These matters were informed during the data collection process, which then interacted with the research design.

This approach is consistent with Creswell (2009, p.131) who states ‘‘expect the research questions to evolve and change during the study in a manner consistent with the assumptions of an emerging design’’. However, it to some extent differs from the tenet that research questions dominate the research design as described in some textbooks, such as de Vaus (2001) and Mason (2002). Obviously, the addition of sub-question 4 requires quantitative inquiry, which modifies the initial qualitative inquiry proposed. In this sense, it is in agreement with Bryman (2007a) that it is questionable that research questions should always guide researchers' methodological choices right from the outset.

Therefore, what Bryman (2007a) calls 'a particularistic discourse' whereby mixed methods research is viewed as only appropriate when research questions warrant it, is reflected in this thesis. Similarly, Creswell (2009, p.138) argues that 'a strong mixed methods study should start with a mixed methods research question, to shape the methods and the overall design of a study'. In this strand, the mixed methods research question is presented in the form of separate qualitative (i.e., sub-questions 1, 2 and 3) and quantitative questions (i.e., sub-question 4) followed by a mixed methods question (i.e., sub-question 5). With the research questions in mind, the research design in this thesis is now explicated.

## 2.3 Research Design

In the well-known book '*Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*', Creswell (2009, p.3) defines research design as ‘‘plans and the procedures for research that span the decisions from broad assumptions to detailed methods of data collection and analysis’’. In a less abstract manner, de Vaus (2001)

likens research design to building construction where people should not order materials or set milestones until they understand what kind of building is needed. This underscores the essential function of a research design to collect evidence that enables unambiguous answers to the research questions raised above. For this reason, Yin (2018, p.26) branded the research design as a 'logical but not a logistical problem'.

Table 1 outlines some of the prominent research designs. In this thesis, the research questions require an *understanding* of the concept of V*f*M and an *explanation* of the variables considered in V*f*M assessment, and the central question is a combination of both. In other words, neither quantitative nor qualitative research design alone can act as a blueprint here. Therefore, the mixed methods research design is adopted to answer the central question and five sub-questions. This mixed methods research as supported by Johnson and Onwuegbuzie (2004) and Creswell (2009, p.4) can generate more robust results to the V*f*M question than purely quantitative or qualitative research. It does not aim to discredit the quality of quantitative or qualitative research and create an agreement for the quantitative-qualitative divide. Not to mention that Bryman (2007b) has noted barriers, such as different audiences, methodological preferences, structure of research projects, role of timelines, skill specialisms and nature of the data, to the integration of quantitative and qualitative research. Rather, it is the nature of the research questions that makes mixed methods research design more suitable. Next, the paradigm, strategies, and methods associated with the mixed methods design are described.

Table 2.1. Available research designs (Adapted from de Vaus, 2001 and Creswell, 2009)

| Research designs | Definition | Key features |
|---|---|---|
| Qualitative research | Explore and understand the meaning individuals or groups ascribe to a social or human problem. | • Suits an inductive style<br>• Build from particulars to general themes<br>• The researcher interprets the meaning of the data |
| Quantitative research | Test objective theories by examining the relationship among variables. | • Suits a deductive style<br>• Ability to generalise and replicate the findings<br>• Protect against bias and control for alternative explanations |
| Mixed methods research | An approach to inquiry that combines or associates both qualitative and quantitative forms. | • Use of both qualitative and quantitative approaches so that the overall strength of a study is greater |
| Experimental design | Draw causal inferences from data obtained. | • Pre/post-test(s) measure(s) on the outcome variable<br>• Comparison groups<br>• Random allocation to the groups before the pre-test(s)<br>• Intervention(s) |
| Longitudinal design | Measure change over time and of doing so by collecting data concerning at least two time points. | • Similar to the experimental design but there is no control group |
| Cross-sectional design | Examine the extent to which variation in the outcome variable is linked with group differences. | • No time dimension<br>• Reliance on existing differences rather than change following intervention<br>• Groups based on existing differences rather than random allocation |
| Case study | Collect contextual information about a case(s) to understand causal processes within a context | • Descriptive or explanatory<br>• Theory testing or theory building<br>• Single case or multiple case<br>• Holistic or embedded units of analysis<br>• Parallel or sequential case studies<br>• Retrospective or prospective |

## 2.4 Research Paradigm

### 2.4.1 The Existing Paradigms

A research paradigm, according to Guba and Lincoln (1994, p.105), is ‘‘the basic belief system or worldview that guides the investigator, not only in choices of method but in ontologically and epistemologically fundamentals ways’’. Following this thread, Creswell (2009, p.6) called it worldview, which is ‘‘a general orientation about the world and the nature of research that a researcher holds’’. Crotty (1998, p.8) focussed on epistemology, which deals with philosophical groundings and the adequacy and legitimacy of knowledge that are generated from them. Tables 2.2 to 2.4 depict the different types of paradigms that these commentators have provided.

It is not uncommon to see the interchangeable use of such terminologies as paradigm, worldview, epistemology, ontology, methodology, approach, perspective, and method. In this sense, inconsistency in the literature on the terms exists. As Crotty (1998, p.1) argues, this can be bewildering for novice researchers. Therefore, this thesis tends to adopt ‘paradigm’ as an organised way of articulating the fundamental considerations because it warrants the discussion about ontology, epistemology, and methodology. In a simple sense, Denzin and Lincoln (1994, p.99) summarise that ontology deals with the nature of reality, epistemology is about the way people know the world and the relationship between the inquirer and the known, and methodology emphasises how people acquire knowledge about the world. Undoubtably, there are alternatives as just mentioned, but maintaining stability (i.e., the consistent use of paradigm) helps an early career researcher (as in this thesis) gradually build his own edifice before being dragged down in the torrent at once.

Table 2.2. Four/ five paradigms

| Paradigms | Ontology | Epistemology | Methodology |
|---|---|---|---|
| Positivism | Naive realism: real reality that is knowable | • Dualist/ objectivist<br>• Findings true | • Experimental/ manipulative<br>• Verification of hypotheses<br>• Chiefly quantitative methods |
| Postpositivism | Critical realism: real reality but only imperfectly and probabilistically knowable | • Modified dualist/ objectivist<br>• Critical tradition/ community<br>• Findings probably true | • Modified experimental/ manipulative<br>• Critical multiplicity<br>• Falsification of hypotheses<br>• May include qualitative methods |
| Critical theory | • Historical realism: virtual reality shaped by social, political, cultural, economic, ethnic, and gender values<br>• Crystallised over time | • Transactional/ subjectivist<br>• Value-mediated findings | Dialogic/ dialectical |
| Constructivism | Relativism: local and specific constructed realities | • Transactional/ subjectivist<br>• Created findings | Hermeneutical/ dialectical |
| Participatory | Participative reality: subjective-objective reality, co-created by mind and given cosmos | • Critical subjectivity in participatory transaction with cosmos<br>• Extended epistemology of experiential, propositional, and practical knowing<br>• Co-created findings | • Political participation in collaborative action inquiry<br>• Primacy of the practical<br>• Use of language grounded in shared experiential context |

(Adapted from Guba and Lincoln, 1994, p.109)

Table 2.3. Four worldviews

| Worldviews | Contents |
|---|---|
| Postpositivism | • Determination<br>• Reductionism<br>• Empirical observation and measurement<br>• Theory verification |
| Constructivism | • Understanding<br>• Multiple participant meanings<br>• Social and historical construction<br>• Theory generation |
| Advocacy/ Participatory | • Political<br>• Empowerment issues-oriented<br>• Collaborative<br>• Change-oriented |
| Pragmatism | • Consequences of actions<br>• Problem-centred<br>• Pluralistic<br>• Real-world practice-oriented |

(Adapted from Creswell, 2009, p. 6)

Table 2.4. Three epistemologies

| Epistemologies | Contents |
|---|---|
| Objectivism | • Meaning/ meaningful reality exists apart from the operation of any consciousness<br>• Understandings and values are considered to be objectified in the people we are studying<br>• Objective truth |
| Constructionism | • Truth, or meaning exists in and out of our engagement with the realities in our world<br>• Different people may construct meaning in different ways, even in relation to the same phenomenon<br>• Subject and object emerge as partners in the generation of meaning |
| Subjectivism | • Meaning is imposed on the object by the subject<br>• Meaning comes from anything but an interaction between the subject and the object to which it is ascribed |

(Adapted from Crotty, 1998, p. 8-9)

Clearly, the list of paradigms is not exhaustive and definitive even in the case of the same commentator. For example, Lincoln *et al*. (2011, p.100), when revisiting their

own work (Guba and Lincoln, 1994), added the participatory paradigm (shown in Table 2.2) to acknowledge the substantial changes in the landscape of social scientific inquiry. Elsewhere, attention has been paid to the 'paradigm wars' where the merits and assumptions (e.g., epistemological and ontological stances) of quantitative and qualitative research are debated (see Figure 2.1 for a distribution of their positions). However, according to Bryman (2008, p.13), the term (i.e., paradigm wars) *per se* is debatable in terms of: (1) what paradigms are involved in discussion; (2) when were the contrasting views began[9] and ended; and (3) whether there is a settlement. Against these three aspects, the next section explains the specific paradigm into which this study is positioned.

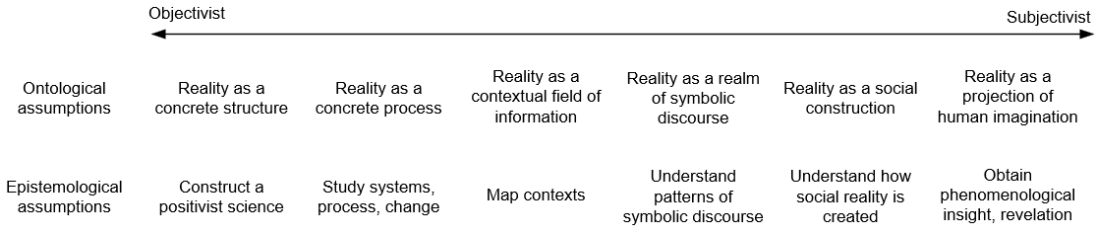



Figure 2.1. Paradigm wars: spectrum of ontologies and epistemologies

(Source: Adapted from Morgan and Smircich, 1980)

### 2.4.2 The Paradigm in this Thesis

It is widely acknowledged that pragmatism derives from a series of works of Charles Sanders Peirce, an American philosopher (Mitchell, 2018). In answering whether there is a settlement for the paradigm wars mentioned above, Bryman (2008, p.23) concluded pragmatism sufficed in alleviating the antagonism between paradigms if

[9] Bryman (2008) indicated that Gage (1989) was one of the pioneers in using the term- paradigm wars alongside Hammersley (1992) and Oakley (1999). Upon checking Gage's 1989 article, Gage (1989) stated 1989 was the year when paradigm wars came to a 'sanguinary climax', and used words such as 'jockeying for position', 'carving out of territory', '*ad hominem* attacks', and 'lack of integrity' to describe the discussions of over 200 partisans on paradigmatic issues in a two-day conference (i.e., International Conference on Alternative Paradigms for Inquiry), which resulted in many more kindred engagements.

not wholly a resolution. Although Lovejoy (1963) cautiously numerated 13 types of pragmatisms and maintained that some single and stable meaning to pragmatism was controversial, Creswell (2009, p.10) perceives that pragmatists focus on the research problem rather than methods, and devote to understanding the problem using all approaches available. Similarly, Teddlie and Tashakkori (2009, p.7-8) define pragmatism as ‘‘a deconstruction paradigm that debunks concepts such as truth and reality and focuses instead on what works as the truth regarding the research questions under investigation. Pragmatism rejects the either-or choices associated with paradigm wars, advocates for the use of mixed methods in research, and acknowledges that the values of the researcher play a large role in interpretation’’.

Two main reasons have underpinned the selection of pragmatism for this research. First, the research problem (i.e., the issue of V*f*M for transport infrastructure projects) calls for both an *understanding*/ *exploration* of the concept of V*f*M and an *explanation* of the relationship between the assessment variables. Upon reflecting on the research process, both the principles of quantitative (underpinned by positivism) and qualitative (underpinned by interpretivism) research have been followed. While it was not immediately connected to the fundamental philosophical assumptions as many inquirers do[10], on hindsight, this process is believed to be in rapprochement with pragmatism because this inquirer sought whatever approaches to understand the problem (i.e., ‘what works’). Second, this inquirer’s education background in built environment plays a role. According to Amaratunga *et al*. (2002), built environment research has elements of cognition, affection, and behaviour that merit qualitative and

[10] Kuhn’s (1970, p.46) viewpoint that ‘Scientists work from models acquired through education and through subsequent exposure to the literature often without quite knowing or needing to know what characteristics have given these models the *status* of community paradigms’ well supports this.

quantitative methodologies. This is true as this inquirer has been trained to grasp knowledge from both sides (evidence can be seen from the modules taught and this inquirer's publications). If Madden's (2021) point is taken, it is the familiarity with various techniques that later make novice researchers create a context for philosophical terms (i.e., pragmatism in this context). Therefore, paradigmatically, pragmatism (Figure 2.2) has guided this research.

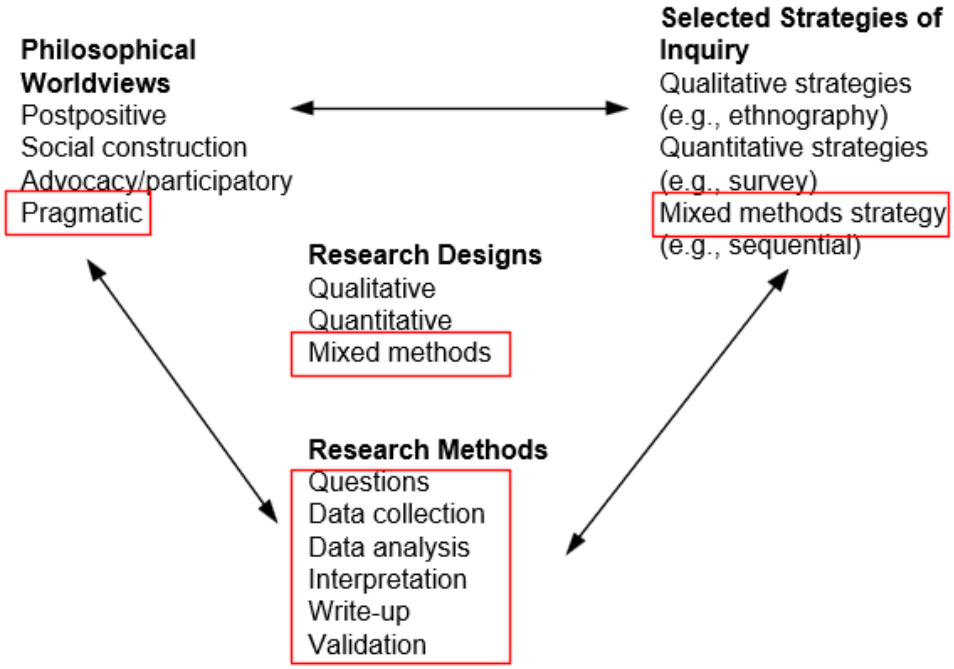



Figure 2.2. Paradigms, research strategies, and research methods in this thesis

(Source: Adapted from Creswell, 2009, p.5, and the red boxes are adopted locally)

*2.4.2.1 Ontology*

In Creswell's (2009, p.11) account of pragmatism, there is an external world independent of the mind and one that is lodged in the mind, which shows a degree of agreement with realism. However, the departure, as Cherryholmes (1992) argues, happens when realists look to explain the 'real' world (they also believe that they can do so) and pragmatists question how realists know they are closer to the 'reality' or not. That is, pragmatism emphasises 'consequences' rather than 'reality'. Or as

Cherryholmes (1992) says, ‘‘when we (as pragmatists) read the world we can never be quite sure if we are reading the world or reading ourselves’’. Accordingly, this thesis holds that an external world is out there but the truth about reality cannot be actually determined. An example is that the relationship between V*f*M variables exists and can be understood (or at least this is acknowledged in this thesis). However, this relationship may not always hold across jurisdictions that assess V*f*M. This stance conforms to Howe (1988), in that knowledge claims are contingent on beliefs, interests, and projects.

*2.4.2.2 Epistemology*

In addressing the epistemological question (i.e., the relationship between the knower and the known) in pragmatism, pragmatists do not commit to positivism or interpretivism. According to Teddlie and Tashakkori (2009, p.90), the epistemology of pragmatism navigates itself on a continuum rather than on extremes. Shaped by the pragmatic ontology, this balanced view means that the investigator and the participants may interact highly with each other to answer questions (e.g., the semi-structured interviews conducted in this research), and sometimes, this interaction disappears when testing hypotheses using collected quantitative data (e.g., when analysing the survey data in this research). In manifests as what Johnson and Onwuegbuzie (2004) calls ‘a strong and practical empiricism[11] as the path to determine what works’. For the value-laden or value-free discussion, the sense of value is obvious in pragmatic

[11] According to Bryman (2004, p. 7), there are often two schools of thoughts on empiricism. The first implies a general approach to the study of reality that suggests that only knowledge gained through experience and the senses is acceptable. The second is termed ‘naïve empiricism’ which refers to a belief that the accumulation of ‘facts’ is a legitimate goal in its own right.

research. As argued by Cherryholmes (1992), the topic pragmatists deemed valuable and interesting is studied in a way that accommodates their value systems.

*2.4.2.3 The use of theory*

Creswell (2009, p. 51) described theory as ‘‘an interrelated set of constructs (or variables) formed into propositions, or hypotheses, that specify the relationship among variables (typically in terms of magnitude or direction)’’. Bryman (2004, p.5) defined it more concisely as ‘‘an explanation of observed regularities’’. There are two issues about theory that are concerned in this thesis, including: (1) what form of theory is used; and (2) how it is used. For the forms of theory, Bryman (2004) presented middle-range theories and grand theories, which operate at a more abstract and general level (see p.5-8 for main differences between them). Referring to theories’ breadth of coverage, Creswell (2009, p.52) identified micro-level (i.e., dependent on time, space, or number of people), meso-level (i.e., link micro-level and macro-level theories), and macro-level (i.e., explain larger aggregates) theories. In terms of how theory is used, it is mainly used deductively (i.e., theory testing) and inductively (i.e., theory building) (Bryman, 2004, p.8). In a mixed-methods research, Creswell (2009, p.66) states that theory can be employed as a theoretical lens or perspective to guide the research, or act as a framework to be tested quantitatively or qualitatively.

In this thesis, *theories of value* and *stakeholder theory* were used as a theoretical lens to propose the initial V*f*M framework. The relevance of theories of value to this study is emphasised by referring to Taylor (1996), who argues that it is at the heart of ‘the distribution of wealth and income’ and ‘the maintenance of microeconomic order’. Hence, theories of value and V*f*M assessment can be seamlessly connected to

understand how V*f*M should be assessed to deliver transport infrastructure projects (c.f., Taylor's 'distribution of wealth and income') and safeguard taxpayers' pockets (c.f.., his 'maintenance of microeconomic order'). While theories of value indicate that demand-side (as presented by end-users) and supply-side (as presented by governments) values should co-exist in V*f*M assessment, stakeholder theory further confirms the rationale of 'the general public' as a stakeholder in V*f*M assessment. This addressed the common confusion about the subjects of value in V*f*M assessment (McKevitt, 2015). Another consideration about the use of stakeholder theory was that 'conflicts' between the interests of governments and the general public were examined. Together, these two theories informed what would be considered in V*f*M assessment. More specifically, based on theories of value, stakeholder theory and existing literature, 'traditional V*f*M' and 'public V*f*M' (including their associated elements) were derived. This then allowed other sub-themes of the elements to emerge during data collection and analysis stages, which in turn refined and developed the initial V*f*M framework. A similar case is located in Zhu and Mostafavi (2017) who borrowed *contingency theory* and *systems thinking* to formulate a complexity and emergent property congruence framework to understand project performance.

## 2.5 Research Strategy

The term 'strategies of inquiry' (referred to as research strategy thereinafter) is synonymous with 'approaches' and 'methodologies'. According to Creswell (2009, p.11), a research strategy is a type of research design that provides specific direction for procedures. In a qualitative research design, research strategies include ethnography, grounded theory, case studies, phenomenological research, and narrative research (see Creswell, 2009; and Denzin and Lincoln, 1994 for details). By contrast,

a quantitative research design consists of such research strategies as survey research and experimental research (see Creswell, 2009 for details).

In a mixed methods research design, Creswell (2009, p.14-15) generalised sequential, concurrent, and transformative research strategies (variations of these can be found in Creswell, 2009, p.211-216). This research began with qualitative interviews to understand the V*f*M concept and extended this understanding in the following quantitative questionnaire surveys (i.e., sequential exploratory). In other words, a sequential research strategy was implemented. This choice was justified by the fact that Creswell (2009, p.212) contends that a sequential exploratory research strategy is especially advantageous when existing instruments are not adequate or available, and that the existing V*f*M assessment is highly controversial (as mentioned in Chapter 1). Further details on data collection (including sampling strategies) and analysis of the sequential exploratory research strategy are provided next.

## 2.6 Research Methods

The selected sequential exploratory research strategy indicates that the preceding qualitative findings support the conduct of the following quantitative research, and the quantitative results facilitate the interpretation of qualitative findings. The work of Hughes *et al*. (1997) is an early illustration of such a sequence. They first interviewed children and young adults about their drinking and their thoughts about the different drinking products, which then impacted the design of a questionnaire to examine the appeal of a certain type of drinks to them. Accordingly, this research strategy prescribed the way of collecting and analysing data for this research shown in Figure 2.3.

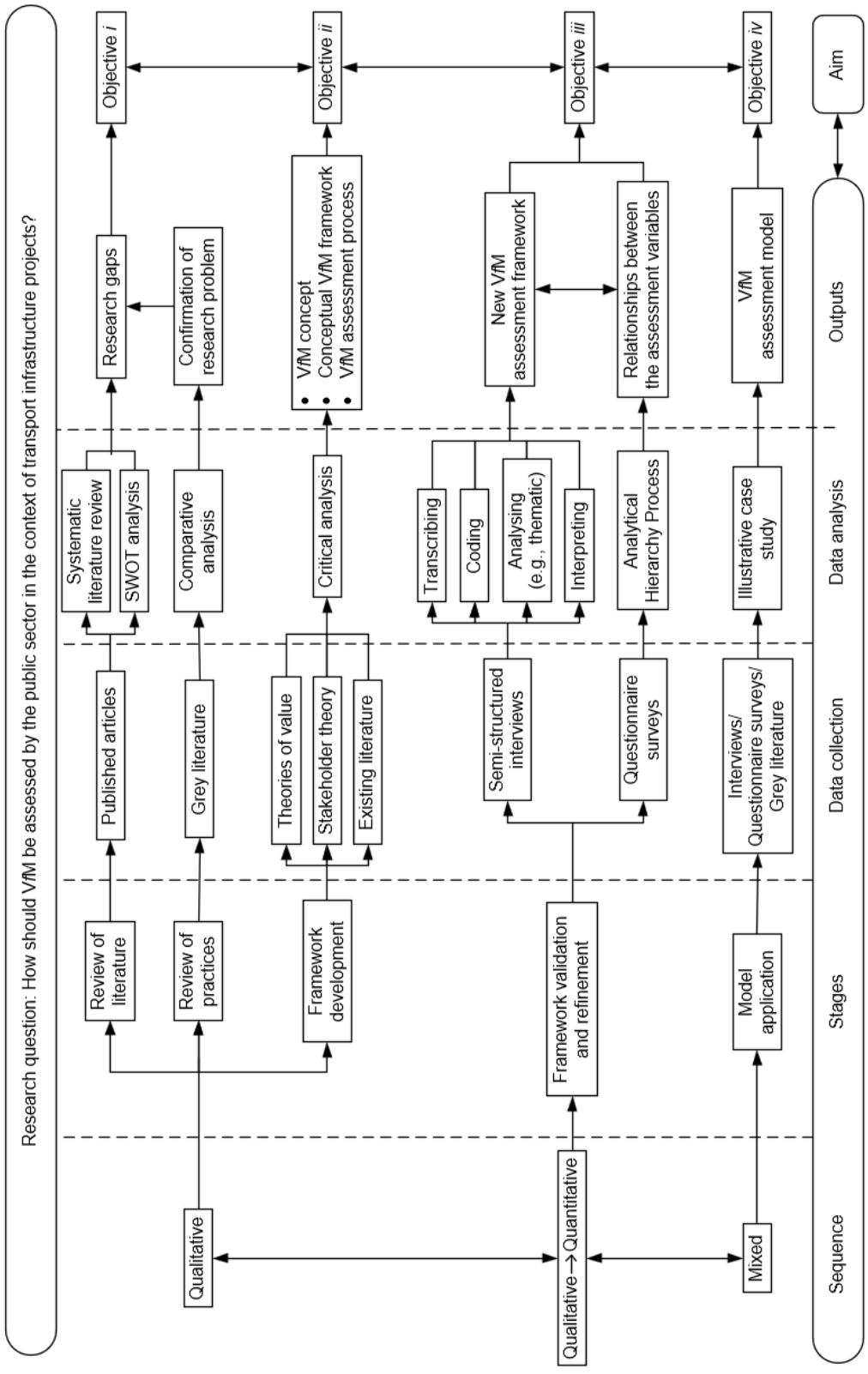



Figure 2.3. Research flow

### 2.6.1 Data Collection

Data in this thesis were mainly collected from primary (e.g., semi-structured interviews and questionnaire surveys) and secondary sources (e.g., published documents). By collecting primary data, as Hox and Boeije (2005) emphasise, the research design and data collection strategy could be tailored to answer the research question(s) (formulated in Section 2.2). On the other hand, because there were relevant data (e.g., government guidelines on V*f*M assessment) already available, these were also used. Hox and Boeije (2005) argue that reusing such resources can both serve the research and reduce cost and time, which countered the drawback (i.e., time-consuming) of the sequential exploratory research strategy (Creswell, 2009, p.212).

#### *2.6.1.1 Systematic literature review*

A systematic literature review (SLR) was conducted to identify the typology of existing V*f*M assessment methods and their evolution. SLR is defined by Fink (2005, p.3) as ‘‘a systematic, explicit, and reproducible method for identifying, evaluating, and synthesizing the existing body of completed and recorded work produced by researchers, scholars, and practitioners’’. Feak and Swales (2009) argue that a SLR can provide transparancy and clarify the state of existing research enabling implications for research and practice to be fomulated. In short, Synder (2019) asserts that pre-specified research questions (i.e., sub-question 1) can be answered using evidence gleaned from such a review.

As shown in Figure 2.4, relevant research literature was retrieved from the Web of Science (WoS) and Scopus databases. According to Bramer *et al.* (2017), using these

databases is robust for generating optimal search results for a SLR. A series of keywords, such as 'value for money assessment', 'value for money analysis', or 'value for money evaluation' and 'PPI', 'PPP', 'PFI' were inputted into the search engines of the selected databases. Keywords were inputted as 'topics' in the WoS for search whilst applied in the 'Title/Abstract/Keyword' (T/A/K) field of the Scopus.

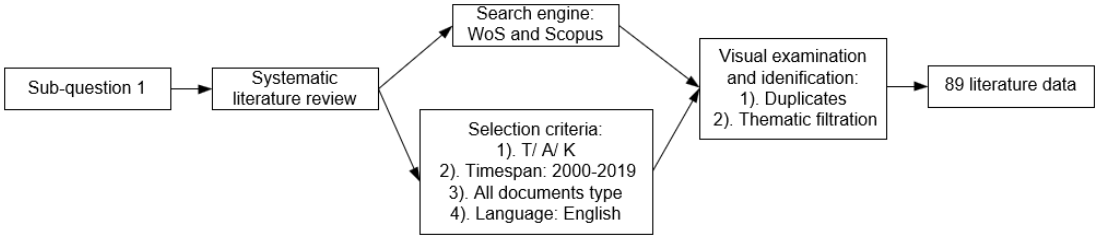



Figure 2.4. The approach to collecting literature data

In line with Feak and Swakes (2009), following criteria and filters were applied to minimise bias: (1) timespan: 2000 to 2019 inclusive; (2) all types of articles (i.e., journal, review, conference proceedings, books and book chapters); and (3) language: English. Subsequently, 261 relevant articles were identified, with the majority being scholarly journal articles. Notably, the number of publications related to V*f*M has significantly increased over the past five years (Figure 2.5). Indeed, this is not surprising as many transport PPPs have been subjected to mis-performance (e.g., lower-than-expected V*f*M) (Macário *et al*., 2015), which may trigger the interest of academics. The titles of the 261 results were compared to eliminate duplication. A total of 13 sources of literature (nine journal articles, two conference reviews and two book chapters) were discarded. Thus, 248 articles were identified for review. The abstracts and keywords were examined to develop a 'pool' specific to V*f*M assessment studies. As a result, 89 articles were clustered together (details of these articles are presented in Chapter 3). It should be noted that this search was completed in 2020. Therefore, literature produced after this time, whilst being evaluated for its

applicability, was not part of this SLR analysis. Notably, Figure 2.5 was updated at the end of this PhD to include any new publications to date.

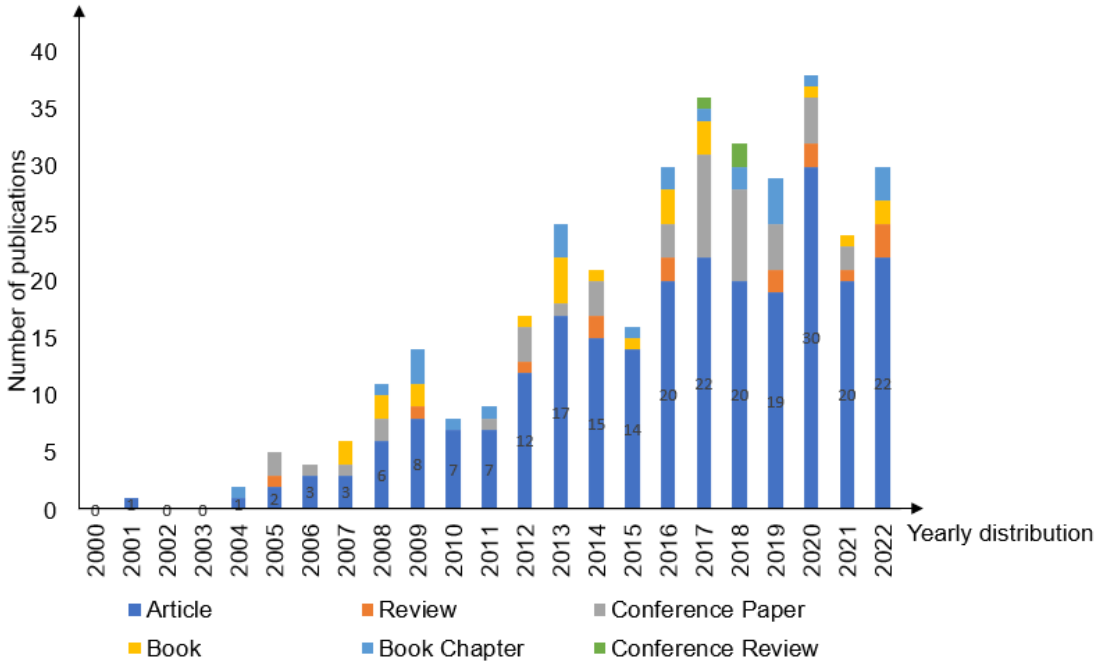



Figure 2.5. Distribution of publications related to V*f*M

*2.6.1.2 Grey literature*

According to the famous 'Luxembourg definition' (Schöpfel and Farace, 2010), grey literature is produced on all levels of government, academic, business and industry in print and electronic formats, but is not controlled by commercial publishers (i.e., publishing is not the primary activity of the producing body)[12]. As shown in Figure 2.3, this research reviewed the practices of V*f*M assessment around the world. Although there are studies (see, for instance, Grimsey and Lewis, 2005) in the published literature that have done a similar work, new situations, which were not captured, have emerged over the years. Therefore, information on V*f*M assessment

[12] This definition was approved in 1997 at the Third International Conference on Grey Literature held in Luxembourg, and the final bit (i.e., ''publishing is not the…'') was added in 2004 at the Sixth International Conference on Grey Literature held in New York.

was directly extracted from governments' latest documents to confirm whether V*f*M pitfalls presented in the published literature exist and understand the state-of-the-art V*f*M assessment practices in global PPP markets. Since these policy documents outline rationales and present proposal, SAGE Research Methods (2017, p.3) has regarded them as traditional primary data sources.

The sampling strategy for gleaning data from global V*f*M assessment practices (based on grey literature) was purposive sampling, and more specifically *typical case sampling* and *extreme or deviant case sampling*. The former covers the most typical, normal, or representative cases of the group, and the latter involves cases that near the end of the distribution of cases under consideration (Teddlie and Tashakkori, 2009, p.176). As the aim here was to draw a comparison between different countries' V*f*M assessment practices, Teddlie and Tashakkori (2009) argue such types of purposive sampling are helpful in achieving representativeness and comparability. Following the characteristics of typical case sampling and extreme or deviant case sampling, three criteria were adopted to choose the sample, and they considered: (1) similar and different systems that can capture variances as well as consistencies as proffered by Lor (2010); (2) representativeness of PPP experience; and (3) data accessibility. Accordingly, three countries – the UK, Australia, and China – were selected because: (1) they have different institutional characteristics that to some extent underlie their methodological approaches to V*f*M assessment (i.e., different systems); (2) V*f*M assessment is a legal procedure in these three countries that has to be followed if PPPs are deemed viable (i.e., similar systems); and (3) the UK and Australia are widely considered mature PPP markets in terms of their complexity and volume of projects (Grasman *et al*., 2014). China's PPP market, since its official adoption in 2014, has

grown to be the world's largest (currently c.£16 trillion - 28 times larger than the UK's) and Perera *et al*. (2019) have equated its maturity to that of the UK and Australia (i.e., representativeness). Table 2.5 displays the data collected. By following the criteria and the reasons explained above, it was envisaged that this comparison would show useful variations on the dimensions of theoretical interest (Seawright and Gerring, 2008).

Table 2.5. Selected countries and their respective V*f*M assessment guidelines

| Countries | Guidelines | Documentary sources |
|---|---|---|
| The UK | Value for Money Assessment Guidance | HM Treasury (2004) |
| | Value for Money Assessment Guidance | HM Treasury (2006) |
| | Quantitative assessment: user guide | HM Treasury (2011) |
| | The Green Book | HM Treasury (2020b) |
| Australia | National PPP Guidelines Overview | Department of Infrastructure and Regional Development (2008a) |
| | Volume 4 Public Sector Comparator Guidance | Department of Infrastructure and Regional Development (2008b) |
| | Volume 5 Discount Rate Methodology | Department of Infrastructure and Regional Development (2013) |
| China | PPP Value for Money Assessment Guidance | Ministry of Finance (2015) |
| | PPP Value for Money Assessment Guidance | Ministry of Finance (2016) |

*2.6.1.3 Interviews*

*Why interviews?*

Teddlie and Tashakkori (2009) have identified four types of interviews, namely, informal conversational interview, general interview guide approach, standardised open-ended interview, and closed fixed-response interview. Bryman (2004, p.113) listed 12 types of interviews, which were broadly grouped into structured, semi-structured, and unstructured interviews. Among them, structured interview is often

associated with quantitative research while semi-structured and unstructured interviews are more related to qualitative research (hence these can be known as 'qualitative interviews') (Bryman, 2004, p.319). As part of the qualitative strand in this research (Figure 2.3), the approach of qualitative interview (i.e., semi-structured interview) was adopted. The definition may vary between writers, but Bryman's (2004. p.113) description corresponds to the approach in this research. Consistent with Bryman's view, semi-structured interviews conducted embody the following characteristics: (i) it carried a series of questions that formed an interview guide; (ii) the order of the questions asked can change (but all questions on the interview guide were asked in similar wordings); (iii) interviewees were given space (and were encouraged) to elaborate on their thoughts; and (iv) follow-up questions (those were not listed on the interview guide) were asked if the replies were seen as significant.

*Why semi-structured interview?*

The use of semi-structured interview is probably the most common method in qualitative research (Bryman, 2004, p.319). DiCicco-Bloom and Crabtree (2006) stressed the role of interviews in exploring meaning and perceptions to gain a better understanding and/ or generate hypotheses. In order to garner an understanding of how V*f*M should be assessed, the semi-structured interview (conducted individually) was adopted for several reasons. First, the structured interview has forced categories for interviewees to respond, thereby limiting the exploration of their knowledge and experience (Bryman, 2004, p.229). Patton (2002) has opposed the use of structured interviews in qualitative research due to its impersonal, irrelevant, and mechanistic nature. Second, in preparing researchers for suitable types of interview, Bryman (2004, p.323) outlines the unstructured interview's aversion to even the most rudimentary

interview guide. If unstructured interview were used, there is a risk of digressing from the main topic. Finally, semi-structured interview enables pre-determined questions to be discussed and provided opportunities for new questions to be asked. Thus, the interviews centred on seeking participants' view on V*f*M assessment while allowed their peripheral points (e.g., comments on PPPs and the rail industry) to be picked up. Having in place a list of planned questions before the interviews also reflected Zhang and Wildemuth's (2009, p.245) argument that even unstructured interview should not go ahead without knowledge and preparation.

*Interview guide*

In semi-structured interviews, Bryman (2004, p.324) states that an interview guide covers relatively structured issues or questions to be addressed. When formulating the interview questions, two critical questions explained by Bryman were considered. The first was 'just what about this thing is puzzling me'. In this study, for example, the question '*what does value for money mean to you*?' was asked because of its ambiguous definition in the existing literature. Bryman's second category was 'what do I need to know in order to answer each of the research question I'm interested in?', which emphasised the importance of asking questions from the standpoint of interviewees. As such, interviewees in this study were prompted to answer the question '*what is the main VfM method*?' (if there is a value for money assessment). Additionally, the interview questions were finalised in an open-ended format so that interviewees would be prompted and encouraged to talk about their experience and thoughts about the concepts of traditional and public V*f*M proposed in the initial framework (discussed in detail in Chapter 5). For clarification purposes, a brief explanation (or context) was provided before going directly to each question. For

example, when asking the question '*what do you think of the importance of social inclusion in VfM assessment?'*, the interviewer added ''besides the direct aim of functionality, transport ultimately works as a means to access other key services such as employment, education, and health''. Following these principles and the procedure in Figure 2.6, an interview guide comprising background, traditional V*f*M, and public V*f*M related questions was generated (the full interview guide can be found in Appendix I).

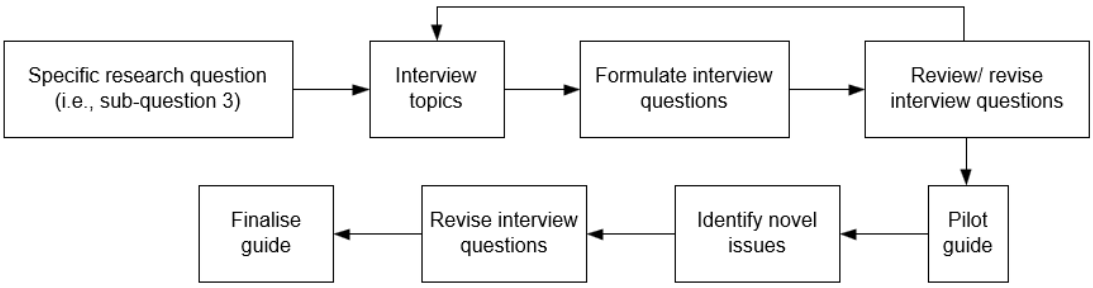



Figure 2.6. The procedure for drafting interview questions

(Source: Adapted from Bryman, 2004, p.326)

As illustrated in Figure 2.6, two rounds of revisions to the interview questions were made. After the questions were drafted, an experienced supervision team reviewed them. For instance, 'quality' was considered a broad term that could cover a variety of meanings. Hence, it was narrowed down to 'delivering projects in conformance with specifications and standards'. When piloting the initial interview guide, there was a discussion about whether 'technology' should be a separate assessment aspect due to its prevalence in the construction sector. It was decided not to include it in the main guide initially, but opportunities were reserved for interviewees to give an opinion. A consensus was later achieved during the interviews that 'technology' should rather be considered an enabler to realise traditional V*f*M and public V*f*M. One of the interviewees even stipulated 'no visual rhetoric' because often there is discrepancy

between what technology shows and what transpires in reality. The revised interview guide also maintained an iterative nature (DiCicco-Bloom and Crabtree, 2006) in that there was back and forth between the interview questions, data collection, and data analysis. Germaine to this is when an interviewee suggested that V*f*M is not only about the benefits of the project but also about the downside (e.g., environmental pollution) the project may incur. Subsequently, the definition of public V*f*M was changed to 'those impacts (originally named 'benefits') a transport intervention can have on the people/ society'. Such an interview guide, according to Patton (2002, 343), provided an underpinning for the interviewer to explore, probe, and ask questions from the perspectives of the interviewees, and elucidate and illuminate V*f*M. It also made possible a systematic and comprehensive way of interviewing a number of different people, from which their views could be compared and contrasted.

*Sampling strategy*

Purposive sampling with a focus on snowball sampling was adopted to identify interviewees (Figure 2.7). This strategy is applauded by Teddlie and Tashakkori (2009, p.173) in being able to address specific purposes associated with research questions using certain units or cases. Maxwell (1997, p.87) further argues that those deliberately selected samples can provide important information that would otherwise not be available from others. This research started with identifying interviewees that appear to have knowledge of infrastructure procurement. They mainly came from two sources: (1) using keywords such as 'PPPs', 'V*f*M', 'infrastructure procurement', and 'transport infrastructure' to search experts on the internet; and (2) familiarity with well-known figures in the topic domain. For example, the website of Major Projects Association, which is a community of people with knowledge and experience in major

projects (including transport infrastructure projects) in the UK, was utilised. Once a potential interviewee (by checking their profile) was identified, an invitation email stating the purpose of the interview was sent out for the interviewee to determine his/ her suitability. Three scenarios followed: some were available, some were not suitable (but sometimes suggested others), and some were non-responsive. At the end of each interview, the interviewee was asked to recommend others who shared experience in PPPs and may be interested in doing an interview. Such a snowball sampling strategy, which is well-known in social sciences research (Biernacki and Waldorf, 1981), helped recruited additional and useful participants.

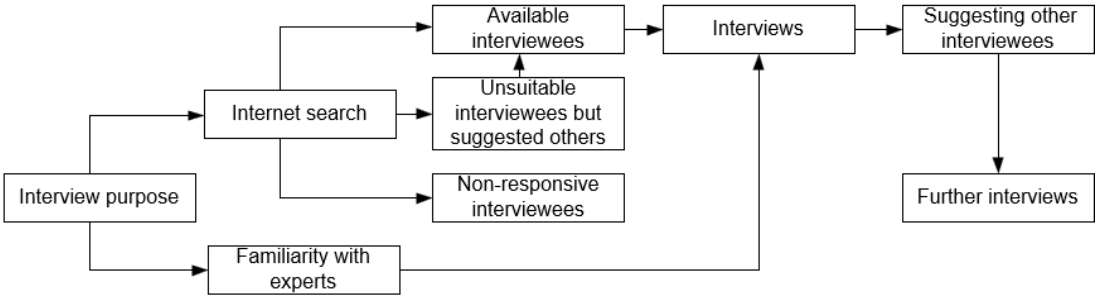



Figure 2.7. Sampling strategy for identifying interviewees

Transport infrastructure projects are capital-intensive and complex investments, requiring considerable specialism, thus the number of capable clients and private partners is often limited. This to some extent impinged on the availability of interviewees. Nevertheless, a total of 13 interviews were secured over 11 months. Although the sample size was not large, Teddlie and Tashakkori (2009, p.174) explain that the sample size of purposive sampling is typically small (less than 30). Guest *et al*. (2006) further document that 12 interviews can be enough for data saturation using purposive sampling; a figure supported by Baker and Edwards (2012, p.5). As an example, the PhD work of Mitchell (2015) uses 14 interviews as the entire data sources to compare the offshoring and outsourcing strategies of German and UK multinational

companies. Taken together, this supports the argument that the number of interviews (i.e., 13) conducted in this research was sufficient. More importantly, the frequently supported criteria of *saturation* (i.e., no further recurring themes) and *pragmatic considerations* (i.e., time constraints and the difficulty to access certain study populations) explained by Vasileiou *et al*. (2018) are cited to justify the sample size. Following analysis of the 13 interviews it was concluded that no new information could be extracted and thus a point of saturation had been reached. In terms of *pragmatic considerations* it was evident that due to the political sensitivity of V*f*M, government officials were hesitant to participate in the interviews. This fact, combined with the exceptional seniority and experience of those that were willing to be interviewed (see Table 2.6) was considered to justify the sample in terms of pragmatism. All interviewees were from public sector bodies or from consulting firms that worked for them. This included the National Audit Office, European Institute of Public Administration, Infrastructure Procurement Authority, The World Bank, Deloitte, PricewaterhouseCoopers, and Ernest & Young. All interviewees had ample experience in PPPs. This satisfies what Malterud (2016) calls 'information power' in which 'the more information the sample holds, relevant for the actual study, the lower amount of participants is needed'. This 'information power' was not only illustrated in the interviewees' seniority in PPPs, but also the amount of information they provided during the interviews. In addition, each interviewee spent a long time (averaged around 74.71% of the total interview time) expressing their views on V*f*M.

Table 2.6. Interviewees' profiles

| Participant code | Sector[13] | Years of experience |
|---|---|---|
| Interviewee A | Private sector | Since 1999 |
| Interviewee B | Private sector | Since 2000 |
| Interviewee C | Public sector | Since 1989 |
| Interviewee D | Public sector | Since 2002 |
| Interviewee E | Private sector | Since 2007 |
| Interviewee F | Public sector | Since mid-1990s |
| Interviewee G | Public sector | Since 1994 |
| Interviewee H | Private sector | Since mid-1990s |
| Interviewee I | Private sector | Since 1997 |
| Interviewee J | Public sector | Since 2009 |
| Interviewee K | Private sector | Since 2003 |
| Interviewee L | Public sector | Since 1993 |
| Interviewee M | Public sector | Since 1999 |

*Before and during the interview*

After an interviewee expressed his/ her willingness to participate in the interview, a participant information sheet (see Appendix II) and a consent form (see Appendix III) were issued. The aim of those files was to ensure the before-interview checklist explained by Whiting (2008) is completed. They further clarified the purpose of the interview and the research topic, sought interviewees' permission to record the meeting (but maintain confidentiality), and assured their right to drop out of the interview at any time. Due to the COVID-19 restrictions on travelling, all interviews were conducted online through Microsoft Teams (i.e., 11) and Zoom (i.e., two) according to what suited the interviewees better. The online interviews saved travel cost and ensured safety during COVID-19. In addition, interview techniques such as 'reflexivity', 'silent', 'echo', 'verbal agreement', 'tell me more', 'leading', 'baiting' (Whiting, 2008) were learnt so that the 'probe' would be effective.

[13] All interviewees are either directly from the public sector (e.g., the Cabinet Office) or as consultants (shown as 'private' sector in this table) working for the public sector in infrastructure delivery. Due to anonymity concerns and the varying job responsibilities throughout their long-term career, a general job title was not provided, but most of them have experienced different stages of an infrastructure project.

At the beginning of the interview, rapport was built to ensure the interview would be what DiCicco-Bloom and Crabtree (2006) call 'a personal and intimate encounter'. This was achieved by warm greetings, the interviewer's telling of the PhD journey (echoed by some of the interviewees with their own PhD experience), exchanging ideas on the recent development of PPPs, etc. The built rapport gradually led to the interviewees' narratives on their working experience (Part A of the interview), and their responses to questions about traditional V*f*M (Part B) and public V*f*M (Part C). The interview finished with the interviewees' general comments on the research and expression of gratitude for their contributions. Markedly, most interviewees expressed their appreciation of the significance of the questions during the interview, and requested a copy of this thesis (when it is available). On two occasions, interviewees had to stop the interview for family businesses (e.g., picking a family remember up at the railway station due to pouring rain), but continued the interview at another appointment. This unexpected 'disruption' actually provided another opportunity for the interviewee to add more information on previous questions. In general, the interview process accorded with Whiting's (2008) phases of building rapport, apprehension, exploration, co-operation, participation, and conclusion. The 'after the interview' (i.e., data analysis) is presented in Section 2.6.2.

#### *2.6.1.4 Questionnaire Surveys*

*Why questionnaire surveys?*

As shown in Figure 2.3, the second strand of the mixed methods research design is quantitative research that explains the relationship between variables validated from the qualitative research. In this type of sequential explorative strategy, Teddlie and

Tashakkori (2009, p.153) report that results of the qualitative research can lead to the formulation of design components for the quantitative research. According to Bryman (2004, p.457), such a guiding function can manifest in the forms of *providing hypotheses* and *aiding measurement*. Specifically, it became apparent after the interview data were collected that different public authorities could place different emphases on V*f*M assessment variables (thus providing a hypothesis), and the interviews revealed a consistent understanding of the variables, which then informed the formulation of survey questions (i.e., aiding measurement). Due to the quantitative nature, a self-completion questionnaire (i.e., respondents answer close-ended questions in the questionnaire themselves without the attendance of the researcher) was administered for data collection. Teddlie and Tashakkori (2009, p.232) point out that responses from this closed-ended questionnaire are efficient to collect and analyse. This is evidenced in its longstanding application in the field of construction management. A case in point is the use of a questionnaire survey by Ahamd and Minkarah (1988) to unpack the underlying factors that impact the construction bidding decision-making process. More recently, Hohari *et al*. (2020) surveyed stakeholders with experience in green construction to explore the impact of stakeholder values on the adoption of green procurement.

*Questionnaire survey design*

Questionnaires are a specific type of survey research (Teddlie and Tashakkori, 2009, p.248), and de Vaus (2002, p.3) contends that the defining features of survey research are the form of the data and the method of analysis. The form of the data was a completed questionnaire and the unit of analysis was the respondent (i.e., professionals with experience in infrastructure procurement). Since AHP was selected as the method

of analysis (explained in Section 2.6.2), a pairwise comparison of the variables was necessary to uncover their relationships. As a result, rank order scales and Likert scales (see Teddlie and Tashakkori, 2009, p.234) were used in the questionnaire. For the comparison of each pair, the respondents were presented with two objects (i.e., variables) and asked to rank them in terms of importance. As mentioned earlier, the variables for the questionnaire survey were derived from the interviews, and a description of these variables was placed at the beginning. Hence, an example was: *between cost and time, which one do you think is more important?* The respondents had to choose between *cost*, *time* or *equally important*. If 'equally important' was not chosen, a following question – *how much more important is the one you selected than the other?* – would be prompted. There were eight scales in the answering option ranging from between 'equally important and moderately more important' to 'extremely more important', as dictated by the AHP method. Preceding the pairwise comparison section was an introduction section that stated the purpose of the questionnaire survey and its anonymity, and a background information section (e.g., organisation type and years of working experience). The full questionnaire is available in Appendix IV. The finalised questionnaire was mapped in Jisc Online Surveys (https://www.onlinesurveys.ac.uk/), a powerful and easy-to-use survey tool authorised by Northumbria University, to which a link was generated for the sampled group to have access.

*Sampling strategy*

Purposive sampling was employed to recruit respondents for the questionnaire survey. It started with selecting clusters in the population of professionals in infrastructure procurement followed by sampling units of interest in the clusters randomly. As shown

in Figure 2.8, three clusters (i.e., 'known figures', 'Major Projects Association', and 'LinkedIn') were identified. Known figures represent prominent people in infrastructure procurement, such as those interviewees with rich experience. Major Projects Association, as mentioned, is a community where people with knowledge and experience in major projects congregate. LinkedIn is another community where professionals actively share information. An invitation email containing the survey link was sent to known figures/ individuals while blogs were posted on Major Projects Association (https://majorprojects.org/blog/supporting-our-academic-members/) and LinkedIn (https://www.linkedin.com/feed/update/urn:li:activity:6915263719857926144/) to elicit their members' responses. This way, the respondents were deemed to be able to cover the range of professionals who have experience with V*f*M assessment and PPPs.

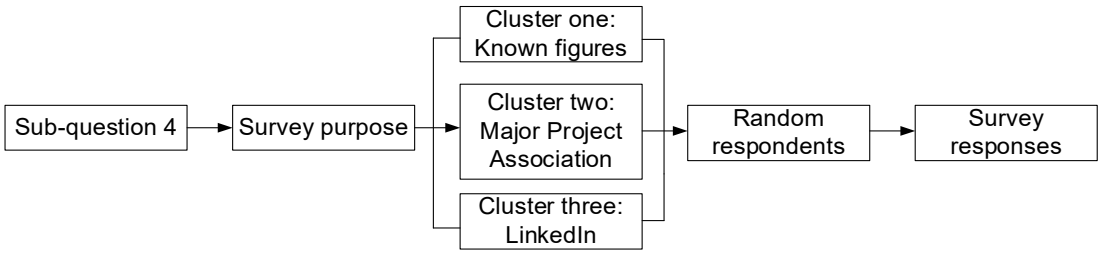



Figure 2.8. Sampling strategy for identifying survey respondents

Unavoidably, there were overlaps within the three clusters. The respondents could quit the survey if they came across the link twice. Additionally, duplicate and meaningless responses were omitted during the stage of data analysis. For example, a response where all variables were considered 'equally importantly' was removed. In light of 'incidental responses' where respondents were only curious about the questionnaire but did not possess pertinent knowledge on the topic, the shortlisting questions in the background information section about their job responsibility and awareness of V*f*M

assessment would ensure only relevant responses were analysed. For instance, two responses that selected 'no' for the question '*are you aware of the existence of VfM assessment in PPP types of project even if you have not directly participated in this work*' were not included for analysis. On this basis, 31 were considered valid among the 34 responses received. In a review of studies in the field of construction management that have used AHP, Darko *et al*. (2018) reveal that a small sample size (from 4 to 30) can be sufficient, and even such apparently small sample sizes can engender a high level of consistency. An extreme case is the study of criteria for pre-qualifying contractors in which Abudayyeh *et al*. (2007) interviewed one director (who had over 35 years of experience in public work projects) to help with the pairwise comparison of AHP. Using a larger sample size (i.e., 34) for AHP, Yuan *et al*. (2019) developed an indicator system to evaluate PPPs' contribution to regional social sustainability. Accordingly, driven by sub-question 4 and the fact that it is a specific issue that does not necessarily require a large sample, the systematically collected data are considered appropriate.

*Before and during the questionnaire survey*

Before the link of the questionnaire survey was formerly released, a pilot study was implemented to rehearse the procedure and identify problems. Within the trial group consisting of 10 academics and one industry practitioner, the 'table form', 'sliding scale form', and 'options form as in Appendix IV' were independently presented to test which would be practical for the pairwise comparison. All academics had research interests in construction management, and had previously used questionnaire surveys as their data collection method. The practitioner, on the other hand, had 13-year direct experience with PPPs. They were also requested to suggest whether the content of the

questionnaire was clear and sensible. Subsequently, nine participants voted in favour of the 'options form', which was seen as easy to follow and understand. Other comments include: (1) making clearer the ethical issues in the introduction; and (2) explaining the definitions of the variables at the very beginning rather than separately embed them in each question. The revised questionnaire was then reviewed by the experienced supervisory team, resulting in no further changes. Bryman (2004, p.139) points out that a common error in self-completion questionnaires is that instructions on how to respond are not clear. Owing to the attributes of the Jisc tool, respondents in this instance were provided with a link that could be easily accessed through any digital device (e.g., mobile phones, iPad, and laptops) and they only needed to click on the buttons to complete the questionnaire. Questions that required only one answer or multiple answers were pre 'hard wired' in the system so that the respondents knew how many clicks were needed.

One major challenge of questionnaires is non-response despite repeated efforts (Teddlie and Tashakkori, 2009, p.232). This could be the case particularly for 'Cluster 1'. Fortunately, the majority of the 'known figures' in Cluster 1 replied the email and confirmed their completion of the questionnaire. This was perhaps because the importance of V*f*M assessment was well understood, and the respondents considered it of benefit to reflect on their V*f*M practices. During the questionnaire survey, the number of responses was constantly monitored, and a reminder was sent to the clusters two weeks after the initial invitation. Another technique proposed by de Vaus (2002, p.84) is drawing an initial sample that is larger than needed. Given the sample size needed is small in this research, the three clusters already represent a much larger group. It to some extent minimised the influence of non-response even after the

reminder. On the closing day of the questionnaire survey (i.e., 31st May 2022), the link automatically became inactivated. The collected data are analysed in Section 2.6.2.

### 2.6.2 Data Analysis

#### *2.6.2.1 Strengths, weaknesses, opportunities, and threats analysis*

The literature (i.e., 89 publications) was analysed to extract the existing V*f*M assessment methods and identify their characteristics using a strengths, weaknesses, opportunities, and threats (SWOT) analysis. To illustrate the intellectual evolution of V*f*M assessment within the selected articles, the algorithmic historiography was programmed using the HistCite software (Garfield *et al.*, 2003). As Garfield *et al*. (2003) contend, historiography helps understand how the basic concepts or the perceptions of a paradigm (i.e., a model of a field) have changed by identifying the significant works on a given topic and providing a graphic and genealogical presentation of the links between them. Within the historiography, the main path has been demonstrated by Carley (1993) to be associated with the thematic or methodological transitions in the development of a topic. Therefore, to further understand the main development of V*f*M assessment, the *Pajek* software was employed as suggested by Mrvar and Batagelj (2016). More specifically, the Search Path Link Count algorithm was applied using the software to extract the main path. This can consider all citation relations that traverse through the nodes and further construct the development of the V*f*M assessment literature (Lucio-Arias and Leydesdorff, 2008).

Following the elucidation of the evolution of V*f*M assessment and associated methods, a SWOT analysis was conducted. A SWOT analysis is widely acknowledged by

Helms Marilyn (2010) and Emet and Merba (2017) as a practical tool for evaluating decision-making processes within organisations. Hence, it was considered suitable for deepening our understanding of the characteristics of current V*f*M assessment methods. According to Ghazinoory et al. (2011), a SWOT analysis encompasses an examination of internal attributes (strengths versus weaknesses) and external impacts (opportunities versus threats). The internal attributes and external impacts within the context of V*f*M assessment methods are presented in Chapter 3.

*2.6.2.2 Comparative analysis*

Grey literature (see Table 2.5) was analysed to make sense of the 'context' of V*f*M assessment by comparing its practices from a global viewpoint. The rationale of a comparative analysis (instead of a pure analysis of the UK' V*f*M assessment) was justified by the boundary spanning theory's call for the external information processing to assist implementation and improvement in addition to the internal context (Marrone, 2010). To do so, Esser and Vliegenthart (2017) suggest that a comparative analysis would fit as a boundary spanner to gain a deep understanding of one's own system by comparing against the routine prevalent in other countries.

As Davidoff (2019) put it: "context plays an important role in both improvement science and implementation science; limited understanding of context therefore limits understanding of both the fundamental principles of improvement and the actions that put improvements into practice." Essentially, the importance of *context* has been emphasised in infrastructure research, such as Hertogh *et al*. (2008), OMEGA centre (2012) and Love and Ika (2021). Noting the hierarchical levels of context identified by Biggermann and Buttle (2009), V*f*M context was framed using the institutional

(macro-level) and the methodological (micro-level) perspectives. In particular, the institutional level was interpreted by a social, economic and political framework, and the methodological level was elucidated through a qualitative and quantitative V*f*M assessment. The framework and the qualitative and quantitative V*f*M assessment are presented in Chapter 4.

#### *2.6.2.3 Framework development*

Drawing on theories of value and stakeholder theory, a framework was developed to conceptualise the concept of V*f*M. It preliminarily identifies that value is generated in the interaction of the supply side (i.e., governments - as project sponsors and part of infrastructure delivery partnerships) and the demand side (i.e., end-users). Specifically, the framework demonstrates that it is the combination of 'traditional' and 'public' V*f*M that together create a more meaningful V*f*M concept. As mentioned in Section 2.4.2.3, the framework then guided the collection and analysis of data, which in turn provided feedback to refine and validate the framework, thereby closing the research loop. Details of the development of the framework are presented in Chapter 5.

#### *2.6.2.4 Thematic analysis*

A thematic analysis was conducted to analyse the interview data collected in Section 2.6.1.3. Thematic analysis is demarcated by Braun and Clarke (2006) as ''a method for identifying, analysing and reporting patterns (themes) within data''. As a method in its own right, Kiger and Varpio (2020) explain that thematic analysis is *powerful* in summarising, highlighting and interpreting key features of a wide range of data sets, and is *flexible* in using both inductive and deductive way of coding and identifying themes. This suits sub-question 3 because the developed framework requires certain

themes to be validated and allows new themes to emerge for refinement. For instance, on top of the interviewees' narratives of themes of the framework, '*are there any other variables that you think should be considered when conducting VfM assessment for transport projects*?' was asked to brainstorm new themes. The insightful work of Braun and Clarke (2006) considers a theme to be important elements of the data that relate to the research question and patterned response or meaning within the data set. Therefore, if a variable is determined by interviewees to be key to V*f*M assessment, it is validated as a theme.

In qualitative research, inadequate disclosure of how analyses are performed can impede meaningful and useful results (Attride-Stirling, 2001) or can result in inconsistent and incoherent development of themes (Nowell *et al*., 2017). To this end, the step-by-step guide for thematic analysis proposed by Braun and Clarke (2006) was followed to make explicit the data analysis. It began with familiarisation with the data, generating initial code, searching for themes, reviewing themes, defining and naming themes, and ended with producing the report. Figure 2.9 illustrates the process. Importantly, due to the pragmatism nature of this research, 'what works' in the thematic analysis took the form of inductive and deductive coding. Braun and Clarke (2006) state that inductive analysis involves coding the data without a pre-existing frame (or the researcher's analytic preconceptions) whereas a theoretical or analytical interest in the area exists in deductive analysis. By doing so, both consistency and flexibility were maintained throughout the analysis.

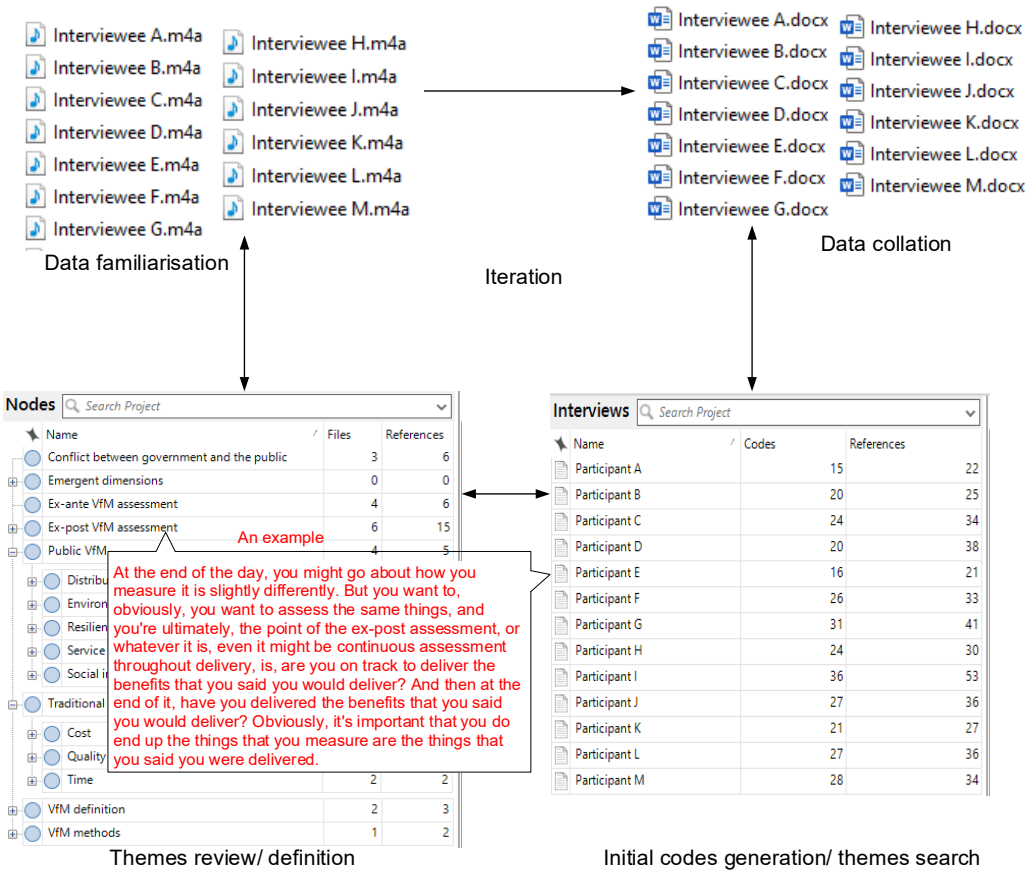



Figure 2.9. The process for thematic analysis

When the thematic analysis was selected, the collected data was transcribed verbatim, leading to a rich data set of approximately 816 minutes (excluding the rapport development) (Table 2.7). The data set was then input into *NVivo* Version 12 for organisation, analysis, and interpretation. Based on the V*f*M framework, eight themes ('parent' codes) were initially established followed by the exploration of 'child' codes that were relevant to each theme. In the meantime, extracts (references) were collated together within the child codes of each theme. All data were coded so that the context of the extracts was not lost, and markedly, contradictions between interviewees were kept for the sake of an unfurnished thematic map[14]. An example of coding is shown

[14] Braun and Clarke (2006) note that a satisfactory thematic map does not have to smooth out or ignore the tensions and inconsistencies within and across data items.

in Figure 2.10. It should be noted that coding was recursive and iterative in this research. For instance, the initial thematic map was reviewed by going back and forth between the coded extracts to ascertain they fit the themes before the themes were finally defined and named. Findings of the thematic analysis are reported in Chapter 6.

Table 2.7. Transcripts as inputs

| Interviewee | Time (Hours: minutes: seconds) | Transcript word count |
|---|---|---|
| Interviewee A | 0: 36: 42 | 4203 |
| Interviewee B | 0: 49: 32 | 6194 |
| Interviewee C | 0: 58: 30 | 7423 |
| Interviewee D | 1: 36: 17 | 12735 |
| Interviewee E | 0: 46: 50 | 6293 |
| Interviewee F | 1: 11: 17 | 7394 |
| Interviewee G | 0: 50: 04 | 6916 |
| Interviewee H | 0: 51: 19 | 7487 |
| Interviewee I | 1: 19: 27 | 11904 |
| Interviewee J | 1: 17: 32 | 11256 |
| Interviewee K | 1: 10: 41 | 7883 |
| Interviewee L | 1: 13: 10 | 9944 |
| Interviewee M | 0: 54: 35 | 8205 |
| Total | 13: 35: 56 | 107837 |

Note: all recordings only started when the first question was asked.

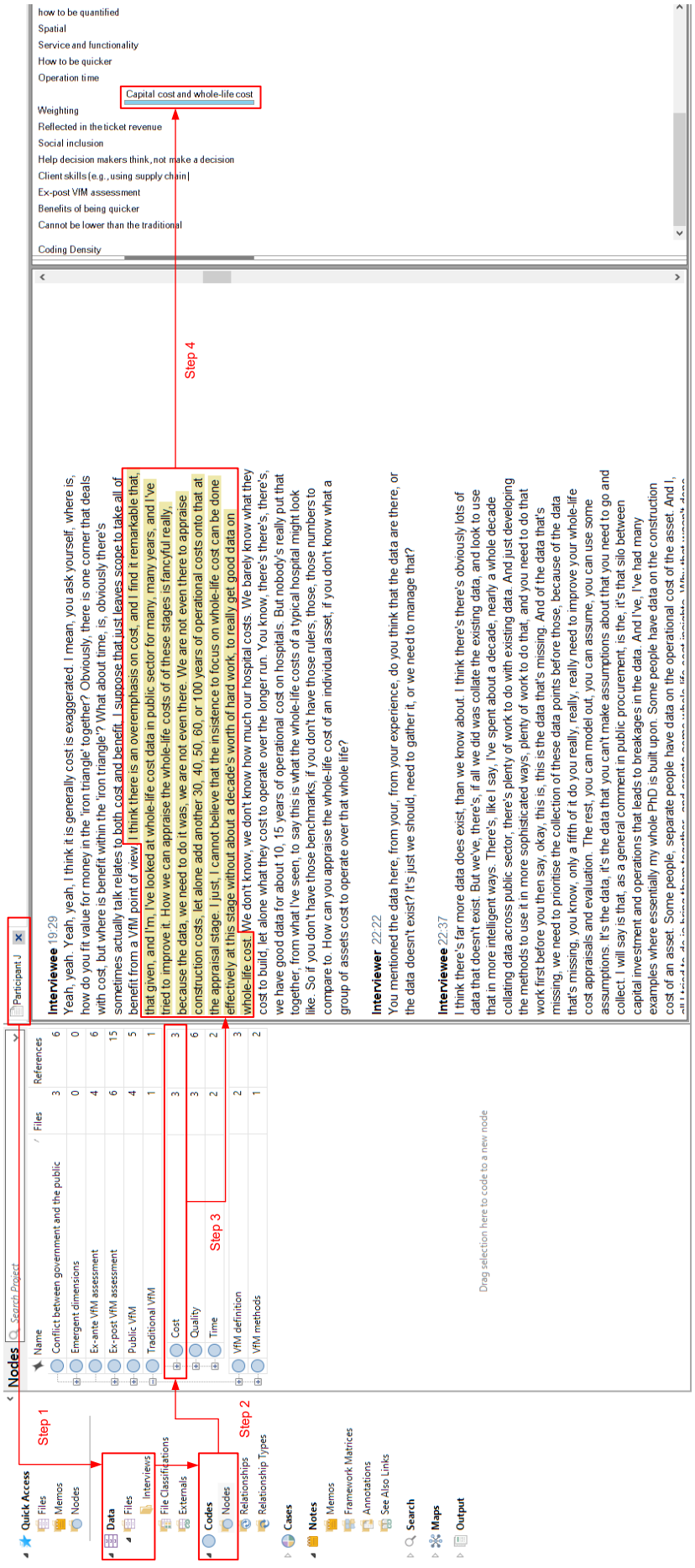



Figure 2.10. An example of coding

As a final step, 15 criteria suggested by Braun and Clarke (2006) were used as an *ex-post* evaluation of this thematic analysis to ensure its quality. The last column of Table 2.8 reflects whether such criteria were met. It demonstrates a sense of reflexivity, which Spencer *et al*. (2003, p.66-67) stressed as important to warrant objectivity (despite this research is within the realm of pragmatism) and avoidance of bias. Nevertheless, this evaluation helped raise the awareness of how biases may emerge, the role of the researcher in the analysis, and the systematic and comprehensive way of addressing biases.

Table 2.8. A checklist for a good thematic analysis

| Process | Criteria | This research (Yes or No) |
|---|---|---|
| Transcription | Appropriate level of detail and accurate transcripts | Yes |
| Coding | Equal attention to each data item | Yes |
| | A thorough, inclusive and comprehensive coding process | Yes |
| | All relevant extracts for all each theme have been collated | Yes |
| | Themes have been checked against each other and back to the original data set | Yes |
| | Themes are internally coherent, consistent, and distinctive | Yes |
| Analysis | Data have been analysed | Yes |
| | Analysis and data match each other | Yes |
| | Analysis tells a convincing and well-organized story | Yes |
| | A good balance between analytic narrative and illustrative extracts | Yes |
| Overall | Enough time has been allocated to complete all phases of the analysis adequately | Yes |
| Written report | The assumptions about, and specific approach to, thematic analysis are clearly explicated | Yes |
| | There is a good fit between what you claim you do, and what you show you have done | Yes |
| | The language and concepts used in the report are consistent with the epistemological position of the analysis | Yes |
| | The researcher is positioned as active in the research process; themes do not just ‘emerge’ | Yes |

(Adapted from Braun and Clarke, 2006)

*2.6.2.5 Analytical Hierarchy Process*

Data collected from the questionnaire survey in Section 2.6.1.4 were analysed using AHP. All 31 respondents were from the public sector (including consultants working for them), and had at least been involved in 1 or 2 transport projects (see Table 2.9 below for a detailed profile). Among them, 18 respondents had 7 years' experience in infrastructure procurement or more, seven had 5 to 7 years, four had 3 to 5 years, and two had 3 years or less. Their hands-on experience in infrastructure project and the associated V*f*M assessment enabled a quality data set to be analysed. As mentioned earlier, the purpose was to explain the relationship between V*f*M assessment variables. This was driven by sub-question 4, and a common perception of different priorities placed on PPPs when governments determine a procurement approach for their infrastructure projects[15] (Hodge *et al*., 2018). Unsurprisingly, this notion was also echoed by one interviewee, stating that the V*f*M assessment they employed in the UK was not smooth in Indonesia.

Table 2.9. The profile of survey respondents

| Category | Options | Frequency (percentage) |
|---|---|---|
| Organisation type | Public sector | 24 (77.42%) |
| | Private sector | 0 |
| | University/ Research institutions | 0 |
| | Consultancy | 7 (22.58%) |
| Working experience with PPPs | 3 years or less | 2 (6.45%) |
| | 3~5 years | 4 (12.91%) |
| | 5~7 years | 7 (22.58%) |
| | 7 years or more | 18 (58.06%) |
| Number of transport projects worked on | 1~2 | 1 (3.23%) |
| | 3~4 | 2 (6.45%) |
| | 5~6 | 11 (35.48%) |

[15] To provide some sprinkling ideas, Hodge *et al*. (2018) used Australia as an example to illustrate the different degrees of private finance in infrastructure by its states. Similarly, Chan *et al*. (2009) compared drivers for adopting PPPs between China and Hong Kong Special Administrative Region, and concluded that China was economy-related while Hong Kong was efficiency-oriented.

| | | |
|---|---|---|
| | 7 or more | 17 (54.84%) |
| Type of work | Feasibility analysis | 9 (29.03%) |
| | Value for money assessment | 19 (61.29%) |
| | Performance evaluation | 1 (3.23%) |
| | Others (i.e., general consultancy) | 2 (6.45%) |
| Awareness of V*f*M assessment | Yes | 31(100%) |
| | No | 0 |

AHP has served as a popular technique for examining the significance and weights of variables in construction-related research. One of the representative cases was the use of AHP by Cheung *et al*. (2001) to determine the importance weightings of the procurement selection criteria (e.g., speed, quality level, and price competition). More recently, and germane to PPPs, Feng *et al*. (2021) employed a fuzzy AHP to evaluate the risks of urban rail transit projects. The fuzzy AHP is a variant of AHP and has been said by Li ang Zou (2011) to be able to simulate the vagueness of human judgement in assessing the risks of PPPs. However, Song *et al*. (2022, p.2060) showed that the difference in the results of AHP and fuzzy AHP was almost non-existent. There are other techniques such as fuzzy synthetic evaluation (Ameyaw and Chan, 2015), (fuzzy) TOPSIS (the technique for order of preference by similarity) (Liu and Wei, 2018), DEMATEL (decision-making trial and evaluation laboratory) (Zhang *et al*., 2019), Simos' procedure (Marzouk *et al*., 2013), and SWARA (step-wise weight assessment ratio analysis) (Valipour *et al*., 2019) that have also been used in PPPs to assess the relationship between factors However, AHP was selected because: (1) these techniques all belong to the family of multi-criteria decision making methods (Velasquez and Hester, 2013); (2) the pairwise comparison enables the experts to think carefully about the relationship between each set of variables for each option rather than, for example, taking them all together in TOPSIS; and (3) pragmatically, AHP is capable of answering sub-question 4 by illuminating the differences between variables

for decision-makers to consider. In practice, the pair-wise comparison has also been recommended by The British Standards Institution – BSI (2022) as one of the three ways of determining weights for the value outcomes in decision making.

AHP was devised by Saaty (1990) to solve problems from personal to corporate to public by considering the overall goal, criteria, and alternatives. Hence, the first step involved structuring the V*f*M assessment problem as a hierarchy where the top layer was delivering V*f*M, the middle layer V*f*M assessment variables, and the bottom layer available procurement options (Figure 2.11).

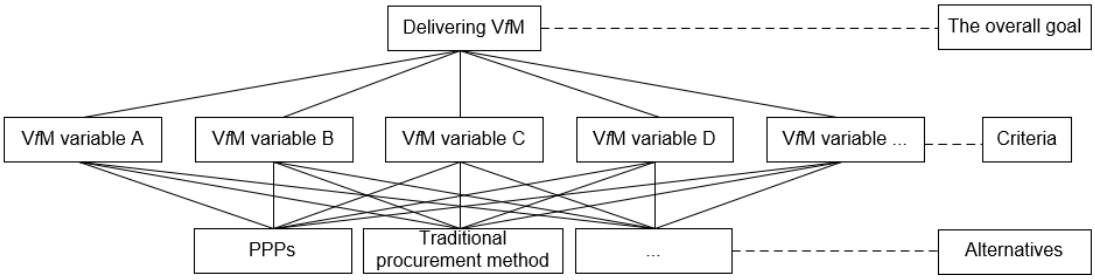



Figure 2.11. The V*f*M hierarchy

The second step was the pairwise comparison of the V*f*M variables with respect to their relative importance in delivering V*f*M. The relative importance was ranked on a scale of one to nine (Table 2.9), which Saaty (1990) assures has not only been practical in many applications but also had been theoretically validated by comparing with numerous other scales. Each survey response then formed a matrix similar to Table 2.10. The grey areas were automatically filled in because they are the reciprocals of the adjacent cells in the non-grey part. For example, if variable *A* was considered to be moderately more important than variable *B*, then the value of $a_{12}$ was 3 and $a_{21}$ automatically became 1/3. Since there were 31 responses (i.e., 31 matrices similar to

Table 2.10 were generated), Saaty (1987) suggests that geometric mean be used as an aggregate value of the final result of each comparison.

Table 2.10. The scale for relative importance

| Scale | Definition | Explanation |
|---|---|---|
| 1 | Equal importance | Two activities contribute equally to the objective |
| 3 | Moderate importance of one over another | Experience and judgement strongly favour one activity over another |
| 5 | Essential or strong importance | Experience and judgement strongly favour one activity over another |
| 7 | Very strong importance | An activity is strong favoured and its dominance demonstrated in practice |
| 9 | Extreme importance | The evidence favouring one activity over another is of the highest possible order of affirmation |
| 2, 4, 6, 8 | Intermediate values between the two adjacent judgements | When compromise is needed |

(Adapted from Saaty, 1990)

Table 2.11. The pairwise comparison matrix

| | Variable A | Variable B | Variable C | Variable D | … |
|---|---|---|---|---|---|
| Variable A | 1 | $a_{12}$ | $a_{13}$ | $a_{14}$ | $a_{1n}$ |
| Variable B | $a_{21}$=1/ $a_{12}$ | 1 | $a_{23}$ | $a_{24}$ | $a_{2n}$ |
| Variable C | $a_{31}$ | $a_{32}$ | 1 | $a_{34}$ | $a_{3n}$ |
| Variable D | $a_{41}$ | $a_{42}$ | $a_{43}$ | 1 | $a_{4n}$ |
| … | $a_{n1}$=1/ $a_{1n}$ | $a_{n2}$ | $a_{n3}$ | $a_{n4}$ | 1 |

Based on Equation (2.1), the previous 31 matrices were combined into Equation (2.2) for further calculation.

$$a'_{ij} = \sqrt[w]{\prod_{m=1}^{w} a_{ij}^{m}} \tag{2.1}$$

Where $a'_{ij}$ is the aggregate value of each cell in Table 2.10; $w$ is the total number of responses; and $m$ is the $m^{\text{th}}$ response.

$$(a'_{ij})_{n\times n} = \begin{bmatrix} a'_{11} & \cdots & a'_{1n} \\ \vdots & \ddots & \vdots \\ a'_{n1} & \cdots & a'_{nn} \end{bmatrix} \tag{2.2}$$

With the new matrix - Equation (2.2), the principal eigenvector that represents the priority of V*f*M variables was calculated using Equations (2.3) and (2.4).

$$P_{VfM_i} = \frac{\overline{P_{VfM_i}}}{\sum_{i=1}^{n} \overline{P_{VfM_i}}} \tag{2.3}$$

$$\overline{P_{VfM_i}} = \sqrt[n]{\prod_{j=1}^{n} a'_{ij}} \tag{2.4}$$

Where $P_{VfM_i}$ is the priority of each V*f*M variable and *n* is the number of variables.

To ensure the result was logically derived, Equation (2.5) was used to check the consistency of the responses.

$$C.R.=C.I./\ R.I. \tag{2.5}$$

Where *C.R.* is the consistency ratio; *C.I.* is the consistency index and is given in Equation (2.6); and *R.I.* is the random consistency index and is given in Table 2.11. According to Saaty (1980), if the *C.I.* is calculated to be lower than 0.10, the comparison results are reliable.

$$C.I. = (\lambda_{max} - n)/(n-1) \tag{2.6}$$

$$(a'_{ij})_{n\times n} \cdot P_{VfM_i} = \lambda_{max} \cdot P_{VfM_i} = \frac{1}{n}\sum_{i=1}^{n} \frac{\sum_{j=1}^{n} a'_{ij} \times P_{VfM_i}}{P_{VfM_i}} \tag{2.7}$$

Where $\lambda_{max}$ is the largest eigenvalue of $(a'_{ij})_{n\times n}$.

Table 2.12. Reference value for *R.I.*

| *n* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *R.I.* | 0 | 0 | 0.58 | 0.90 | 1.12 | 1.24 | 1.32 | 1.41 | 1.45 | 1.49 |

(Adapted from Saaty, 1987)

Saaty (1990) continued the pairwise comparison to the elements in the bottom layer of Figure 2.11. The result of this comparison was multiplied by the priority (Equation 2.3) to yield an alternative that had the highest score. In order words, the available

procurement options should be compared against each other in terms of their ability to satisfy each V*f*M variable in the middle layer. However, the survey respondents were not asked to compare, for example, the superiority of PPPs over the traditional procurement approach. This was because the aim of this research is not to tell practitioners which procurement route they should go with in general. This would seem dictatorial and impractical. Another reason was that the performance (e.g., time and cost) of PPPs and traditional procurement approach is still debatable (see, for example, Blanc-Brude *et al*., 2006). Therefore, this level of comparison (i.e., the pairwise comparison in the bottom layer) can be placed in a project-specific context. In a nutshell, the analysis here provides a model for decision makers to think 'what to consider' when they plan to select a procurement method and monitor it afterwards. Nevertheless, Chapter 7 presents a case study that describes how the bottom-layer comparison was conducted, how the decision was made, and whether V*f*M has been realised.

## 2.7 Evaluation of the Research Design

Reliability and validity are two prominent criteria used to evaluate a research design. Due to competing philosophical stances (Section 2.4), Bryman (2004, p.277) suggests that the measurement of reliability and validity in quantitative research be differently adapted to qualitative research. As a mixed methods research design, different measures were taken to ensure that the qualitative and quantitative parts in this research are equally reliable and valid.

### 2.7.1 Reliability

According to Bryman (2004, p.277), reliability deals with issues of consistency of measures. It is parallel to dependability in qualitative research, and Teddlie and Tashakkori (2009, p.209) explained that dependability refers to the extent to which variation in a phenomenon can be tracked or explained consistently across different contexts. As shown in Table 2.12, two procedures prescribed by Gibbs (2007) were followed to engender qualitative reliability. In addition, the steps of collecting and analysing data were documented in detail in Section 2.6 to remain consistency. The quantitative reliability was achieved by the consistent measures used throughout the questionnaire survey, and the consistency ratio (i.e., *C.R.* in Equation 2.5) was calculated.

Table 2.13. Qualitative reliability

| Procedures | This research |
|---|---|
| Check transcripts to make sure that they do not contain obvious mistakes made during transcription | All interviews were transcribed verbatim, and the transcripts were carefully read before the analysis |
| Make sure that there is not a drift in the definition of codes, a shift in the meaning of the codes during the process of coding | The coding process was guided by a theoretical framework, and the definitions of the codes were clearly defined. The coding results were double-checked. |

### 2.7.2 Validity

Bryman (2004, p.72) defines validity as 'the issue of whether an indicator (or set of indicators) that is devised to gauge a concept really measures that concept'. The concept is further divided by de Vaus (2001, p.27) into internal and external validity. It should be noted that one cannot be precise about validity (de Vaus, 2001, p.30) and the discussion on this can potentially be misleading (Bryman, 2004, p.74). Nevertheless, several tests (e.g., the qualitative validity in Table 2.13) were run in this

research to argue for validity. Tables 2.13 and 2.14 outline how the external validity was established in this mixed methods research.

Table 2.14. Qualitative validity

| Tests recommended by Creswell (2009, p.191-192) | This research |
|---|---|
| Member checking | Transcripts and findings were sent to the participants for confirmation. |
| Rich and thick description | All contents were coded and were described in detail in Chapter 6. |
| Bias clarification | An interview guide was devised to facilitate the data collection, and the systematic framework guided the analysis. The elements of reflexivity were mentioned in Section 2.6.2.4. Nevertheless, the researcher played a role in interpretating the results. |
| Negative or discrepant information | As mentioned in Section 2.6.2.4, different views (sometimes tensions) from the interviewees were retained. |
| Prolonged time | The mixed methods research design itself is time-consuming, and the researcher dedicated over 11 months to the interviews and analysis. |
| Peer debriefing | The accuracy of the findings was enhanced by the supervisory team who reviewed and asked questions about them. Additionally, parts of the findings have been peer-reviewed and published (Appendix V), adding another degree of validity. |

Table 2.15. Quantitative validity

| Tests recommended by de Vaus (2001, p.29-30) | This research |
|---|---|
| Criterion validity | The survey results did show cost was not the sole measure of V*f*M, and other variables were ranked important as well. |
| Content validity | As a sequential explorative strategy, the content of the questionnaire survey was validated from the previous interviews, which revealed the different aspects of V*f*M. |
| Construct validity | Results from the survey confirmed the theoretical expectation that there is a priority cascading among the V*f*M variables. |

Internal validity was gauged by the capability of the mixed methods research design to provide an in-depth understanding of how V*f*M should be assessed. It has been

widely acknowledged that mixed methods research design enables a platform where the strengths of both quantitative and qualitative research can be exploited. By following a rigorous research design as mentioned above, the interview and survey data were triangulated to develop a new V*f*M assessment model.

## 2.8 Ethics

Ethical issues arose throughout this research, stemming from research problem, through data collection, analysis and interpretation, to writing-up. Due to human participation, ethical considerations were adopted to protect participants, prevent misconduct, and maintain the integrity of this research. In Chapter 6, identifiable project information (e.g., project name) was anonymised. In addition, every care was taken to follow the University's guidelines on ethics and integrity, and the research received full ethical approval (Ref: 17897) from the Faculty of Engineering and Environment Research Ethics Committee. Appendices II and III detail the 'Participant Information' and 'Consent Form'.

## 2.9 Chapter Summary

This chapter explained the fundamental considerations behind the research methodology of the study. The mixed-methods research design reinforced by pragmatism was selected to answer the research questions formulated at the beginning of this chapter for this research. In accordance with the sequential explorative research strategy, both qualitative (i.e., interviews) and quantitative (i.e., questionnaire surveys) data were collected to complement each other. Such data were later analysed using SWOT analysis, comparative analysis, thematic analysis and AHP. This chapter has focused on why these choices were made and how they were conducted. Finally, to

check the congruence between research questions (what was said) and the research design (what has been done), the reliability and validity of this research was assessed and discussed.

The proper location in a thesis of the Methodology chapter is sometimes debatable. Here, it is positioned in the second chapter because it acts as an overarching framework that explains how the following chapters are generated. The next chapter presents the systematic literature review that corresponds to sub-question 1.

# CHAPTER 3 PUBLIC PRIVATE PARTNERSHIPS

## 3.1 Chapter Introduction

Chapter 2 has reported that this chapter is mainly a systematic literature review that partially contributes to fulfilment of the first objective (i.e., establishing the state-of-the-art V*f*M assessment practices in global PPP markets and evaluating them in the light of common critical reactions) set out in Chapter 1. As a point of departure, the aim of Chapter 3 is to review existing literature about Public Private Partnerships (PPPs) and value for money (V*f*M). It starts with a brief overview of the history of PPPs, their various definitions of PPPs, and in particular, PPPs' development in the United Kingdom (UK), where the prototype of modern PPPs was produced. Following that, the connection between PPPs and one of their popular applications to the transport sector is established. Within the many research areas in transport PPPs, this chapter then focuses on reviewing the concept of V*f*M. Specifically, the existing methods for assessing V*f*M are systematically identified, and are analysed via a strengths, weaknesses, opportunities, and threats (SWOT) analysis. The output is the research gaps in PPPs and V*f*M that need to be addressed.

## 3.2 Public Private Partnerships

Ensuring infrastructure is delivered using an appropriate procurement approach is critical for satisfying clients' expectations and ensuring project success (Love *et al.*, 1998), especially when governments are subjected to fiscal constraints (Reeves, 2015; Penyalver *et al*., 2019). The budgets of most governments often do not include sufficient money to underwrite such projects, particularly those of a large-scale that may need to be delivered. In cases where the public sector cannot fund a needed and/or

demanded infrastructure asset, it may engage Private Participation in Infrastructure (PPI) to bring forward the project. According to the APMG PPP Certification Guide (2016, p.24), PPI is not identical to PPPs, and it covers such other forms of procurement options as short-term service or management, design-build (or purely build, and design-build-finance), public domain or public authorisation for regulated assets, and privatised companies in liberalised and regulated market. However, Vives *et al*. (2010) would reject this classification because they considered all projects as PPPs due to the inevitable participation of public and private sectors.

Another discussion surrounds whether privatisation is the same thing as PPPs. An early description by Henk (1998) treated the combination of design, build and operate in a single contract as 'superturnkey privatisation'. Privatisation's equivalent for PPPs was also resonated by Cordelli (2013) where governments encourage private agencies to take public functions by providing tax deductions or direct subsidies. Curz and Marques (2011), however, distinguished privatisation from PPPs in that PPPs do not involve a complete divestiture of assets. Nathan Associates's (2017, p.25) report to the UK's Department for International Development further explained that this extreme scale of selling off assets would mean the ownership indefinitely remains with the private sector while it is temporary with PPPs. On the basis of different degrees of responsibilities and oversight governments retain in privatising public-owned services/ enterprises/ assets, Savas (2000) then classified PPPs as a form of privatisation. Similarly, Leclercq (2020) listed entirely private development, PPPs, and community-led development as three variants of public space privatisation. The debate in this sphere can linger, but it implicates the importance of understanding what a PPP is (or is not) despite the prevalent use of PPPs for infrastructure provision. A

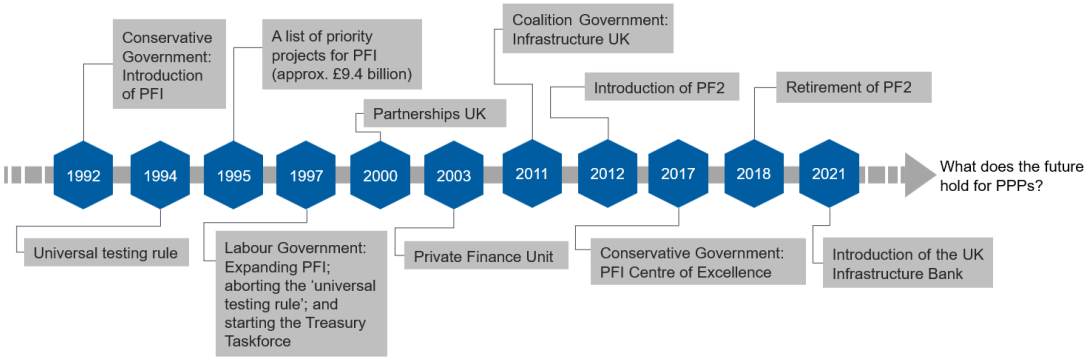
taste of the history of PPPs might offer insights into the gradual stability of a PPP definition.

### 3.2.1 The History of Public Private Partnerships

The World Bank's Public Private Partnership Legal Resource Centre (2009) noted the primitive signs of PPPs in the Roman Empire two thousand years ago and in France during the 12th and 13th centuries, respectively. The municipalities of the Roman Empire used competitive bidding to award a private company's right to construct and manage their postal stations for five years (known as a 'manceps' contract). In France, villages were conceded to the occupants for improvement (known as an emphyteutic contract), and the community utilised the tolls of bridges and highways collected from concessionaires to finance new projects. Baker (1975) recorded the origin of PPPs in the United States (US) when in 1786 a private company helped built the Charles River Bridge across Boston and Charlestown and collected fees for 70 years. According to Yescombe and Farquharson (2008, p.11), this continued to the late 19th century when the private-sector capital invested the Brooklyn Bridge in New York.

Although the above examples in Europe and the US set the concept of PPPs not to be new, it is widely recognised that the UK fostered Private Finance Initiative (PFI), the modern forms of PPPs in the 1990s. Figure 3.1 depicts the evolution of PPPs in the UK. In the Autumn Statement (1992), Norman Lamont (the then Chancellor of the Exchequer) announced the government's plan to boost joint ventures between the public and private sectors instead of the previous either wholly private or wholly public projects. An even extreme 'universal testing rule' where all public sector projects should consider PFI came in 1994 (UK Parliament, 2008). As a result, Burnett

(2012) noted that 21 PFI contracts were signed by 1995. Although this rule was scrapped by the successive government, House of Commons (2003) documented that the Labour government in 1997 largely expanded the impetus to PFI, and established the Treasury Taskforce in 1997, Partnerships UK and the Office of Government Commerce in 2000, and Private Finance Unit within HM Treasury in 2003 to develop and promote it. Faced with strong criticisms (e.g., the Committee of Public Accounts, 2011; and the Treasury Committee, 2011) on PFI, it was rebranded as Private Finance 2 (PF2) in 2012. For this Labour Government, HM Treasury (2019) estimated that an average of 55 contracts were signed every year between 1997 and 2010. According to European PPP Expertise Centre – EPEC (2012), the onus was on Infrastructure UK in 2011 to manage PFI and PF2. However, PF2 was only applied to six projects (five schools and one hospital) before it retired in 2018 (NAO, 2018, p.42). For the remaining PFI and PF2 projects (around 704 projects worth a capital value of £57 billion) (HM Treasury, 2019), the PFI Centre of Excellence was set up in 2017 to provide expert advice. More recently, the UK Infrastructure Bank was formed in 2021 to harness public and private investment in vital infrastructure.




Note: the events may not be exhaustive, but are milestones of PPPs in the UK.

Figure 3.1. The timeline for PPPs in the UK

### 3.2.2 The Definitions of Public Private Partnerships

The footprints of PPPs above have implied that they are a popular form of infrastructure delivery. However, their common application does not result in a common definition of PPPs, as governments assume different priorities and intentions (Muleya *et al*., 2020). Again, taking the UK as an example, UK Parliament (2008) reported that the original introduction of PFI was to leverage up the government's budget so that more investment could take place. Only later were justifications such as private innovation, better risk management, refinance, and quality services considered (UK Parliament, 2008). The overall economic climate can also affect the intention. For instance, NAO (2018) noted that the 2008 financial crisis reduced the use of PFI because the cost of private finance increased. In the literature, Cherkos and Jha (2021) reported that emerging markets embrace PPPs mainly due to economic and financial stimuli, compared with developed countries' pursuit of service quality. As a result, various approaches such as PFI, build-operate-transfer (BOT), concession and franchise, have been generated to accommodate multiple types of assets (e.g., new or existing), functions borne by private sectors, and payment sources such as users or governments (The World Bank, 2017).

In the UK, HM Treasury (2021b) defined PFI as 'a long-term contract between a private party and a government entity where the private sector designs, builds, finances and operates a public asset and related services.' Australia's Department of Infrastructure and Regional Development (2008a) perceived PPPs as 'a long-term contract between the public and private sectors where government pays the private sector to deliver infrastructure and related services on behalf, or in support, of government's broader service responsibilities'. Developing countries, such as China'

s Ministry of Finance (2014), sought to build a long-term partnership where private entities design, build, operate and maintain the infrastructure while the government supervises its price and quality. Table 3.1 outlines some other international organisations' and economies' understandings of PPPs. These definitions reinforce the perception that a 'one-size-fits-all' approach to PPPs may be problematic.

Table 3.1. Definitions of PPPs

| Organisations and economies | Definitions | Reference |
|---|---|---|
| The World Bank | 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. | PPP Knowledge Lab (2020) |
| EIB | An arrangement between a public authority and a private partner designed to deliver a public infrastructure project and service under a long-term contract. | EPEC (2022) |
| OECD | Arrangements whereby the private sector provides infrastructure assets and services that traditionally have been provided by government, such as hospitals, schools, prisons, roads, bridges, tunnels, railways, and water and sanitation plants. | OECD (2007) |
| The UK | Long-term contracts where the private sector designs, builds, finances and operates an infrastructure project. | UK Government (2020) |
| Australia | A service contract between the public and private sectors where the Australian Government pays the private sector (typically a consortium) to deliver infrastructure and related services over the long term. | Department of Infrastructure, Transport, Regional Development and Communications (2018a) |
| Canada | A cooperative venture between the public and private sectors, built on the expertise of each partner, that best meets clearly defined public needs through the appropriate allocation of resources, risks and rewards. | The Canadian Council for Public-Private Partnerships (2020) |
| The US | Contractual agreements between a public agency and a private entity that allow for greater private participation in the delivery of projects. | US Department of Transportation (2021) |

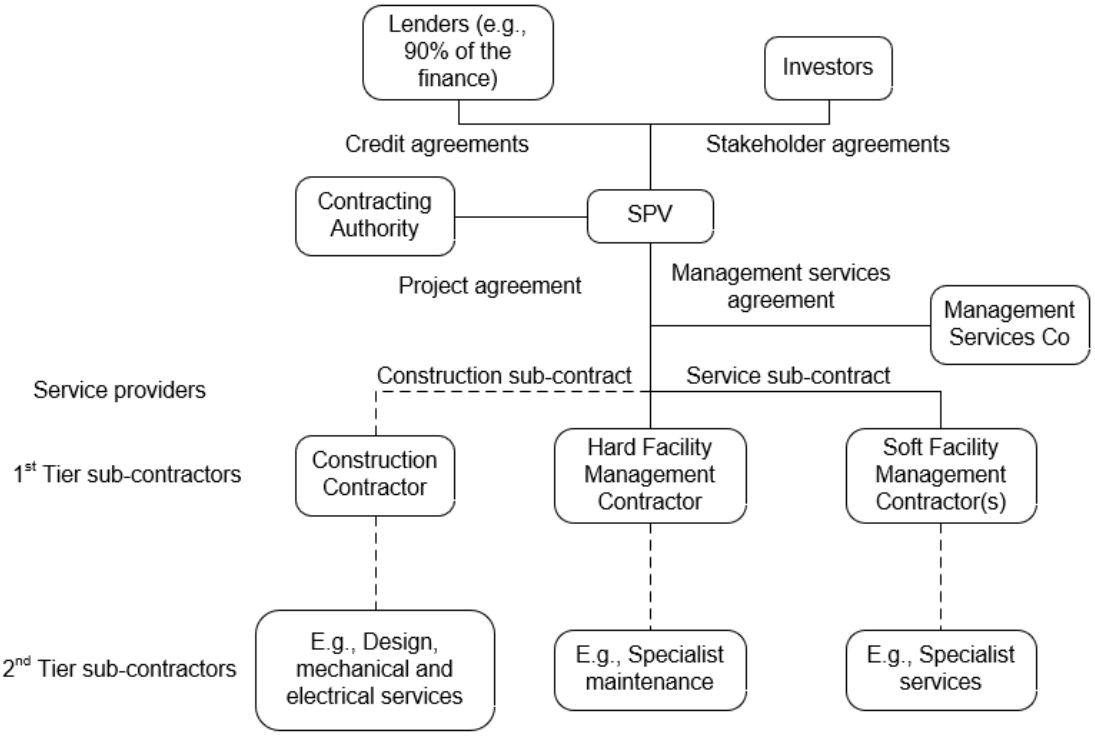
| | | |
|---|---|---|
| South Africa | A contract between a public-sector institution and a private sector, where the private sector performs a function that is usually provided by the public sector and/ or uses state property in terms of the PPP agreement. | National Treasury (2021) |

Nevertheless, some common characteristics of PPPs can be seen, including: (1) long-term partnership (Garvin, 2010); (2) risk-sharing (Akintola *et al*., 2003); (3) value realisation (Chen *et al*., 2015); and (4) innovation (Hodge and Greve, 2016). With these core elements, variants of PPPs have materialised over recent decades. The World Bank (2020) has grouped them into: (1) utility restructuring, corporatisation and decentralization; (2) civil works and service contracts; (3) management and operating agreements; (4) leases/ affermages[16]; (5) concessions, BOT, design-build-operate (DBO); (6) joint ventures and partial divestiture of public assets; (7) full divestiture; and (8) contract plans and performance contracts. A typical structure of PPPs is provided in Figure 3.2. As can be seen, a special purpose vehicle (SPV) with no other business than the specific PPP project is at the core of the structure. With a project agreement with the public sector, the SPV then signs the credit and shareholder agreements with lenders and investors, respectively. Its daily operation (e.g., periodic performance reporting) is often run by a management services company (can be independent or belong to investors) via a management services agreement. Within the structure is also the construction and service sub-contracts signed between the SPV and contractors. The shareholders of the SPV are corporate entities associated with

[16] According to The World Bank (2020), leases and affermage contracts are generally public-private sector arrangements under which the private operator is responsible for operating and maintaining the utility but not for financing the investment. In affermages, the operator is assured of its fee and the authority shoulders the risk of collecting receipts from customers to cover its investment commitments.

one or more PPP funds. Notably, IPA (2022b) stated that there could be one or more levels of further SPVs responsible for the lending and investment activities.

In order for the SPV to display V*f*M, one of the most important issues regarding the choice of a PPP is the (pre-)arrangement of an exit strategy, namely, early termination (Song *et al*., 2018) or expiry (Yuan *et al*., 2015). For instance, in the case of a government's intention to terminate the PPP contract before the expiry date, Xiong *et al*. (2016) developed a model (based on a market value approach, and socio-economic and project performance variables) to calculate the amount of compensation to the private entity, while ensuring the project would still be V*f*M in the charge of the public sector. Yuan and Li (2018) quantified the risks associated with the handover stage of PPP (where the asset is often transferred back to the host government) and confirmed that having in place disciplined asset management and strict hand-back requirements would enable PPPs to outperform the traditional procurement. Specifically, in their case of highway pavements projects, the residual value (when transferred back to the government) of PPPs equates to 45% of the capital expenditure while that is 24.7% of the capital expenditure for the traditional procurement. Taking these in the consideration of V*f*M assessment, it demonstrates that a balance needs to be struck between value issues and the commercial strategy (See details in Chapters 5 and 6).




Note: this structure is not definite, and can change across projects.

Figure 3.2. A typical structure of PPPs

(Source: Adapted from IPA, 2022b)

A basic understanding of what a PPP is (or is not) then leads to the question '*why is there a need for the uptake of PPP forms of contract for public services provision?*'. This is because PPPs are expected to bring forward better risk management (Grimsey and Lewis, 2002), reduced project costs (Chou and Pramudawardhani, 2015), economic development (Cherkos and Jha, 2021) and sustainability (Hueskes *et al*., 2017) through a bundled 'construction and operation' contract (Chan *et al*., 2009). Institutionally, the European Commission (2003) put forward a number of advantages of PPPs, including accelerated infrastructure provision, faster implementation, lower whole life costs, better risk allocation and incentives to perform, improved service quality, additional revenues, and enhanced public management. However, empirical evidence on whether these advantages are realistic remains contested and anecdotal

(Hodge and Greve, 2016). For example, Soomro and Zhang (2015) examined 35 failed transport PPPs and found both governments and taxpayers suffered substantially from the unachieved V*f*M. In a similar vein, Medda *et al*. (2013) and Roumboutsos and Pantelias (2014) identified that risks in real-world transport PPPs are not optimally allocated and these projects often cost more and are delayed. HM Treasury (2018a) acknowledged in its Budget 2018 the inflexibility of PF2 and its fiscal risk to the government. The backlash on PPPs can be subjected to debate. However, it may well put V*f*M under the spotlight and trigger wider reflection on how to improve the procurement decision-making process for future PPPs (NAO, 2018).

### 3.2.3 Public Private Partnerships and Transport Infrastructure

PPPs have been widely adopted in the sectors of transport (Koppenjan, 2005), telecommunication (Falch and Henten, 2010), healthcare (Barlow *et al*., 2013), water (Ameyaw and Chan, 2015), sewage treatment (Yang *et al*., 2017), housing (Kavishe *et al*., 2019), and energy (Shahbaz *et al*., 2020) among others. In the European PPP market, EIB (2022) revealed that the transport sector remained the largest transaction values and the number of projects over the past five years from 2017 to 2021. In 2021, 16 transport projects with a transaction value of €6.0 billion reached financial close followed by the environment, telecommunications, education, and recreation and culture sectors. Among the current PPP projects in the UK, HM Treasury (2019) showed that Department of Transport was responsible for around 60 projects worth c.£7.5 billion. The data have indicated the close relationship between PPPs and transport projects. This corresponds to the earlier history (see Section 3.2.1) in which PPPs were formed in the transport sector. Now, they are often procured via concessions in the form of BOT (Zhang *et al*., 2018), DBFM (Design-Build-Finance-

Maintain) (Verweij, 2015), and DBFMO (Design-Build-Finance-Maintain-Operate) (Yescombe and Farquharson, 2018). Table 3.2 showcases some of the research on PPPs and transport infrastructure over the last decade.

Table 3.2. Research into transport PPPs

| Type of Asset | Research Themes | Authors |
|---|---|---|
| Metropolitan subways | Cost/Finance | de Jong *et al.* (2010) |
| Metropolitan transport systems | Critical Success Factors (CSF) | Yuan *et al.* (2010) |
| Toll road | Cost-related risk management | Gross and Garvin (2011) |
| Metro | Cost/finance | Chang (2013) |
| Metro | CSFs | Liu and Wilkinson (2013) |
| Metro | Finance | Chang (2014) |
| Light rail | Risk sharing and cost effectiveness | Carpintero and Petersen (2014) |
| Motorway | Risk allocation and mitigation | Carbonara *et al*. (2015) |
| Entire transport sector | Finance | de Albornoz and Soliño (2015) |
| Urban rail | Cost management | Hong (2016) |
| Entire transport sector | CSFs | Zhang and Soomro (2016) |
| Urban rail | CSFs | Ke *et al.* (2017) |
| Urban rail | Cost-related management (recovery ratio/land value) | Chang and Phang (2017) |
| Airport | Demand risk management | Engel *et al.* (2018) |
| Road | Demand risk management | Feng *et al.* (2018) |
| Toll road | Interest rate risk | Pellegrino *et al*. (2019) |
| Bridge | Concession price and subsidies | Yuan *et al*. (2019) |
| Highway | Performance management | Yuan *et al*. (2020) |
| Port | Failure factors | Feng *et al*. (2021) |
| Entire transport sector | Adoption ideology and project success | Anago (2022) |

Transport projects have been traditionally procured via the traditional public procurement in which governments delegate construction and operation to separate contractors but remain responsible for their commissioning and finance. During the procurement process, a cost-benefit analysis is conducted to make the ‘go or no-go’

investment decision. Different procurement methods are then evaluated against a set of criteria including time to completion, quality, risk allocation, and availability of price competition (Naoum and Egbu, 2016; Pu *et al*., 2020). Although transparency and fairness are stressed, surveys by Love *et al*. (2008) and Burger and Hawkesworth (2011) have shown that clients had an intrinsic preference for the traditional public procurement as they are more familiar with it. However, according to Medda (2007) and Jin and Zhang (2011), this situation is offset by the aforementioned advantages PPPs can potentially offer and by the presumption that private consortia are more capable of managing the complexities (e.g., large-scale investment and uncertainties) embedded in transport infrastructure. The shift to PPPs has made them become what Reeves (2011) has called 'the only game in town'. Rather than provide better V*f*M, the driving forces behind the commitment to PPPs are that they, *inter alia* can keep the public debt off the balance sheet and leverage up governments' limited budget (Chan *et al*., 2009; EPEC, 2015; NAO, 2018). The private sector, because PPPs are potentially profitable, advocates their adoption. This is what Edgar *et al*. (2018) refer to as 'impression reinforcement' to consolidate the underlying public policy tendency. It should be noted, however, that results from a sample of 258 transport projects investigated by Flyvbjerg *et al*. (2004) indicate that the claim that the private sector can better manage cost than the public sector is exaggerated. Leigland (2018) has argued that some previous proponents of PPPs have been persuaded against them because of compelling evidence that some PPPs are not successful. Evidently, the 'mechanisms' that are in place to facilitate the decision whether to adopt PPPs or its counterpart, the traditional public procurement, are subjected to controversy. Therefore, it is important that the current methods of assessment should be improved if the true transport V*f*M is to prevail, regardless of the procurement method.

## 3.3 Value for Money in Public Private Partnerships

Although research topics about PPPs change over time (see, for example, studies conducted by Tang *et al*., 2010, Song *et al*., 2016, and Cui, *et al*., 2018 that have identified PPPs' research trends), V*f*M continues to be in symbiosis with PPPs. Grubišić Šeba (2015) highlighted that an ineffective assessment of V*f*M (e.g., lack of comparisons between PPPs and the conventional procurement) can result in project mis-performance. Practically, in order to determine the feasibility of a PPI and the procurement options (e.g., PPPs) to be considered, they are compared with conventional forms (e.g., Alliancing or Design and Build) using a public sector comparator (PSC) to assess their ability to provide V*f*M (EIB, 2015). In other words, V*f*M is determined by comparing the Net Present Value (NPV) of a PPP's life-cycle costs with the PSC (Siemiatycki and Farooqi, 2012).

### 3.3.1 The Concept of Value for Money and its Significance

The use of V*f*M ranges from daily life (e.g., buying a phone) to professional trade (e.g., selecting a best practice procurement approach). Yet in the latter, the concept of V*f*M is not clear-cut because of variables such as stakeholders, measurement, attribution, and stability (McKevitt, 2015). Barton *et al*. (2019) went on and argued that the lack of a universally accepted definition of V*f*M resulted from the complexity of monetising 'value'. Nevertheless, Almarri and Boussabaine (2017) suggested that life-cycle cost efficiency and clear service outputs should be elements of V*f*M. Ismail (2013) affirmed that V*f*M depends on realising technical innovation through competitive tendering. These commentators consider V*f*M to be a function of multi-attributes. Under the auspices of *Value Theory*, value is represented by a specific price

(money) within a market (Milios, 2003). Similarly, Ng *et al*. (2012) and Cui *et al*. (2019) have identified that cost effectiveness is the most fundamental driver for V*f*M. This to some extent explains why cost is paid overriding attention in actual V*f*M assessment. Contrastingly, value in the context of transport infrastructure projects is framed as providing the public with value in terms of economic, social and environmental benefits (Department for Transport, 2017; Love *et al*., 2021).

Suffice to say, however, the fundamentals associated with V*f*M have been well-documented by the public sector whereby terms such as 'economy', 'efficiency' and 'effectiveness' take centre stage (Jackson, 2012). Additionally, 'equity' is identified as another element of V*f*M, which is referred to as the "fair spend (of public money) to provide the public with the non-compromised quality of services" (NAO, 2011, p.1). Accordingly, V*f*M is defined by HM Treasury (2006, p.7) as the "optimum combination of whole-of-life costs and quality (or fit for purpose) of the good or service to meet the users' requirement". In this case, V*f*M is adopted to determine if a government has spent their money appropriately and achieved its expected outcomes (NAO, 2013).

Several studies (Morallos *et al*., 2009; Garrido *et al*., 2017; Wallis, 2020) have evaluated the project outcomes of transport infrastructure using V*f*M. Here project evaluation comprises formative and summative assessments. A formative evaluation is initiated at the project's inception stage and used for decision-making (i.e., *ex-ante*). A summative evaluation is performed by examining actual outputs (i.e., *ex-post*) (Harlen and James, 2006). A V*f*M assessment of PPPs is typically carried out during the inception stage of a project and is used by the public sector as a decision-making

tool in conjunction with the business case to assist with the selection of an appropriate procurement strategy (Morallos and Amekudzi, 2008; Opara, 2018; Zhao *et al.*, 2021). The *ex-post* V*f*M assessment is often entangled with performance measurement to target whether V*f*M has been realised via the selected method (Liu *et al*., 2018). Some organisations, such as the UK's NAO, have institutionalised V*f*M assessment into the scrutiny of government spending, thereby aligning and comparing an *ex-post* with the *ex-ante* V*f*M assessment (Heald, 2003).

Given the lump-sum capital investment, unsuccessful infrastructure delivery will not only result in the financial vulnerability of stakeholders but loss of overall social welfare. As such, according to Shi *et al*. (2020), V*f*M assessment has attracted attention in academia and formed a major research area in PPP related studies. In practice, it has become a mandatory procedure in the procurement process of some countries (e.g., UK, Australia and China) if PPPs are being considered. A number of other countries, such as Belgium (van den Hurk, 2018), Malaysia (Ismail, 2013), Albania (Keçi, 2019), and Vietnam (Hang, 2016) are also proposing and implementing their own V*f*M frameworks.

### 3.3.2 Value for Money and Transport Public Private Partnerships

Despite the significant role of V*f*M as a benchmark to evaluate PPPs, studies have indicated that prevailing V*f*M assessment techniques emphasise cost savings rather than assessing value *per se* (e.g., asset functionality) (Liu *et al.*, 2018; Yescombe and Farquharson, 2018; Zhao *et al.*, 2021). For example, Decorla-Souza and Farajian (2017) argued that social impacts should be considered in V*f*M assessment when selecting a PPP. Even in the case of a 'cost only' scenario, Grout (2005, p.48)

contended that the price of the London Underground project showed limited V*f*M due to uncertain revenue prices and high transaction cost (i.e., around 1.5% of the 30-year deal price). In this instance, the validity of PSC becomes questionable as it provides asymmetric comparisons between projects based on subjective assumptions (Reeves, 2013) and is overly reliant on contentious discount rates and inaccurate estimates (Bain, 2010; Zwalf *et al.*, 2017). As such, Decorla-Souza *et al.* (2013) suggested that cost-benefit analysis (CBA) would be a far more comprehensive, robust and effective approach to determining V*f*M than the PSC. Yet Ackerman and Heinzerling (2002, p.1553) were highly critical of CBA and considered it to being akin to "pricing the priceless" benefits. What is more, Penyalver *et al.* (2019) stated that CBA is unable to capture the intergenerational impacts of transport infrastructure in its V*f*M assessment. Thus, determination of a suitable method to assess V*f*M for transport PPPs remains problematic for decision-makers.

There are efforts that have addressed the critical success factors (Almarri and Boussabaine, 2017), risk transfer (Siemiatycki and Farooqi, 2012), and information exchange (Ren *et al*., 2019) in V*f*M assessment. However, according to the NAO (2018) and the UK Government (2018), the inability of the public sector to safeguard and deliver V*f*M to taxpayers due to the ambiguity of prevailing tools used for its assessment is prominent. In the case of roads procured through PFI, Bain (2010) even branded the V*f*M assessment as 'the black box'. The UK is not alone here, as others such as Australia, Canada, South Africa and the US to name a few, are faced with a similar dilemma. With an average worldwide investment of US$3.7 trillion on infrastructure (Global Infrastructure Hub-Oxford Economics, 2017) and shortages in finance as a result of the COVID-19 pandemic, there is a greater need to deliver V*f*M.

Reinforcing this point, the Global Infrastructure Hub (2021, p.4) maintains that "mobilising private capital is key to closing the infrastructure financing gap and has become even more critical as the COVID-19 pandemic has further limited the investment capacity of governments". As the PPI forms need to be rationalised by V*f*M assessment, it becomes self-evident that understanding the inherent characteristics of existing techniques is essential for governments to choose one to appraise their approach to deliver transport infrastructure projects.

### 3.3.3 Methods for Assessing Value for Money

As mentioned in Chapter 2, a systematic literature review was conducted to identify the existing methods for assessing V*f*M. Before presenting the methods, the algorithmic historiography, which aims to illustrate the intellectual evolution of V*f*M assessment within the literature was programmed using the HistCite software developed by Garfield *et al.* (2003). As Garfield *et al*. (2003) contend, historiography helps understand how basic concepts or perceptions of a paradigm (i.e., a model of a field) have changed by identifying the significant works on a given topic and providing a graphic and genealogical presentation of the links between them.

In the context of V*f*M assessment, this understanding was acquired by the relationship between the chronological distribution and pedigree of the V*f*M-related literature. In the relationship network, the nodes represent the publications systematically selected (i.e., 88 articles as in Chapter 2), and the sizes of the nodes are proportionate to the number of their citations within the WoS and Scopus. The 'links' depict the relationships cited with each other in the selected 88 articles and reflect the interrelationships of the knowledge generated from them (Zhuge, 2006). Among the

links, the main path has been demonstrated by Carley (1993) to be associated with the thematic or methodological transitions in the development of a topic. Therefore, to further understand the main developments in V*f*M assessment, the *Pajek* software was employed as suggested by Mrvar and Batagelj (2016). More specifically, the Search Path Link Count algorithm was applied using the software to extract the main path. It can consider all citation relations that traverse through the nodes and further construct the development of the V*f*M assessment literature (Lucio-Arias and Leydesdorff, 2008).

The main path (i.e., links in red) in Figure 3.3 comprises the nodes 11, 19, 35, 41 and 64, in which Morallos and Amekudzi (2008) (node 11) investigated the advantages and disadvantages of V*f*M assessments used in practice in Australia, Canada, Hong Kong, South Africa and the UK, and noted that the PSC provides a measure of value. Continuing with this research, Morallos *et al.* (2009) (node 19) examined the application of V*f*M assessment in the U). This was followed by the work of Liang and Hu (2017) (node 64) to examine V*f*M assessment in China. In a recent study, Peng *et al.* (2014) (node 41) echoed Morallos and Amekudiz (2008) and re-examined the weakness and inadequacy of PSC. Moving beyond PSC, Tsamboulas *et al.* (2013) (node 35) proposed a Multi-Criteria Analysis (MCA) approach to assess V*f*M within a qualitative context. Notably, however, the most significant node 7 is neither a critical part of the main path nor cited by any literature in the article 'pool'.

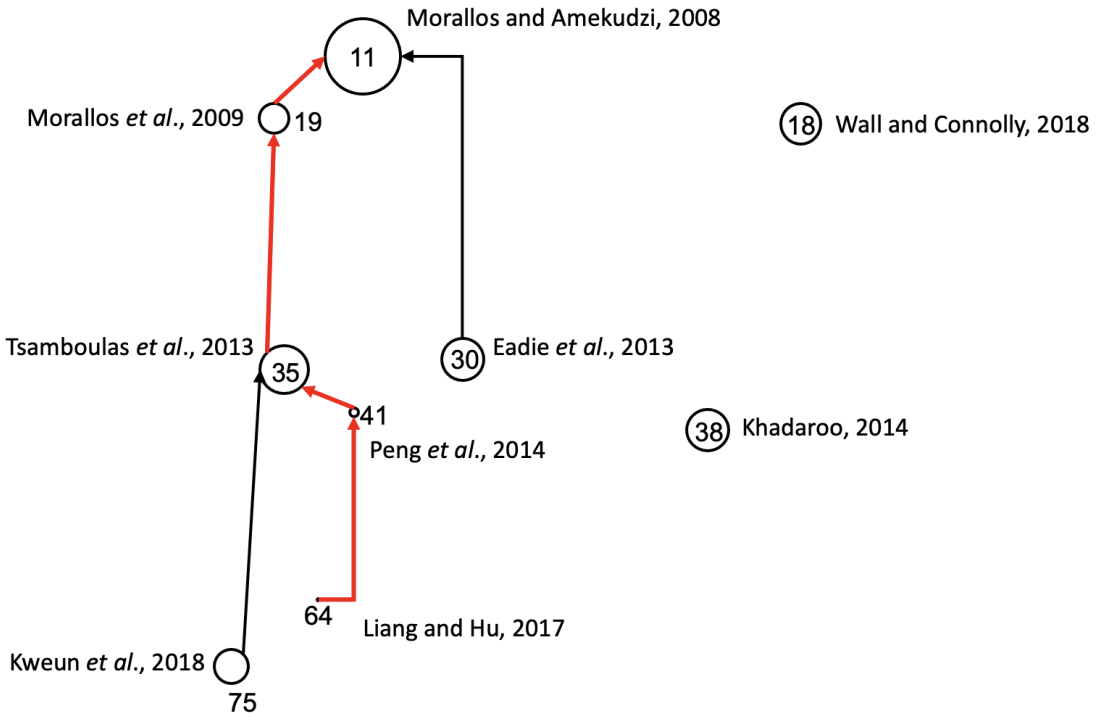



Figure 3.3. The main path (algorithmic historiography) of V*f*M assessment

This main path analysis has revealed that the development of V*f*M assessment focused on: (1) its application in different countries; (2) constructing and evaluating PSC; and (3) assessing the qualitative aspects. Meanwhile, the overall development of V*f*M assessment has been overlooked, and more importantly, research in V*f*M assessment has been fragmented rather than systematic. Evidence can be seen in Figure 3.3, where such 'big' nodes as 18 and 38 do not interact with any other nodes in the network, and nodes 30 and 75 only have one connection. Hence, there is an urgent need to collectively identify and analyse all existing approaches to assessing V*f*M so that new knowledge can be created to support the procurement of infrastructure projects.

Within the 88 articles, seven V*f*M assessment methods have been identified in Table 3.3. As mentioned above, PSC is the most widely-used technique in practice for assessing and determining V*f*M and the choice of a procurement strategy for transport

projects worldwide, such as Australia, Canada, China, New Zealand, the UK and US. It comprises the quantification of generic components, including: (1) raw PSC (base costing); (2) competitive neutrality; (3) transferable risk; and (4) retained risk (Hromada, 2017; Decorla-Souza, 2018). Notably, risk transfer influences the rationale and justification for using a PPI form of procurement (Makovšek and Moszoro, 2018; Cui *et al.*, 2019). In this case, PSC may draw on Monte Carlo simulation to determine project sensitivities to variations in price, risks and uncertainties (Peng and Liu, 2013; Liang and Hu, 2017).

Table 3.3 Existing V*f*M assessment methods

| Methods | Relevant Research |
|---|---|
| PSC | Miyamoto *et al*. (2005); Ball and King (2006); Abdel Aziz (2007); Queiroz (2007); Coulson (2008); Merna and Lamb (2009); Morallos *et al*. (2009); Reeves (2011); Ismail *et al*. (2012); Karmperis *et al*. (2012); Fantozzi *et al*. (2014); Vining and Boardman (2014); Opara *et al*. (2017); Kweun *et al*. (2018); Hu and Han (2018); Leigland (2018); Hang (2019); Wang and Li (2019) |
| Monte Carlo simulation | Miyamoto *et al.* (2005); Morallos *et al.* (2009); Aldrete *et al.* (2012); Peng and Liu (2013); Liang and Hu (2017) |
| Outline Business Case (OBC) | HM Treasury (2006); Cheung *et al.* (2009); UK Department for Transport (2013) |
| PPP-VALUE | Decorla-Souza (2014); Decorla-Souza and Lee (2017) |
| MCA | Tsamboulas *et al.* (2013) |
| Multiobjective Bayesian Network (BN) | Xie and Ng (2013) |
| CBA | Karmperis *et al*. (2012); Decorla-Souza *et al*. (2013); Decorla-Souza *et al*. (2016); Decorla-Souza *et al*. (2017); Moore *et al*. (2017) |

The UK government developed the OBC to improve V*f*M assessment of infrastructure projects (HM Treasury, 2006). Underpinning the OBC is a quantitative assessment that compares the cost of PPPs with that of the conventional procurement forms. Thus, the OBC is somewhat akin to PSC (Department for Transport, 2013). Similarly, the

US Federal Highway Administration (FHA)'s recommendation of PPP-VALUE for assessing the V*f*M of transport projects is a derivative of PSC (Decorla-Souza, 2014).

While MCA is often used to evaluate the environmental and safety impacts of projects, it has also been implemented by Tsamboulas *et al.* (2013) to determine value when employing PPPs. At this juncture, it needs to be pointed out that MCA is only applicable when PPPs have been demonstrated as a preferred procurement method. In essence, MCA is not intrinsically a decision-making technique but rather a tool for confirming the 'choice' of a selected procurement method. That is to say, MCA is restricted to dealing with the qualitative side of PSC and thus forms part of its decision-making toolkit. Additionally, multi-objective BN models proposed by Xie and Ng (2013) can support the use of PSC, particularly for non-financial aspects of the projects.

As well as the PSC-related methods above, CBA (also referred to as Benefit-Cost Analysis, BCA) can monetise the benefits and costs of a project from a broad perspective by attending to the question '*do benefits accrued to the public sector surpass the costs?*' (Decorla-Souza *et al*., 2013, p.32). The European Commission (2014) listed six steps for conducting CBA, involving: (1) presentation and discussion of socio-economic benefits along with project objectives; (2) clear project identification; (3) study of project feasibility and alternative options; (4) financial analysis; (5) economic analysis; and (6) risk assessment. It is outside the remit of this thesis to explain the 'how' of the PSC and CBA, but a detailed explanation can be found in the works of Decorla-Souza *et al*. (2016), Hu and Han (2018) and Hang (2019).

### 3.3.4 Characteristics of Value for Money Assessment Methods

As mentioned in Chapter 2, a SWOT analysis was performed to analyse the characteristics of existing V*f*M assessment methods. It encompasses an examination of internal attributes (strengths versus weaknesses) and external impacts (opportunities versus threats) (Ghazinoory *et al.*, 2011). Both the internal attributes and external impacts within the context of the V*f*M techniques and procurement methods are now examined (Tables 3.4 and 3.5)

Table 3.4. Internal attributes of V*f*M assessment methods

| Methods | Strengths | Weaknesses |
|---|---|---|
| **PSC**<br>Monte Carlo simulation<br>OBC<br>PPP-VALUE<br>MCA<br>Multiobjective BN | • Quantification of financial benefits<br>• The simplified procurement selection process | • Asymmetry in cost comparison<br>• Contentious discount rate<br>• Undefined components<br>• Subjective assumptions and inaccurate estimate |
| **CBA** | • Decision-making for a broader context<br>• Comprehensive evaluation | • Time-consuming and non-standardised process |

Table 3.5. External impacts of V*f*M assessment methods

| Methods | Opportunities | Threats |
|---|---|---|
| PSC and CBA | • Prosperous market<br>• Scientific and technical stimulus | • Ideological inclination |

#### *3.3.4.1 Strengths*

*Quantification of financial benefits*

Governments have to evaluate the potential benefits of using PPPs and consider taxpayers' best interests (Broadbent and Laughlin, 2004). Therefore, PSC is used to determine if it is financially beneficial to use a PPP and thus alleviate taxpayers from

funding a project (Cheung *et al.*, 2009). A case in point is the Indian Bangalore Nelmangala National Highways 4 Project. Here PSC demonstrated that a saving of US$24.3 million from the public budget could be achieved using a PPI (Gopalkrishna and Karnam, 2015). While PSC tends to overlook non-financial benefits (e.g., regional development, environmental impacts and public support), some governments, such as the US's PPP-VALUE, incorporate a form of non-quantitative analysis into assessing the viability of procurement routes (Almarri and Boussabaine, 2017; He *et al.*, 2018; Sun *et al.*, 2019). For instance, the PPP-VALUE method considers travel time saving and accident and emission reduction, which PSC has overlooked (FHA, 2012).

*Simplified procurement selection process*

The PSC process is relatively straightforward to implement as it focuses on comparing the NPV of an asset over its life-cycle with and without the private sector's financial contributions (Zwalf *et al.*, 2017; Kweun *et al.*, 2018). In stark contrast, CBA is more complex to implement as there is a need to quantify the costs and benefits of all possible options that can be realised. While CBA goes some way to providing insights into expected benefits of transport investments, it is prone to producing inaccurate estimates and thus has several shortcomings, for example, "pricing the priceless benefits", "distorting the future using inappropriate discount rates" and "ineffective capturing dynamic uncertainties" (Ackerman, 2008, p. 3-7).

*Decision-making for a wider context*

Conventionally, PSC is only applied at the inception of a project to determine whether a PPI form of procurement method should be used. However, CBA is applicable for multiple stages over a project's life-cycle for decision-making. Typically, it can be

implemented to develop a business case of a transport project. Furthermore, CBA is regularly used in the post-construction stage, by monetising benefits, though will depend on the benefit-cost ratio (Lam and Gale, 2014; Rouhani *et al*., 2016; Almarri and Boussabaine, 2017). Hence, CBA can provide governments with insight into the V*f*M of alternative procurement methods and understand the economic and social benefits of the project (Decorla-Souza and Lee, 2017).

*Comprehensive evaluation*

PSC, as addressed above, is a form of cost-oriented evaluation, overlooking a series of social and environmental benefits (i.e., creation of job opportunities and environmental impacts) (Ng *et al.*, 2012; Peng and Liu, 2013). For instance, PSC was applied to justify the approach used to deliver the M1-A1 project in the UK. A cost-saving of £84m with the private sector's financial contribution was the main reason for choosing the build-finance-operate mode (Mackie and Smith, 2005). Contrastingly, CBA can perform an overarching evaluation covering both costs/economic risks and social benefits (Decorla-Souza *et al.*, 2013). By integrating traffic forecasts and revenue analysis, CBA provides decision-makers with a clear pathway to whether a project should move to its next stage of development (Cruz and Sarmento, 2020). For example, the French government applied this approach when deciding whether its high-speed rail line (HSRL) would pass through the suburb of 'Métropoles du Sud' or 'Côte d'Azur'. Due to higher ridership forecasts, 'Métropoles du Sud' was chosen (Hyard, 2012). Of note, major transport projects funded by the European Union are explicitly required to conduct a rigorous CBA (The European Commission, 2014).

*3.3.4.2 Weaknesses*

*Asymmetry in cost comparison*

To recap, PSC generates a hypothetical scenario to compare PPI and conventional procurement options. In this case, it is meaningless to benchmark the theoretical costs of conventional procurement approaches with actual bids relating to PPPs (Gopalkrishna and Karnam, 2015). Even when making financial comparisons, the discount rates used for PSC and the relevant shadow bid model[17] (SBM) vary in practice to accommodate the specific risks of two different procurement approaches (Zwalf *et al.*, 2017). While governments tend to use a social discount rate (SDR) in PSC, organisations from the private sector (i.e., private Special Purpose Vehicles) prefer the weighted average cost of capital for the cost estimate of the projects to be delivered by PPI (Decorla-Souza *et al.*, 2016). This inconsistency results from using two different discount rates in the cost comparison of a project, which leads to an asymmetric estimate and having an adverse impact on PSC's reliability (Zwalf *et al.*, 2017).

*Contentious discount rate*

A key aspect of the PSC calculation relates to the selection an appropriate discount rate (Zwalf *et al.*, 2017). Technically, there are five types of discount rate available: (1) social rate of time preferences (SRPT); (2) social opportunity cost of capital (SOCC) (3) mixture of the SRPT and SOCC; (4) equity premium; and (5) risk-free interest rate (Sarmento, 2010). While several studies have attempted to secure an appropriate discount rate, the choice remains contentious.

[17] SBM is the Responsible Agency's best estimate of a private party bid price (in net present value/cost terms) to deliver the output specification under a PPP project structure (The Treasury of New South Wales, 2017: p.48).

A small change in the discount rate can distort the result of the procurement selection process (Grout, 2003; Zwalf *et al.*, 2017; Wang, 2018). Essentially, a high discount rate often favours the selection of PPI forms to deliver projects (Parks and Terhart, 2009; Contreras, 2014). Taking the UK as an example, the rate required by the government was set at 6% in the 1990s (Shaoul, 2005). Such a high discount rate led to an overestimate of the PSC, favouring the option of PPIs (Opara *et al.*, 2017). Consequently, the UK government had to lower the rate to 3.5% to enable a 'fairer' comparison between PPIs and conventional procurement methods (Hodgson and Corrigan, 2005). As a result, there have been clarion calls for standardised discount rates for all procurement options for the sake of transparency and enable 'apples to be compared with apples' (Reeves, 2015; Liang and Hu, 2017; Kweun *et al.*, 2018).

*Undefined components*

Governments are reluctant to publicise the process and components of PSC, as often the estimates of many transport PPPs subjected to cost overruns indicated a preference for conventional procurement approaches to deliver the projects (Bayliss and Van Waeyenberge, 2018). Moreover, different public authorities tend to use distinct components for their PSCs to suit specific risks (Chen *et al.*, 2016). The PSC adopted by the US's FHA (2012) covers financing costs, retained risk, transferable risk and competitive neutrality. In the UK, the PSC that has been devised for road/railway projects comprises the costs and risks of the asset's construction, operations and maintenance (Bain, 2010). In sum, there are no universally accepted components of the PSC for transport projects (Department for Transport, 2017). These variations have led to an inconsistency of the PSC-oriented estimates, adversely affecting the

reliability of the results regarding whether PPI should be used (Henjewele *et al.*, 2012; Cruz and Marques, 2013; Reeves, 2015).

*Subjective assumptions and inaccurate estimate*

An underlying assumption with PSC is that PPI type projects can provide higher levels of service quality to the public sector at a lower cost. However, many have been subjected to schedule or budget overruns and even contract terminations (Vining and Boardman, 2014; Chen *et al.*, 2016). An investigation of the European road projects has indicated that PPPs consume 24% more costs than conventional procurement approaches (Blanc-Brude *et al.*, 2009). This result contradicts the claim above that PPPs provide a cost-efficient, timely and enhanced delivery process.

The first eight UK road projects procured using PFI, essentially, could have saved £100m if the conventional procurement forms had been selected (Edwards *et al*., 2004). Inaccurate estimating due to optimism bias, amongst a range of other factors, has been attributable to the cost increases of these PFI projects (Edwards *et al*., 2004).

As previously mentioned, an essential component of PSC is risk transfer, which can be unsuccessful if risk quantification and assessment are inaccurate (Aldrete *et al.*, 2012). There have been cases reporting that disproportioned risks transferred to the private-sector entities led to decreased ridership in some transport PPPs (Siemiatycki and Friedman, 2012). More importantly, an inaccurate risk quantification can skew the decision-making process used to select a procurement option (Reeves, 2013; Patil and Laishram, 2016; Decorla-Souza and Farajian, 2017; Opara and Rouse, 2019).

*Time-consuming and non-standardised process*

Conducting a CBA, as noted above, is a time-consuming process, as it requires a complete evaluation of all possible options (Grimsey and Lewis, 2005). But monetising all alternatives to evaluate them is a costly process and is impractical, particularly in the case of large-scale transport projects associated with a large number of uncertain issues (OECD, 2008).

Another drawback of CBA relates to the complexities of determining the risk premium of the social discount rate. An excessive risk premium is provided to private-sector to bear all transferred risks, hurting taxpayers' pockets (Makovšek and Moszoro, 2018). However, there are limited official guidelines and/or practice codes about determining an appropriate risk premium for PPI projects (Freeman *et al.*, 2018).

*3.3.4.3 Opportunities*

*Prosperous market*

Over the past decade, there has been an increasing demand to modify existing and construct new transport infrastructure in many countries worldwide due to population growth and demographic changes and ease congestion in major cities (Girmscheid, 2009; Sing *et al.*, 2019). As a result, the UK Government invested £600 billion to develop its domestic transport networks (HM Treasury, 2018b). In a similar vein, the Commonwealth Government of Australia announced that AU$110 billion would be invested in the next decade to deliver vital transport infrastructure (Australian Government, 2021). Yet, in an era of austerity, which the COVID-19 pandemic has exacerbated, governments have turned to the private sector for assistance to deliver much-needed transport infrastructure (Love *et al*., 2021). The upshot is that V*f*M

assessment now becomes a core feature of the procurement decision-making process (Opara and Rouse, 2019). Despite the importance of V*f*M assessment, prevailing approaches have been heavily criticised, as identified in this chapter.

*Scientific and technical stimulus*

As V*f*M assessment forms a mandatory part of the PPI procurement decision-making process in developed and developing countries, many studies have ameliorated its practice (Shaoul, 2011; Tsamboulas *et al.*, 2013; Jasiukevicius and Vasiliauskaite, 2018). For instance, the Monte Carlo simulation has been used to enable accurate quantification of risks (Aldrete *et al*., 2012). Similarly, a new decision-making model based on the Bayesian Network was developed by Zhao *et al.* (2021) to quantify the significance of asset functionality in the V*f*M assessment of transport projects. Building Information Modelling has also been proposed to improve the cost estimates of V*f*M assessment (Ren *et al*., 2019). Although controversy still pervades in V*f*M assessment, the contributions above have led to the development of current practice dominated by PSC and CBA.

*3.3.4.4 Threats*

*Ideological inclination*

'Inclination', which is referred to as the preference of a particular procurement approach, should not exist in governments' decision-making process of infrastructure project delivery (Eadie *et al.*, 2013). However, many governments tend to employ PPIs, rather than conventional procurement methods, due to budget capital constraints (Loxley, 2012; HM Treasury, 2020). Governments often provide profit guarantees/subsidies as incentives to attract PPI (Reeves, 2011; Bayliss and Van

Waeyenberge, 2018). With a tendency to involve a private entity's financial contribution to projects, the PSCs of many transport projects were made by the clients (i.e., governments) to indicate that using the conventional procurement method was more expensive than that of PPI (Hodgson and Corrigan, 2005; Wall and Connolly, 2009; Whiteside, 2020). Essentially, the NAO (2011; 2013) in the UK has criticised the tendency of inappropriately employing PSC in the V*f*M assessment, which has led to the unreliable results of choosing PPI.

### 3.4 Points of Departure

The SWOT analysis conducted in Section 3.3.4 outlined the critical issues of V*f*M assessment Recognising the strengths and opportunities of existing V*f*M assessment methods, it also brings to the fore their weaknesses and threats that should be addressed. Key points on research directions governed by an 'onion' architecture (Figure 3.4) are now discussed to ensure better V*f*M assessment of infrastructure projects.

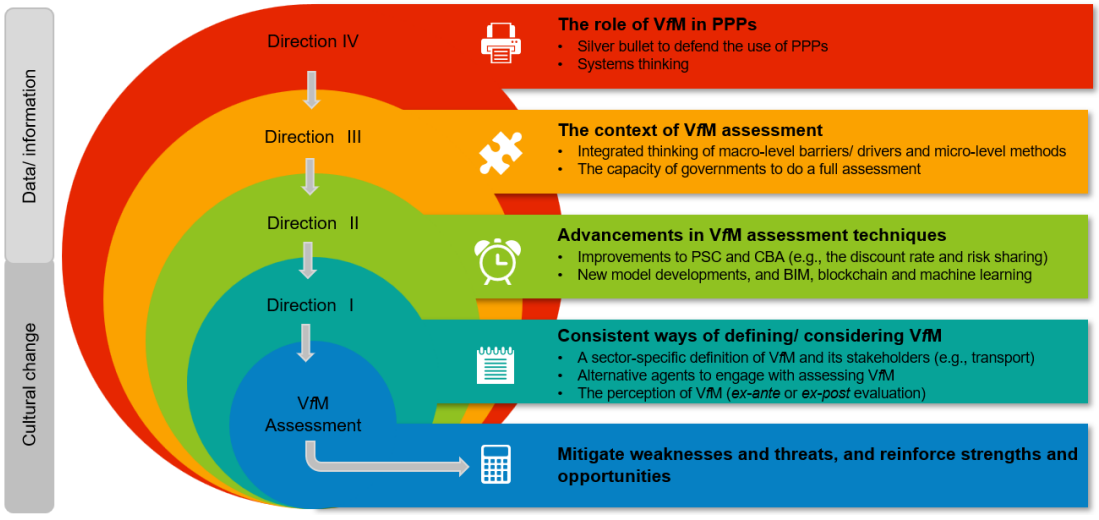



Figure 3.4. The V*f*M 'onion' architecture

### 3.4.1 Point One: Consistent Ways of Defining/ Considering Value for Money

The importance of V*f*M cannot be understated. Flanagan (2014) has considered it the most important issue for all clients and businesses. At the very least, it becomes the golden threshold for a PPP to be viable. Yet, the diagnosis above has uncovered it to be an ambiguous concept. In practice, the UK's Construction Leadership Council (2018, p.4) states a lack of "an industry-wide definition of value that considers more than capital cost''. This is not wrong due to the variability of governments' goals. However, problems could arise because McKevitt (2015) argues such ambiguity affects how to assess and when to declare V*f*M is achieved.

Hence, two lines of inquiry in this regard are urgent: (1) a sector-specific definition of V*f*M and its stakeholders; and (2) alternative agents to engage with assessing V*f*M. For the former, Cui *et al*. (2018) found it was common for public attitudes and other stakeholders' expectations of V*f*M to be ignored. While studies have tapped the idea of public involvement in PPPs (Boyer, 2019), research about defining its meaning is not proportionate to the abundant volumes of transport PPPs. For the latter, it is worth considering the private sector's V*f*M assessment for the public sector. This view is based on: (1) the private sector is the main body to finance, design, build, and operate the asset and is considered to have the expertise to do so (natural advantage); and (2) the public sector has a tradition of outsourcing infrastructure procurement and loses the capacity to do so over the time horizon (external impetus).

Coupled with the definition of V*f*M is 'how' it is perceived and 'what' (i.e., wider impacts) should be captured in future studies. Currently, it has been accustomed to the use of V*f*M to justify the selection of a PPP at the front end. There are studies, such as

those undertaken by Yuan *et al*. (2009) and Liu *et al*. (2018), which have developed performance indicators for PPPs to achieve V*f*M over their life-cycle. It can be debatable whether their criteria align with the initial V*f*M to retain consistency. Understandably, the uncertainties over the project life cycle that may divert the V*f*M goals should be captured, but it is pivotal to keep a marginal difference between perceived, expected, and materialised V*f*Ms. Thus, in accordance with Samset and Christensen (2017), having in place essentially the same criteria in *ex-ante* and *ex-post* project evaluation will increase the likelihood of success (i.e., V*f*M).

### 3.4.2 Point Two: Advancements in Value for Money Assessment Methods

Section 3.3.3 has broadly classified existing V*f*M assessment methods into PSC and CBA. It is clear that these techniques have their strengths in quantifying financial benefits, and simplifying the procurement selection process. Under the auspices of a standardised V*f*M definition, the awareness of the weaknesses of V*f*M assessment methods needs to be raised so that their potential can be maximised. There are two aspects here that can be accounted for in the future. First, research can be conducted to guide the selection of an appropriate discount rate. Several options are already available (e.g., social opportunity cost, social time preference, and the capital asset pricing model) (Stafford, 2011). Still, understanding their rationale and sensitivity to the assessment result need to be improved. Associated with the discount rate is the consideration of risk-sharing rather than risk transfer/ allocation that is prevalent in the existing literature. The focus on risk-sharing is driven by the fact that, more often than not, the touted risk transfer to the private partner exits only in the 'ideal' world. A good example is that COVID-19 has forcefully transferred the demand risk back to the public sector, and the UK Department for Transport (2022) ended up paying

£20.5219 billion from 2019 to 2021. It is not about forecasting the future here. Still, future studies need to bear in mind the identification and, more importantly, the management of such unmeasurable risks when preparing for a V*f*M assessment. The work of Casady and Baxter (2020), where a comprehensive revision of *force majeure* PPP contract provisions was called for, may well be a progressive direction in this domain.

Second, future research should develop new techniques since the SWOT analysis has identified scientific and technical stimulus as an opportunity for re-evaluating V*f*M assessment. This imperative need emanates from the scrap of PSC in the UK (NAO, 2013) and the contention of Flyvbjerg and Bester (2021) that CBA is 'broken'. To date, however, only the use of regional equilibrium (Rouhani *et al*., 2016), intergenerational redistributive effects model (Penyalver *et al*., 2019), and dynamic discrete choice model (Zhao *et al*., 2022) for the V*f*M assessment of transport projects if not all can be detected. It should be noted that developing new techniques does not mean negating the beneficial role of PSC and CBA in public expenditure. Aa a matter of act, Flyvbjerg and Bester (2021) have recommended four steps to reform CBA. They are: (1) systematic and effective de-biasing of cost-benefit forecasts; (2) introduction of skin-in-the-game for cost-benefit forecasters; (3) independent audits of cost-benefit forecasts; and (4) adaption of cost-benefit forecasting to the messy, nonexpert character of democratic decision-making. To support this progress, future studies can also look at the application of novel technologies as Whyte (2019) has demonstrated the ability of digital information to transform project delivery models. For example, Ren *et al*. (2019) and Yuan *et al*. (2020) have adopted building

information modelling in V*f*M related PPP evaluation. Obviously, these set a foundation for others such as blockchain and machine learning to be investigated.

### 3.4.3 Point Three: The Context of Value for Money Assessment

There is no doubt that V*f*M assessment is conducted within each jurisdiction's context (More can be found in Chapter 4). Rye *et al*. (2021) explained that politics predominantly shape the way people conceive of partnership/ franchising to bus services in two regions in the UK. It is appreciable that existing literature has dealt with macro-level institutional (Matinheikki *et al*., 2021) and political (Peña-Miguel and Cuadrado-Ballesteros, 2021) drivers/ barriers to PPPs or micro-level V*f*M assessment methods as unfolded earlier. Seldom, however, is an integrated thinking of why V*f*M is assessed in the way it currently is. Or, conversely, does V*f*M assessment contribute to achieving the macro-intentions that initiated PPPs in the first place, for example, the social, environmental, and economic benefits as stated in Local Government Association (2022)? Future studies can embrace this missing link as research (Liu *et al*., 2015) has confirmed that politics and V*f*M are critical factors influencing the success of PPPs.

Another aspect that should be made aware of under a particular context is that V*f*M assessment methods may differ. It is reasonable to assume that the UK practice may not survive on the soil of some developing countries. It is one thing that they are only concerned about raising project financing and constructing roads, as reported by Cherkos and Jha (2021). It is the other that whether they have the capacity to do a full-scale V*f*M assessment like the UK does. For instance, Burger and Hawkesworth (2011) have suggested the in-availability of skilled staff as one of the significant factors that undermine the pursuit of V*f*M. While studies on the comparison of V*f*M assessment

in different countries are not scarce, future studies can pay attention to enhancing the ability to undertake a proper V*f*M assessment when a standardised V*f*M concept (see Section 3.4.1) and associated techniques (see Section 3.4.2) are available. Faced with the threat (i.e., ideological inclination) unveiled above, studies on understanding the macro-level intentions and enhancing assessment abilities can serve as promising countermeasures.

### 3.4.4 Point Four: The Role of Value for Money in Public Private Partnerships

While an array of topics associated with PPPs are subjected to controversy, there is consensus that they should provide better V*f*M than conventional procurement approaches. After PPPs became popular in 1992 in the UK, the immediate reflection was that V*f*M should be embedded in 1999 by the then Private Finance Treasury Taskforce. V*f*M since then has become a somewhat silver bullet to defend the use of PPPs, even though the evidence remains anecdotal. Therefore, it is worth asking: is V*f*M assessment a panacea for all the problems that may emerge over PPPs' long-term project life cycle? The analysis suggests the opposite given the limited abilities (i.e., weaknesses and opportunities) of the existing methods to provide a comprehensive assessment. This does not mean the project itself is a 'failure' because it could still benefit society, as depicted in the toll motorways case by de Albornoz *et al*. (2021). Hence, future studies need to inject *systems thinking* into V*f*M assessment by answering, "*how can VfM continue to play a role in PPPs after they are selected as the preferred procurement approach*?" As Flanagan (2014) explains, systems thinking is concerned with not only 'hard' systems (e.g., project planning, scheduling and control) but also 'soft' systems (e.g., people, actions, reactions and intentions) to look at complex systems (e.g., PPPs). It may provide a lens for future studies to apply

*procurement management* and *network approach* from a process perspective to assess V*f*M.

## 3.5 Chapter Summary

The assessment of V*f*M is indispensable in selecting an appropriate procurement strategy, particularly decisions between forms of PPI and the traditional procurement approaches. It aims to create a definitive decision during the inception stage of projects so that the infrastructure asset can be successfully delivered. With that in mind, this chapter dived into the *status quo* of PPPs and V*f*M assessment. After presenting the basics of PPPs and their connection to V*f*M, a total of 88 publications have been systematically selected, which helped identify seven popular V*f*M assessment methods that can be clustered into the realms of PSC and CBA. Such techniques were examined by using a SWOT analysis. Based on the analysis results, four points of departure have been conceptualised in an 'onion' architecture. These are (i) consistent ways of defining/ considering V*f*M, (ii) advancements in V*f*M assessment techniques, (iii) the context within which V*f*M is assessed, and (iv) the role of V*f*M in PPPs. The next chapter then takes these points on aboard, and examines how V*f*M is assessed in practice.

# CHAPTER 4 VALUE FOR MONEY ASSESSMENT IN GLOBAL MARKETS

## 4.1 Chapter Introduction

In conjunction with Chapter 3, this chapter counters the first objective (i.e., establishing the state-of-the-art V*f*M assessment practices in global PPP markets and evaluating them in the light of common critical reactions) set out in Chapter 1. It starts with encapsulating the problems with V*f*M assessment. Then the priority is placed on how V*f*M is assessed in global markets to examine whether the problems exist in practice. As mentioned in Chapter 2, drawing on the theory of boundary spanning, this chapter mainly focuses on a comparison of *when*, *what*, and *how* V*f*M is assessed in the UK, Australia, and China. In the meantime, the 'context' within which V*f*M is assessed in these three mature PPP markets is unpacked. Together, they explain why V*f*M is assessed in the way as it currently is in global markets. The output of such a comparative analysis is an option framework proposed to make headway towards sensibly selecting an infrastructure procurement approach and delivering V*f*M afterwards.

## 4.2 Problems with Value for Money Assessment

The debate on the utility of PPPs is enduring (see, for example, Shaoul, 2005; Hodge *et al*., 2018; and Verweij and van Meerkerk, 2021). Proponents cite their abilities in easing governments' budget constraints (Chan *et al*., 2009), transferring risks to the private sector (Jin and Zhang, 2011), and curbing delays and cost overruns (Raisbeck *et al*., 2010). However, according to Hodge and Greve (2017), solid evidence to support the rhetoric is extremely rare. If anything, most commentators are critical and

argue to the contrary. A case in point arose in China where Xiong *et al*. (2021a) contend that political opportunism has partially contributed to the failures of PPPs there. Moreover, the methodology enshrined in V*f*M assessment has been criticised as being deeply flawed and un-rigorous (Shaoul, 2005; Zhao *et al*., 2022). In order to improve the delivery of infrastructure, governments, especially those experiencing 'failures' with PPPs, therefore need to learn from each other and be equipped with a robust instrument that can evaluate their V*f*M. This is supported by the theory of 'boundary spanning', where Marrone (2010) argues that organisations must increasingly coordinate across their boundaries and actively manage external relationships to achieve success. The already constrained budget is exacerbated by the COVID-19 pandemic. In the UK, for example, according to the Office for National Statistics (2021), its debt has risen above the European Union (EU) average (i.e., 12.3% higher) during the pandemic, which means the public budget has to be carefully allocated after COVID-19. Such a situation may make the use of PPP types of investment in the UK increasingly relevant. Therefore, it becomes important that those opportunities (i.e., the use of PPPs) provide V*f*M. Against this circumstance, the next two sections explain why comparing different V*f*M assessment practices is necessary, and what the problems are.

### 4.2.1 Why were Different Value for Money Assessments Compared?

Studies on V*f*M in a single country are not scarce. For instance, Ismail (2013) used survey results to propose a V*f*M assessment framework that integrates financial and non-financial aspects in a Malaysian context. Opara (2018), on the other hand, suggested improved information disclosure, transparency and risk quantification of V*f*M assessment in Canada. Acknowledging the need to engage in what Aldrich and

Herker (1977) called 'external information processing', Grimsey and Lewis (2005) compared the views of academics and practitioners on V*f*M assessment and its practice in different countries. Subsequently, Morallos and Amekudzi (2008) reviewed the V*f*M model adopted by agencies in Australia, Canada, Europe, and Asia. Addressing the variances in different states in the US, Morallos *et al*. (2009) surveyed their V*f*M analyses for transport projects. While these studies have attempted to span the single-country boundary to a number of settings to draw lessons, they focused on V*f*M assessment without considering the context underlying it; did not reflect the spectrum of changes within organisations, particularly in the most recent situations; and did not provide a possible solution to the procurement conundrum. Therefore, this chapter provides a timely inquiry to make sense of the V*f*M assessment in global markets, which is particularly directed at policy in the UK, to inform its future use of PPPs.

### 4.2.2 Problems with Value for Money Assessment

The pervasive use of V*f*M assessment in project evaluation requires the methodology itself to be sound and reliable, otherwise the validity of the decision would be in doubt. However, current questions in the V*f*M debate include, *inter alia*: what is a suitable discount rate? And should the same discount rate be used for evaluating PPPs and traditional procurement? Jomo *et al*. (2016) confirmed that discounting PPP costs at a higher discount rate renders a lower, more attractive net present equivalent, and thus may bring a disproportionate advantage to the PPP option. Another argument concerned the balance of risk allocation between the two main contractual parties (Jin and Zhang, 2011). There are cases where undue risks have bankrupted the PPP provider. For example, Ng and Loosemore (2007) reported that Airport Link Company, the private consortium of the $920 million New Southern Railway project in Sydney,

Australia entered into receivership due to the project's controversial risk allocation. In addition, with a contract valid up to 30 years, an exhaustive and accurate prediction of risks and their valuation is a persistent challenge (Kumar *et al*., 2018). More importantly, Grimsey and Lewis (2005) argued that V*f*M assessment relies heavily on a hypothetical cost construction of a public delivery, known as the 'public sector comparator' (PSC), which evades an 'apple-to-apple' comparison. Therefore, Opara (2018) commented that V*f*M assessment is compromised as a bureaucratic tool to legitimate a pre-conceived mindset, i.e., that PPPs are better. Examples have been seen worldwide (including those in the UK, the EU, Australia and the US) that PPPs have, retrospectively, been shown to be more expensive than estimates of the same delivery using a traditional method (Hodge and Greve, 2007; Leigland, 2018). If headway is to be made against these problems, after decades of PPP development, it is necessary to conduct a comparative study of global markets to extract best practices.

### 4.3 Institutional Characteristics Underpinning the Assessment

Chapter 2 has explained why the UK, Australia and China were selected for the comparison. Their institutional and methodological 'contexts' are framed into the social, economic and political conditions (Table 4.1), and qualitative and quantitative V*f*M assessments, respectively. This explorative perspective has shown that: (1) some institutional barriers need to be removed before PPPs' adoption; (2) PPPs are an approach of the incumbent government to delivering their promises to their people; (3) The use of private investment in infrastructure is a way to stimulate economy; (4) The social, political and economic backgrounds divert PPPs to different application fields (e.g. social or economic infrastructure); and (5) V*f*M assessment becomes an

instrument to legitimate PPPs and is necessary to monitor whether the best V*f*M is delivered.

Table 4.1. Institutional characteristics of V*f*M assessment

| | The social | The economic | The political (governance) |
|---|---|---|---|
| The UK | 1) High unemployment rate; hight interest rate; housing crisis; 2) Demand for quality NHS and education; 3) Under-investment in infrastructure; 4) Protection for staff; 5) Ongoing need for better public services, opportunity and security. | 1) The early 1990s recession; 2) Fiscal responsibility and government guarantee; 3) 60% PFI are on the balance sheet; 4) The 2008 financial crisis and tighter regulations on banks | 1) NPM, retirement of the 'Ryrie rules' and the 1992 general election; 2) the 1997 general election; 3) Using PFI to meet the investment challenge in 2003; 4) Using PFI to strengthen long-term partnership; 5) Introducing equity finance and transparency |
| Australia | 1) Population size; 2) Expectation for excellence in public service provision; 3) Reluctancy to more tax | 1) High public debt; 2) The longest sustained increase in commodity prices and the terms of trade but generally healthy* | 1) NPM; 2) Federal government; 3) Reform of Australian Public Service |
| China | 1) Population aging; 2) Poverty; 3) Environmental issues | 1) Economic downward pressure; 2) Insufficient domestic demand | 1) New administration; 2) Law modifications (e.g., long-term budget plans and taxation) |

* Source from Gerard and Kearns (2011), The Australian Economy in the 2000s.

### 4.3.1 The UK Context

The shift to 'new public management (NPM)' (see Hood, 1991 for details regarding NPM), and the departure from the 'Ryrie rules[18]' cleared the institutional barriers to

[18] According to the 'Ryrie rules', private finance could only be used if there were no favourable risk terms, such as a government guarantee; that projects must yield benefits in terms of improved efficiency and profit commensurate with the cost of raising risk capital from financial markets; and

PFI in 1992. Before this time, according to House of Commons (2011), Ryrie rules had implied that if private finance can provide V*f*M then the public way of procurement can provide more V*f*M. Retirement of these rules was followed by the 1992 general election of a Conservative government to tackle with deepened recession, high unemployment rate, high interest rate, high public borrowing, housing and construction crisis that had put pressure on taxpayers. This context made the recourse to private finance official as the then Exchequer Norman Lamont tried to maximise capital spending to the society. That is, money contributed by the private sector would not be accounted in public spending, which was considered by many commentators as the main driver (i.e., off the balance sheet) to PFI rather than V*f*M. This private investment momentum was further evidenced by the UK Parliament (1998), documenting "when the private sector is wholly responsible for a project needing Government approval, and can recoup costs through charges at the point of use, it is no longer necessary to compare the project with a notional public sector alternative".

The take-off of PFI was ignited by the 1997 Labour government. In order to improve public services in National Health Service (NHS), school and fiscal responsibility, 34 PFI hospitals with an estimated cost of £21.76 billion were commissioned between 1997 and 2003. As the healthcare and education sectors were not prone to user charges, the priority of transferring risks to the private sector in 1992 changed to government guarantees during this period. Alongside the government guarantees was the debate on whether PFI could actually save money, which led to the introduction of the first V*f*M assessment guideline (i.e., PSC) by the Private Finance Treasury Taskforce in

that use of private finance could not be additional to public finance (Heald and McLeod, 2002, p. 402). Available at: http://www.davidheald.com/publications/stair-publicexpenditure.pdf.

1999. Following the debate about PFI's failure to deliver high-quality public services to taxpayers and their importance in promoting opportunity and security for the citizens, V*f*M became the criterion to justify PFI in 2003, as opposed to the previous 'off the balance sheet' motivation. The number of PFI projects then remained stable (around 60 every year) in the UK until the 2008 financial crisis stoke tighter regulations on banks. Although PF2 was initiated in 2012 to introduce equity finance and address the transparency issue, its use was substantially reduced. In 2018, only one PF2 project, the Arc21 Residual Waster Infrastructure Procurement, reached financial close at which time PFI and PF2 were deemed inflexible and complex.

### 4.3.2 Australian Context

The popularity of NPM also relaxed the partnership between the Australian government and the private sector. However, its federal parliamentary system sets the difference from the UK. For example, compared with the central governance (i.e., IPA) in the UK, it was the establishment of 'Partnerships Victoria' within the Victoria State Government in 2000 that marked the formal adoption of PPPs (see English and Guthrie, 2003 for detailed pre-2000 private finance in Australia). Other state-level PPP units, such as 'Projects Queensland' (now Queensland Treasury's Commercial Group) and 'New South Wales (NSW) PPPs' (now the Infrastructure and Structured Finance Unit), followed suit. They are responsible for the procurement of PPPs in each jurisdiction and apply state-specific guidelines where the National PPP Policy and Guidelines (NPPG) allow. At the federal level, the Council of Australian Governments monitors, reviews, and refines the NPPG with the assistance of its 'holder', Infrastructure Australia. Table 4.2 shows the relevant guidelines alongside the uptake of PPPs by each unitary player (the three major states and Infrastructure Australia).

Socially, as of 2020, the population of NSW, Victoria and Queensland account for 77.85% of total Australian population and the highest population growth, which may account for the predominance of PPP projects in these states. Specifically, roads, water and sewerage, energy and rail PPPs play a significant role in delivering the quality public services to the society. Other socio-economic-political factors that prompted PPPs, include Australian government's predisposition to NPM agenda, citizens' reluctancy to more tax, and the need to reduce public debt. As the government is reforming its Australian Public Service (Australian Government, 2019), PPPs continue to breathe and grow even amid the COVID-19. Cases can be seen in the Sydney Metro City & Southwest OTS2 PPP, the Footscray Hospital PPP, the Inland Rail PPP in NSW, Victoria and Queensland, respectively.

Table 4.2. Federal and state guidelines on PPPs in Australia

| Unit | Guidelines | Document year | Number of projects/ Project value after 2000* |
|---|---|---|---|
| Infrastructure Australia | National PPP Policy and Guidelines which contain: (1) National PPP Policy Framework; (2) National PPP Guidelines Overview; (3) Volumes 1-7 on detailed technical instructions; (4) Roadmap for Applying the Commercial Principles | 2008: Original release;<br>2015: Revised version | 90/ ≈$109.13 billion |
| Partnerships Victoria | Partnerships Victoria Requirements | 2009: Original release;<br>2010: Update on PSC;<br>2013: Revised version;<br>2016: Revised version | 24/ ≈$29 billion |
| Queensland Treasury's | Queensland public private partnership supporting guidelines | 2015 | 11/ ≈$24 billion |

| | | | |
|---|---|---|---|
| Commercial Group | | | |
| NSW Infrastructure and Structured Finance Unit | NSW Public Private Partnership Guidelines | 2012: Original release; 2017: Revised version | 26/ ≈$38 billion |

* Source from Infrastructure Partnerships Australia in July 2021.

### 4.3.3 China Context

In China, the populating aging, eliminating extreme poverty for 100 million people, urbanisation, environmental worries, the economic downward pressure and the insufficient domestic demand urgently require infrastructure stimulus. This contextual backdrop also coincides with the surging number of PPPs in the area of urban and city development, the elderly care, environmental protection, and social housing. The first BOT project (i.e., Shajiao B power plant) in Shenzhen, China can be traced back to 1984 with foreign direct investment. However, the central government's enthusiasm for private finance in 2014 (see Cheng *et al*. 2016 for macroeconomic environment and policies that shaped PPPs in China pre-2014) casted a watershed in PPPs. This was attributed to the newly elected administration declaring, in 2013, the decisive role of market in resource allocation and allowing the private sector to invest in infrastructure.

The milestone policy by the Ministry of Finance (MoF) (2014) then considered PPPs as a way of transforming economy, support urbanisation, converting the role of government in public service, and reforming the finance and taxation system. So far[19], China's PPPs centre has recorded some 10,231 PPP projects (over £1.6 trillion) across

[19] Data were sourced from https://www.cpppc.org:8082/inforpublic/homepage.html#/projectPublic in May 2022.

China led by the municipal sector, transport, environment, and urban and city development. One significant characteristic embedded with this rapid uptake is the involvement of state-owned enterprises (SOEs) [20] due to their ample resources and extensive political and financial access (Xiong *et al*., 2021b). In addition, dozens of laws, regulations and policies have been administered mainly by its national-level Standing Committee of the National People's Congress, State Council, MoF, National Development and Reform Commission to promote, regulate and stabilise PPPs. Nevertheless, PPPs in China are more related to financing, as can be seen in its introduction of REITs into infrastructure in 2020. This finance orientation, however, has been warned by its MoF perception against excessive invisible public deficit that may result. Surprisingly, this phenomenon resembles the UK as both governments need to repay the projects that last decades.

## 4.4 Methodological Perspectives

### 4.4.1 What does Value for Money Mean in their Contexts?

As the pioneer of PPPs, the UK has been grappling longest with their assessment. Specifically, the UK has replaced the PSC model developed in 1999 with a three-level (programme level, project level, and procurement level) assessment in 2004 and 2006, withdrawn the quantitative assessment in 2012, and re-invigorated PSC in 2020 (HM Treasury, 2020b). In contrast, Australia maintains its 2008 version while China updated its 2015-practice in 2016. In addition to the UK's definition of V*f*M within these documents (i.e., 'the optimum combination of whole-of-life costs and quality (or fitness for purpose) of the goods or service to meet the user's requirement'), Australia

[20] The role of SOEs is also detected in Queensland and NSW, Australia (Queensland Government, 2015; The NSW Treasury, 2017). In Queensland, the application of the PPP policy is not mandatory for Government Owned Corporations, indicating an exempt from V*f*M assessment.

specifies 'V*f*M is a combination of the service outcome to be delivered by the private sector, together with the degree of risk transfer and financial implications for government.' Although China does not have an explicit V*f*M definition, its MoF (2014) emphasises the improvement of service quality and operation efficiency, or reduced project cost over the project lifecycle.

It should be noted that here V*f*M is considered in the context of a comparison between PPPs and the traditional procurement method. Other forms of procurement may fall into a wider evaluation. For example, Australia enacts a 'procurement options analysis' that can evaluate PPPs against construct-only, design and construct, alliance contracting, etc. in areas such as objectives, policy context, agency capability, and market. For PPPs to qualify as a potential V*f*M alternative, each country has a shortlisting mechanism, shown in Table 4.3. Despite the $50 million restriction in Australia, small projects that present measurable risk transfer, whole-of-life costing, innovation, measurable outputs, asset utilisation, better integration, and competitive process may also qualify for PPPs. Compared with the conditions required in the UK, in Australia and China projects with certain characteristics (Table 4.3) can be identified. If the listed thresholds are met, a V*f*M assessment is then undertaken between PPPs and the traditional procurement approach.

Table 4.3. Projects that may be suitable for PPPs

| Countries | Conditions |
|---|---|
| UK | Non-IT/ICT projects*; Capital investment over £20 million |
| Australia | Capital investment over $50 million (≈£27.5 million) |
| China | Projects characterised with flexible price adjustment, high degree of market openness, high capital expenditure and stable demand. |

* According to Whitfield (2007), 105 ICT projects experienced major cost overruns (an average of 30.5%), delays and terminations.

### 4.4.2 When does Value for Money Assessment Take Place?

The UK's three-stage V*f*M assessment takes place during the annual budgeting round, outline business case (OBC), and post-OBC to financial close, respectively. In the latest *Green Book* (HM Treasury, 2020b), these stages have been restructured as the longlist and shortlist appraisal stages. Australia and China conduct assessments after the investment decision is made and before the request for proposal is launched. In addition, China requires a mid-term assessment (3~5 years after the project is in operation) to check if the initial V*f*M is attained. There are also differences in the order of quantitative assessment (i.e., PSC) and qualitative assessment. Australia and China proceed with the quantitative assessment followed by a qualitative assessment. This emphasises the importance of the qualitative assessment, particularly when the PSC is close to the bidders' lowest price. The UK, however, has shifted from an identical practice to the opposite procedure, where critical success factors and other qualitative issues are assessed first, followed by a PSC calculation. A potential problem of this approach concerned by Coulson (2008) could be that the earlier qualitative assessment is not well interpreted. It also repeats the suitability test that is used to preliminarily screen projects that may be amenable to PPPs. This is exacerbated by the evidence that UK's PSC guidance is biased towards PPPs (Pollock *et al*., 2007). Similarly, China originally used a qualitative assessment certified by a group of experts, with the quantitative assessment being at the discretion of responsible agencies. The transformation to its current practice may again corroborate Coulson's (2008) concerns about qualitative V*f*M. The implication is that the UK should perhaps consider the general processes prevailing in Australia and China and thus avoid unnecessary repetition.

### 4.4.3 How is Value for Money Assessed?

#### *4.4.3.1 Quantitative value for money*

PSC represents the hypothetical cost of a traditional procurement approach which in turn exposes the cost difference between that and a PPP in order to demonstrate V*f*M. Currently, the components of PSC are not detailed in UK's *Green Book* 2020. Drawing on relevant literature and practices in Australia and China, a PSC can be said to comprise: (1) a 'raw' PSC (i.e., the construction and operation costs associated with delivering the output specifications over a period), (2) competitive neutrality, (3) transferred risk; and (4) retained risk. This benchmarking cost can be revisited when consulting private sectors to illuminate potential market capability before the formal tendering. In Australia, it is then compared against the PPP bidders' price to quantify V*f*M. In China, a PPP value, which incorporates the cost the government is required to bear in the PPP scenario, is calculated. As it is undertaken at the pre-tender stage, this PPP value is akin to a shadow bid value (Grimsey and Lewis, 2005, p.353). In addition to the PSC comparison against a PPP, an additional comparison between the value of a PPP version of 'do the minimum' and a normal PPP is required in the UK. Furthermore, the comparison can be widened to include 'Business as Usual', 'do the minimum option', 'PPP', and any other viable alternatives if no outsourcing or insourcing change exists. This results in a cost-benefit analysis similar to the approach taken at investment decision stage.

The importance of selecting a discount rate which underpins the net present value calculation is recognised. China proposes a discount rate based on local governments' bond yields (e.g., a road project procured in 2019 in Fujian province used 4.08%) for both the PSC and PPP. It also requires that, if there are multiple discount rates

available, the minimum discount rate should be used. This could be an attempt to avoid the debate that a higher discount rate underestimates the value of a PPP. The use of a single discount rate also reveals the lack of a sensitivity analysis (which is common in the UK and Australia) to trial the impact of different discount rates on decision-making. Regarding Australia's social infrastructure, the PPP side discount rate is adjusted to reward the private sector for assuming the transferred risks. For example, a risk premium is added to the risk-free discount rate based on the percentage of risk sharing. Although this practice has its roots in the capital asset model, the presumption that governments can really transfer risks to the private sector can be disputed (Pollock and Price, 2004). For its economic infrastructure, the project rate and risk-free rate are used in a PSC and a PPP, respectively. In the UK, a 'social time preference rate' of 3.5% is applied for all possible options at the shortlist stage. It shows the government prefers the present society to the future, which in turn fits the institutional characteristic that the UK's PFI is finance-oriented. This is reflected in the £199 billion that the UK government has to pay for existing PFI projects until the 2040s (NAO, 2018).

To enable better risk management, all three countries uniformly price risks that governments are exposed to in PSC. In the process, risks are identified, and their probabilities and impacts are combined. Point estimate and Monte Carlo simulation are recommended as techniques for risk quantification in the UK and Australia. The UK additionally suggests decision trees and real options for a follow-up decision as the project progresses. Instead of instructing these techniques, China promotes the use of scenario analysis (in cases where the impacts of risks can be measured but not their probabilities); a percentage method (when both impacts and probability are hard to estimate); and the 'probability × impact' method (when both can be calculated). Risk

valuation is ultimately split into retained risks and transferred risks to prepare for the risk sharing that exists in PPPs. In order to avoid the illusion that a large project can be created with a small amount of investment, the UK has included an 'optimism bias' adjustment based on experience of public-funded infrastructure. However, it is not clear how the 'optimism bias' is addressed in PPPs. For example, can a lower 'optimism bias' percentage be applied to a PPP bid since private sectors are considered to have greater expertise? Moreover, empirical data reveal that change of 'scope' and 'client requirement' can lead to project cost inflation (Love *et al*., 2019). Similarly, transaction costs, which can be as high as 20% of the capital investment in PPPs are not clearly addressed. Such omissions can sow the seeds for an overestimation of a PSC and an underestimation of a PPP.

#### *4.4.3.2 Qualitative value for money*

In light of the extensive criticism of the UK's PSC practice (e.g., Shaoul, 2005 and Pollock *et al*., 2007), the quantitative assessment became dormant in 2012. As previously mentioned, despite the resurgence of PSC in 2020, its components and how it is operated are elusive. However, a new form of qualitative assessment at the longlist stage asks 'how well the option optimises social, economic and environmental values in terms of the potential costs, benefits and risks'. Table 4.4 outlines the qualitative factors that are considered in each of the three countries.

Table 4.4 Qualitative V*f*M factors

| Countries | Timing | Factors |
|---|---|---|
| UK | Before quantitative assessment | Measurable objectives and outputs; risk allocation and management; operational flexibility; equity, efficiency and accountability; innovation; contract duration and residual value; incentives and monitoring; The Market; timescale; skills and resources. |

| | | |
|---|---|---|
| Australia | In conjunction with or after quantitative assessment | Service delivery and operational requirements; interface/relationship and project management; design considerations. |
| China | After quantitative assessment | Life-cycle integration; risk identification and allocation; performance and innovation; competitiveness; governments' capabilities; financeability; asset correlation in the bundled contract. |

Spackman (2002) and Sun *et al*. (2021) argued that financial constraint skews the ideology to PPP forms of procurement in the UK and China. Consequently, a large number of projects are made possible by leveraging up limited budgets to meet immediate infrastructure demands. The concomitant risk is an uplifting public debt level and the long-term V*f*M in jeopardy (Ball *et al*., 2001). In practice, a red flag was waved by China's State-owned Assets Supervision and Administration Commission (2021) regarding local SOEs' debt risk. The UK and Australia have a similar affordability analysis to avoid using PPPs simply as a way of the 'off-balance sheet' funding. Currently, this affordability is set at around 10-15% of total investment in public services. However, in Australia's qualitative assessment, *service* is emphasised through combined consideration of project management and prescient design inclusion. The ensuing result is its better performance at least in terms of cost and time (Raisbeck *et al*., 2010). In summary, the qualitative assessment employed by each of the three governments reflects their policy orientation in a specific spectrum, but each is subjected to methodological weaknesses.

The emphasis on 'service' does not make the qualitative assessment in Australia faultless. Compared with the UK and China, not only is the number of factors considered confined but also is its assessment unclear. In the UK, a series of simple questions (see Table 4.4) have to be answered by the procuring team to pass the

evaluation. By contrast, China implements a relatively robust qualitative assessment. An even number (more than nine) of experts in the fields of finance, accounting, regional development, construction, etc. are summoned to rate the weighting and score of each factor using criteria set by the local PPP unit. A total weighting of 20% is assigned to the 'supplementary factors' that are not listed in Table 4.4 to accommodate the project characteristics. The cut-off between 'fail' and 'pass' is 60. However, a weighted average of over 80 can waive the need for a PSC, instigating pressure on the panel's independence and professionalism. Issues that are common to all three countries are that: (1) factors are appraised purely against the PPP option (and not against its traditional procurement alternative); and (2) the criteria are generic and not sector-sensitive. For qualitative issues to play their part in V*f*M calculations there should be a carefully considered and rigorously designed qualitative assessment to minimise bias and subjectivity.

### 4.4.4 Summary of the Methodological Comparison

The UK and China converge on the financial stimulus that drives the use of PPPs while Australia is service-oriented. Contrary to the stereotype, China is shown to be exerting the power of the market on PPP infrastructure delivery. In terms of the concept of V*f*M, the UK focuses on quality and whole-of-life cost while Australia seeks service, risk transfer and cost, and China prioritises cost, service quality and operational efficiency. As a consequence, PSC serves as a reliable tool in Australia and China for comparing the net present value of two options. The record of PSC in the UK is a recurring theme of adoption, replacement, withdrawal and re-adoption. Yet, the current version remains vague on its components and how it operates.

Other issues such as 'optimism bias' and transaction costs are touched upon but are not clearly estimated especially in the case of the evaluation of PPPs. In light of the potential manipulation of PSC, the spotlight has shifted to qualitative assessment. Both Australia and China conduct such assessment after the PSC comparison, while the UK undertakes the opposite. The concrete steps take the form of questions in the UK and a weighted average in China capitalising on experts' experiences. Australia, on the other hand, proposes a few qualitative factors without providing 'how'. The comparison further reveals that in spite of the 'weaknesses', China has a direct and simple way on both types of assessment whilst the UK is enigmatic on PSC and Australia falls short on qualitative assessment.

### 4.5 The Option Framework

The UK has been confronted with the controversial use of PFI in that sometimes services are compromised (Ahmad *et al*., 2021), costs more expensive (40%) (NAO, 2018), and best V*f*M not achieved (Heald, 2003). The institutional characteristics and V*f*M assessment have provided an understanding of why this is the case by comparing the UK with Australia and China. It further corroborates the inherent political nature of PPPs as argued by Hodge and Greve (2017). However, even when the institutional barriers are removed to advocate PPPs, the comparison identifies that: (1) V*f*M is increasingly lauded to rationalise PPPs in the scheme of things; and (2) lessons can be learnt from the global markets to improve the V*f*M assessment. Since governments will be held ultimately accountable for public expenditure (Wu *et al*., 2016), a robust V*f*M assessment is required to defend the move to PPPs. In Figure 4.1, therefore, an option framework for V*f*M assessment is proposed as the catalyst for action albeit its conceptual nature. Its aim is to stimulate an enhanced practice and to accommodate

the institutional characteristics because a 'one-solution-fits-all' approach may not work for all jurisdictions. Notably, this framework is designed in the UK context, but can be adapted to fit other national settings.

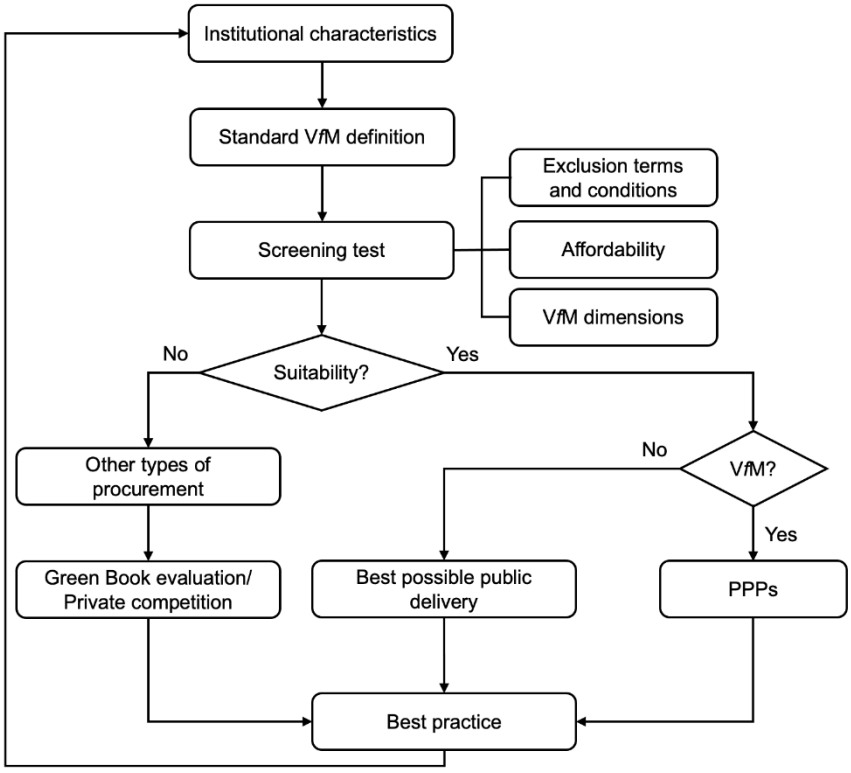



Figure 4.1. An option framework for V*f*M assessment

In the face of what Pollock *et al*. (2002) called the 'sleight of hand' in justifying PPPs, a government-wide definition of V*f*M which integrates government-side considerations (e.g., cost savings) and taxpayer-side benefits is urgently needed (details of this definition can be found in Chapter 5). This compound definition is supported by the global market's consensus that cost is not the sole determinant of V*f*M. The emergent prototype (i.e., a standard V*f*M definition) then sets the tone for V*f*M assessment and particularly how qualitative assessment is employed (a concrete model is provided in Chapter 5). The implications are that quantitative assessment and qualitative assessment (which often uses a quantitative scoring system) are

complementary and together yield a solid decision. The importance of the qualitative assessment becomes more relevant as Vickerman (2021) argues that COVID-19 has made the prevailing competitive model (i.e., low costs as in the quantitative assessment) infeasible. In fact, Butcher (2018) has suggested a transition from 'on the market' to 'on the track' competition (i.e., performance measurement as in the qualitative assessment) to sustain the UK's rail system.

To address the problem of process repetition identified in the UK, a screening test is proposed prior to the V*f*M assessment. In it, the affordability analysis is similar to existing examples, but the 'exclusion terms and conditions' will shortlist projects for sector-specific V*f*M dimensions check. By doing so, this initial test appraises all available options rather than the previous PPP-only qualitative assessment, and includes the currently absent but important sector-specific circumstances (Roe and Craig, 2004). The necessity of this is emphasised by the fiasco of ICT contracts revealed by Whitfield (2007), which demonstrates that PPPs are not suitable for all areas. If PPPs are potentially suitable, they will be compared against the best possible public delivery, which would otherwise be the V*f*M option. In addition to the normal *Green Book* evaluation (e.g., 'Business as Usual' and 'do the minimum option'), a *private competition* (as opposed to PSC) is added to ensure the best practice is selected from other types of procurement (e.g., design-build and alliancing). The rationale of competition in both sides lies in the fact that if PSC is there to demonstrate the V*f*M of PPPs, a 'private sector comparator' should be formed to stimulate the public sector (Burger and Hawkesworth, 2011). This 'public-private' and 'private-public' competition is important as it can compensate for the limited competition between bidders. This arises, according to OECD (2014), from the limited tender participation

due to the complexity of PPPs, leading to potential monopoly and thus the sacrifice of V*f*M. Therefore, the result (best practice) generated from the rigorous screening and suitability test will be able to deliver V*f*M and in turn justify the institutional characteristics that originally underlie the V*f*M assessment. Equally, as the framework is fixed and consistent, concerns raised by Shaoul *et al*. (2010) and NAO (2018) over the previous obscure process can be mitigated to encourage transparency.

## 4.6 Chapter Summary

This chapter has fulfilled Objective I of this thesis by answering the sub-question '*what is the status quo of VfM assessment*?'. Given the significant role infrastructure plays (including recovering from COVID-19) and the lack of detailed V*f*M assessment in the UK, this chapter extracted the best practice to safeguard the public purse when it prepares for future forms of PPP. Specifically, the UK, Australia and China were selected to make sense of the way V*f*M assessment is underpinned by their individual institutional characteristics. The understanding of the institutional characteristics and V*f*M assessment then provided a foundation for the option framework to be developed. With this option framework, the next chapter aims to introduce a sector-specific V*f*M concept and develops a new V*f*M model in detail.

# CHAPTER 5 DEVELOPING A FRAMEWORK FOR ASSESSING TRANSPORT VALUE FOR MONEY

## 5.1 Chapter Introduction

Considering the points of departure (i.e., consistent ways of defining V*f*M and advancements in V*f*M assessment techniques) identified in Chapter 3 and the option framework proposed in Chapter 4, Chapter 5 aims to address the second objective of this thesis (i.e., proposing a new V*f*M concept based on value and stakeholder theories, and developing a comprehensive framework for assessing V*f*M). It begins with an examination of *theories of value* and *stakeholder theory* to explore whether there is a theoretical lens that can prescribe what should be considered in V*f*M assessment. The outputs of such an inquiry are a conceptual framework for V*f*M assessment of transport infrastructure projects and a life-cycle V*f*M assessment process that together form a V*f*M assessment model to be validated.

## 5.2 Setting the Scene

As mentioned in Chapter 4, HM Treasury's (2006) definition of V*f*M as 'the optimum combination of whole-of-life costs and quality (or fitness for purpose) of the good or service to meet the user's requirement' is widely recognised. This, perhaps, can be traced down to the traditional value engineering (Palmer *et al*., 1996), in which V*f*M is considered to be an integration of cost and function. Similarly, through a longitudinal analysis of the UK's PFI projects, Broadbent and Laughlin (2004) have argued that V*f*M in essence should be about whether improved public service can be derived. Nevertheless, it is possible that the commonly-applied term 'fitness for purpose' creates room for 'interpretation' and does nothing to counter the criticisms

that existing V*f*M assessment is biased and skewed (see, for example, Coulson, 2008; Reeves, 2013; and Opara, 2018). A good example is that public-sector clients worldwide rely heavily, if not wholly, on the lowest-price bidder for transport infrastructure projects. For example, results from 305 US design-build highway projects showed that 80% of them were awarded to the lowest bidder (Calahorra-Jimenez *et al*., 2020). In Europe, Bovis (2008) revealed that transport public services were operated by suppliers require the lowest compensation in PPPs.

Evidently, this reality is in contrast to HM Treasury's (2006) appeal for not equating V*f*M to the lowest cost bid. According to McKevitt (2015) and Calahorra-Jimenez *et al.* (2020), this occurs due to a lack of what constitutes V*f*M, and in particular, an understanding of what taxpayers perceive as a V*f*M transport service. Similarly, Wang *et al*. (2017) have explained that the challenge in defining V*f*M resides with stakeholders' different perceptions of project success. However, V*f*M assessment is carried out by public clients who are obliged to ensure that public spending is economical, effective and efficient (Grimsey and Lewis, 2005). Therefore, it is important to investigate whether 'money' is an accurate proxy to 'value', and what can be done to ensure V*f*M prevails. Such a scene now provides a foundation for deriving implications from the fundamental theories of value and stakeholder theory (an explanation of how and why these were used can be found in Section 2.4.2.3 in Chapter 2) to clear the conceptual ambiguity of V*f*M, for which was called by McKevitt (2015).

## 5.3 Theories of Value

In the *Oxford Handbook of Value Theory* (Hirose and Olson, 2015), value theory is said to be across the philosophical and economic disciplines. Its traditional philosophical strand, echoed by Schroeder (2021), involved evaluating what makes a thing to be good or bad. Taylor (1996) illustrated value theory's extension to economics by connecting 'value' with 'profits', and asking the question 'where do they come from?'. Recognising value theory is at the intersection between philosophy and economics, which both have several directions to explaining value, the term 'theories of value' was chosen to cover a wide range of discussions below on V*f*M.

### 5.3.1 The Philosophical Discipline and Value for Money

In philosophy, value has been studied with respect to normativity (Zimmerman, 2015), intrinsicality (Rønnow-Rasmussen, 2015), desires (Oddie, 2015), emotions (Tappolet, 2015), relativity (Cullity, 2015; Bykvist, 2015), and hedonism (Heathwood, 2015; Tiberius, 2015), among others. At this juncture, it needs to be pointed out that this section is not going to examine all the issues value has with philosophy, which have in many ways been already extensively researched. Rather, it discusses their main views and how they may shape the understanding of V*f*M.

The focus of value and normativity is on whether 'good' (i.e., value) can be accounted in terms of 'right' (i.e., normativity) or the other way round. Since the discussion on 'right' is not within the scope here, the consequentialists' view (e.g., Moore, 1903) that the right is asserted as a result of better or less evil outcomes is not elaborated. By contrast, the fitting-attitude analysis attempts to define 'good' as 'fitting object of a pro attitude'. In Ewing's (1948) discourse, 'fitting' is synonymous with 'right' (e.g.,

duty and obligation). That is, if there are positive attitudes towards something and it is right to do so, then that 'something' is valuable. In the case of emergence of PFI in 1992, the original attitude was that PFI could enable more investment to provide services (UK Parliament, 2008). Hence, given the sheer number of projects that have been made possible via PFI, it matches the original purpose. This 'rightful' conduct, according to the fitting-attitude analysis, justifies V*f*M, and is in line with the 'fitness for purpose' element in the UK's definition of V*f*M. Simultaneously, this account of value by virtue of normativity would accept that value is tantamount to money because the only consideration at that time was the investment initiated by PFI. It probably provides a foundation for the enduring existence of cost in V*f*M assessment (even in the future).

The intrinsic and extrinsic value divides on what is valuable (or not valuable) for its own sake. Intuitively, PPPs are considered to cost less than their traditional counterparts due to the participation of the intellectual private sector. This presents, on face value, intrinsic value of PPPs to the public sector. However, when cost mis-performance occurs, it becomes a means for the private sector to make more money in addition to their already affluent profits (i.e., the extrinsic value). In this stance, 'the isolation test' proposed by Moore (1903) would reject the use of cost reduction to intrinsically justify V*f*M of PPPs. This is because if PPPs stand in absolute isolation, PPPs cannot always demonstrate a profile of 'cost goodness'. At best, PPPs assume some sort of extrinsic value (for the private sector) under such circumstances as just mentioned, which however, opposes the interests of project clients (not to mention the taxpayers' interests). Notwithstanding, PPP projects (e.g., transport assets), once delivered, can at least withstand to some extent the blast of floods, or alleviate road

congestion, reduce carbon emissions, and enable more people to access public transportation. Such attributes can exist even if PPPs exist alone (without the intervention of others). While the debate on intrinsic and extrinsic value may not be dismissed, this school of value thought shows that cost is not intrinsically reliable to justify PPPs, and more importantly, such aspects as environment and social inclusion can both intrinsically and extrinsically provide rationale of V*f*M to PPPs.

The relationship between value and desires is explained by Oddie (2015) from the distinction between idealism and realism. That is, suppose the procuring authority is an idealist, the value of a specific procurement approach will be dependent on the authority's desire or aversion to that approach. Then, it explains that PPPs have value as the Governments of the UK (e.g., the 1992 Conservative Government and the 1997 Labour Government) in the 1990s desired them. However, that value disappeared when the Governments of the UK (e.g., the 2010 Coalition Government) started to avoid the use of PPPs in the 2010s. The obvious conflict here is PPPs can have value and do not have value at the same time, which highlights the importance of clarifying the subject of value (i.e., who the value is for in V*f*M assessment). Nonetheless, PPPs did successfully make possible a number of infrastructure projects in the 1990s, so the governments' overall desire (i.e., more capital investment to take place) was satisfied. In this stance, despite some particular individuals' aversion to PPPs, their value was widely distributed and recognised. In another scenario, if the procuring authority shares the views of some realists, the value question then will need to be answered by the appropriateness (or rightness) to value or to desire. As such, possibly, the value of PPPs can appear in the form of the desire to use them, and be represented by the fittingness of this desire (i.e., governments have a responsibility to replace outdated

public services with quality ones). In either case, the important lesson is V*f*M assessment may be subject-dependent, and desire, as its representative, should be justified to be accurate.

Seemingly, values are also tied to emotions, and can be treated as evaluative concepts (e.g., admirable and disgusting). Their connection is expressed by Tappolet (2015) as ‘‘something falls under an affective concept if and only if feeling the corresponding emotion is appropriate in response to that thing’’. Here, affective concepts are considered to be inherently evaluative. That is to say, it can be justifiable to determine the value of a procurement approach if it is appropriate to have a positive or negative feeling about it. In this sense, this is similar to the fitting-attitude analysis of the relationship between value and normativity. However, the public sector should be cautioned as not all affective concepts may be closely related to emotions. Put plainly, the decision to select a particular procurement method can be challenged if it is based purely on emotions. The procuring agents need to be able to consider non-emotion related aspects, or spell out how they relate the decisions and their emotions (if they are able to).

The relativity of value is discussed in terms of subjects (or valuers) and time. The former is akin to part of the discussion on the relationship between value and desire as mentioned earlier. In this category, value exists in the name of the bearer as is the case with different governments’ varying attitudes towards PPPs. Akin to this, a balanced view is that value judgement is about evaluating what is ‘goodness’ (and what is not) which is termed by Schroeder (2021) as ‘agent-relative value’. Applying this to infrastructure delivery means that what is ‘good’ (e.g., simply a lower cost) for the

government does not mean the decision is sensible as it can still short-change taxpayers if the perceived service falls short of the expected service. This accords with Vining and Boardman's (2014) contention that the self-interest of governments opposes the society. This highlights a principle that value and V*f*M are relative concepts and depend upon who the value is for.

In the time sphere, Bykvist (2015) has posited that good things (i.e., value) have a temporal feature. On this basis, it informs the public sector of a trend the chosen procurement method may display in the future. Note that this procurement method should be perceived as good in the past. However, the public sector has to be made aware of the possibility of this procurement method deviating from this trend due to the temporal matter. In the case of V*f*M assessment, the consideration of time also flags the importance of not double counting the overall benefits of PPPs (or other forms of procurement). On the contrary, what already happened was the overestimate of the corporation tax in PFI (i.e., over discounting a future flow to the current scheme). The UK Parliament (2018) has suggested that often the offshore investors of PFI projects ended up paying a lower tax than the amount that had been counted as a benefit of PFI. Consequently, the public sector needs to pay back more money to the private sector operator over the contract period. This can be linked to hedonism and value, which will be discussed next.

The value and time have created a scene where the pleasure of PFI was established at the expense of future payments. Heathwood (2015) takes this forward and relates the 'pleasure' to 'hedonism' from the perspectives of monists and pluralists, respectively. In some substantive monists' view, the value takes the form of realising what people

want. As a result, PPPs can have value if governments prefer the projects to be delivered through such a scheme. Notably, however, this notion of 'getting what you want' should be rational. Otherwise, the public's payment of around £220 billion for PFI until 2040 (O'Dowd, 2018) can be expected again. To this end, this rational hedonism also sets its difference from pure desires mentioned above. A further response to the approximation of value to pleasure is the substantive pluralists, they hold the view that ''there are an irreducible plurality of basic goods (or bads)'' for us. Put it into context, delivering as many as infrastructure projects (i.e., more capital investment) cannot deterministically justify PPPs. There are, for example, abilities, knowledge, and the awareness of true beauty (Parfit, 1984), and accomplishment, autonomy, understanding, enjoyment, and deep personal relations (Griffin, 1986) that should be captured to represent value. Similarly, cost should not be the sole variable in V*f*M assessment as many other variables can reflect the multiply facets of the procurement approach.

### 5.3.2 The Economic Discipline and Value for Money

The values of commodities, as Marx has highlighted, "must ultimately regulate their market prices and are exclusively determined by the total quantities of labour fixed in them" (explained in Sitton, 2010). This delineates a scenario whereby value, as represented by the working hours of average labour, can be crystalised to an amount of price. Thus, a given value/ price comprises the wages paid to the labour and the profits earned by the capitalist. Although the total amount (i.e., the given value) is fixed, the trade-off is that the more the wages (as costs to the capitalist) are, the less the profits will be and *vice versa*. This *labour theory of value* as explained in Sitton (2010) believes that value is formed in the production process and to some extent

supports the current focus on 'money' and 'cost-savings' in decision making. For example, a transport PPP project is considered to offer V*f*M when its cost is minimised (Verweij and Meerkerk, 2020). However, Taylor's (1996) *marginal theory of value* holds that value arises in the exchange (i.e., demand and supply) process in a marketplace. As evidenced by the fact that price, in most cases, differs from the value produced, this school of thought unequivocally points out that price is affected by multiple factors beyond simple production (i.e., total quantities of labour). For example, demand (e.g., people's varying needs for transport service) can adjust the price associated with the product. Though debates on the dominant forces behind prices representing value are recurrent (Oldak, 1970; Onishi, 2019), Bryer (1994) acknowledges that the consensus is that value plays an important role in governing modern economic activities. As such, economic decisions are made on the ground that value exists and can be pursued. With this tenet in mind and in the face of the above-mentioned 'failure' in existing practices, the question, therefore, leads us to consider what may better explain V*f*M and its assessment so that rational procurement decisions are made.

From the perspective of classical political economists (i.e., *the labour theory of value*), V*f*M is realised if the cost of the project (i.e., government spending) can maintain its service at a get-by level. This is because value is partly conceived-of as the wages paid to the labours so that they can survive at subsistence level (Henry, 2000). This would support the approach to the selection of procurement where the lowest net present value of an option, be it the traditional procurement approach or PPPs (given that both can provide a baseline service), is preferred. However, similar to the general critique, as outlined by Bellofiore (1989), that *the labour theory of value* is not sufficient to

explain a product's long-term price. Thus, the current practice in assessing V*f*M fails to consider a project's lifecycle performance. A case in point is that the UK's PFI projects were said to be cheaper at first sight but experienced cost and time overruns over the long term (Pollock, *et al*., 2007; Bain, 2010). By contrast, in neoclassical economists' view (i.e., *the marginal theory of value*), Kauder (1965) indicated that this kind of price (i.e., cost) should be consistent with the equilibrium price that satisfies both the demand (i.e., taxpayers) and supply (i.e., government) side. That is, end-users' perceived service should equate to the expected service.

Sheth *et al*. (1991) initiated *the consumption theory of value* and asserts, from the perspective of customers (i.e., demand side), that the consumer choice behaviour is a function of multiple consumption values, comprising functional, emotional, social, epistemic and conditional elements. The focus on the impact of a mixture of values on the choice decision making reflects a shift from 'price' to a wider realm. It demonstrates that customers value not only 'affordability' but an improved service (Ravald and Gronroos, 1996). For example, Arvidsson (2009) illustrated that the emerging social production requires that value takes in the form of 'intangible' items, such as knowledge, brand and flexibility rather than just market price. To emphasise the importance of intangibles, Lange *et al*. (2018) estimated that they represent an 'unexplained residual' that accounts for around 70% of global wealth. Despite the fact that governments are not the direct consumer in terms of infrastructure delivery, the implication is that cost should not be the single benchmark when assessing V*f*M and the real customers' value (i.e., taxpayers) should be considered.

Hitherto, the selected infrastructure procurement approach is providing *prima facie* V*f*M when in fact, according to Chan *et al*. (2009) and McQuaid and Scherrer (2010), the driving forces behind value are that PPPs can save cost, keep the associated spending off the balance sheet and thus leverage up the budgetary arrangement. A concomitant of analysing theories of value in the disciplines of philosophy and economics, as shown earlier, provides some principles of V*f*M assessment: (1) although cost can be easily and reasonably factored into V*f*M assessment, it by no means is the mono-determinant of V*f*M; (2) V*f*M is a relative concept, and in the subject domain, it should represent the interests of the government (supplier) and the end-users (consumer) that pay for the service. In the time domain, the assessment should be time-proof; and (3) elements considered in V*f*M assessment should intrinsically be equivalent to V*f*M. For instance, not only the quantitative value but also the socially recognised value can contribute to the final good of the society.

## 5.4 Stakeholder Theory

One of the important provocations of theories of value is V*f*M should be subject-dependent. In a typical PPP structure (see Figure 3.2 in Chapter 3), the contractual parties are the public sector (e.g., government authorised agencies) and the private sector (e.g., contractors, equity investors and operators). However, the conducive non-contractual party (i.e., the general public) is increasingly recognised as a key stakeholder of PPPs (Yuan *et al*., 2019; dos Reis and Gomes, 2022). Essentially, as an elected government, they should represent the interests of the people by delivering what they have promised (Warsen *et al*., 2020). Given the assumption that the procuring authority is the subject of V*f*M assessment (see Chapter 1), this section now, by applying stakeholder theory, evaluates Boardman and Vining's (2012) claim that

governments sometimes neglect the interests of the general public in their approach to PPPs. It then attends to what subjects (i.e., stakeholders) should be considered in V*f*M assessment.

### 5.4.1 What is Stakeholder Theory?

In the seminal book *Strategic Management: A Stakeholder Approach*[21], Freeman (2010, p.49) defined stakeholders as ‘‘those groups who can affect or are affected by the achievement of an organisation’s purpose’’. As the ‘father of stakeholder theory’, Freeman emphasised how this stakeholder concept can help understand organisations’ performance, and how they should set and implement direction. Mainly, Freeman’s (2010, p44) strategic management-based stakeholder theory deals with: (1) the direction or mission of the organization; (2) paths or strategies to achieving such a mission; (3) resource (or budgets) allocations for strategies implementation; (4) strategies control to ensure they are on track; and (5) necessary macro-systems and structures for implementation. Additionally, stakeholder theory has ramified into other disciplines such as finance, accounting, management, marketing, law, health care, and public policy (Freeman *et al*., 2010).

In research, Laplume *et al*. (2008) summarised five themes of stakeholder theory, namely, stakeholder definition and salience, stakeholder actions and responses, firm actions and responses, firm performance, and theory debates. Among them, the Project Management Institute (2021, p.31) seemed to align with Freeman, and defined in its *Standard for Project Management* stakeholders as ‘‘individuals, groups, or

[21] The first version of this book was published in 1984 by Pitman, Boston. This thesis refers to its latest version published in 2010.

organisations that may affect, be affected by, or perceive themselves to be affected by a decision, activity, or outcome of a portfolio, programme, or project.'' However, Phillips (2003) argued that this broad view of stakeholders can be of little value as the inclusive nature merits everyone a stakeholder. Post *et al*. (2002) believed that stakeholders are those that contribute voluntarily or involuntarily to the organisation's wealth-creating capacity and activities. In this sense, stakeholders were narrowed down to the organisation's potential beneficiaries and risk bearers. Despite the contention on the broad/ narrow sense of stakeholder (and perhaps the precise origin of stakeholder concept), the argument about stakeholder theory focused on the creation of value for stakeholders. Clearly, this value here is not dominated by the cost comparison in the current V*f*M assessment. Freeman *et al*. (2010, p.4) provide direct evidence for this, and describe that ''as capitalism became the dominant means of organising value creation and trade, it became clear that restricting attention to its 'economic' effects yields a damaging partial view.''

### 5.4.2 Who are the Stakeholders in Public Private Partnerships?

The legitimacy of stakeholders in PPPs is explained by De Schepper *et al*. (2014) and lies in the contractual relationships or the general public's perceptual relationships (e.g., norms, values, and beliefs). From the public initiator's perspective, they categorised private consortium, users, local community, and investors into normative stakeholders, to whom the organisation has a moral obligation. The remaining subcontractors were grouped into derivative stakeholders, whose actions and claims must be accounted for by managers due to their potential effects upon the organisation and its normative stakeholders. Even from the private sector's perspective, LaFrance

and Lehmann (2005) reinforce the importance of putting people (as a stakeholder) before profits so that corporations' PPPs can be legitimately sustained.

Applying stakeholder theory to the UK's infrastructure provision, McErlane *et al*. (2016) identified the SPV, including financiers, construction contractors, and facilities management contractors, and the public authority to be key stakeholders of PPPs. Although the existence of end-users was not recognised, they briefly mentioned that the authority safeguards the interests of the wider public. In Ireland, end user along with a myriad of government departments and the SPV were considered by Burke and Demirag (2017) to be key stakeholders of road PPPs. By contrast, EI-Gohary (2006) specifically refined stakeholders of transport PPPs to public involvement. Through meetings, workshops, site office, surveys, etc., the general public can express their expectation from the project, and impact the choice between different procurement alternatives.

### 5.4.3 Why is Public Engagement Important in Public Private Partnerships?

The *Standard for Project Management* has listed the aspects stakeholders can affect projects, which can include scope/ requirements, schedule, cost, project team, plans, outcomes, culture, benefits realisation, risk, quality, and success (Project Management Institute, 2021). In PPPs, Osei-Kyei *et al*. (2017) confirmed stakeholder management to be a critical success factor of their operation and advocated the avoidance of neglecting stakeholders' concerns. Specific to public involvement in PPPs, Boyer *et al*. (2016) revealed that such deliberate activities (e.g., in-person and virtual approaches) can win support from both citizens and political leaders for PPPs, and situate project designs with local conditions.

Notwithstanding, it is not uncommon to witness the failure of public engagement in PPPs. This is especially the case in the planning, tendering and contracting phase of highway PPPs where Chen *et al*. (2013) stated the focus is on government-investor relation. However, these highway projects were often boycotted in the operation stage by citizens' resistance to pay for charges and choosing alternative routes. A germane case was the Skye Bridge PPP project in the UK, which was brought back by the government due to continuous public protest (Soomro and Zhang, 2016). In the US and Malaysia alike, EI-Gohary (2006) have recorded the failures of major transport PPPs as a result of public opposition. Notably, such oppositions were not specifically targeted at PPPs as Boyer and Van Slyke (2019) found that citizens' attitude towards PPPs is positive when they feel that the private partner is competent and have trust in the government. That is to say, the complexity associated with PPPs makes it more important for public engagement in that familiarity with PPPs can gain public support.

The general public, in any taxonomy, has been listed as a key stakeholder of PPPs. However, as expected, this important player is often overlooked, i.e., the interests of the general public are sometimes not represented by the governments. That is, the claim of Boardman and Vining (2012) as mentioned at the beginning of Section 5.4 still exists. In accordance with stakeholder theory, it is imperative to take the general public into consideration as a subject of V*f*M assessment. More importantly, juxtaposed with theories of value, they together reject the current practice of V*f*M assessment. On this basis, the following sections explains the general public' V*f*M in a more meaningful framework.

## 5.5 A Value for Money Framework for Transport Infrastructure Projects

The analysis of theories of value has identified that value is generated in the interaction of the supply and demand side. In the case of transport infrastructure projects, the suppliers are represented by the governments, acting as project sponsors/ clients and part of infrastructure delivery partnerships, whereas the role of customers is assumed by project end-users. Moreover, stakeholder theory has corroborated the legitimacy of the general public (i.e., end-users) in V*f*M assessment. Taken together, they have not only re-assured the element of cost in the assessment (but perhaps is not dominant) but also emphasised other dimensions as concerned by the end-users. Against this backdrop, a V*f*M framework consisting of traditional V*f*M and public V*f*M is now proposed.

### 5.5.1 Traditional Value for Money

As mentioned, the theoretical bases reveal that the supply-side value is not flawless. Empirical evidence provided by Edwards *et al*. (2004) and Blanc-Brude *et al*. (2009) endorsed the theories by confirming that governments' existing V*f*M assessment does not guarantee the success of PPP. It is argued in this thesis, however, that their measures for V*f*M (i.e., traditional V*f*M), namely, time, cost and quality (TCQ), are significant and continue to be an ingredient in the newly proposed value concept (Figure 5.1). Support for this view can be found in Locatelli's (2020) rebuttal illustrating that 'megaprojects (e.g., transport infrastructure) that are delivered late and over budget aren't necessarily failures'. This does not mean that 'cost' and 'time' are no longer elements of project success. Rather that they remain important but as part of a wider picture. In other words, it is proffered that it is by means of collaboration between the supply side and the demand side that co-creates V*f*M.

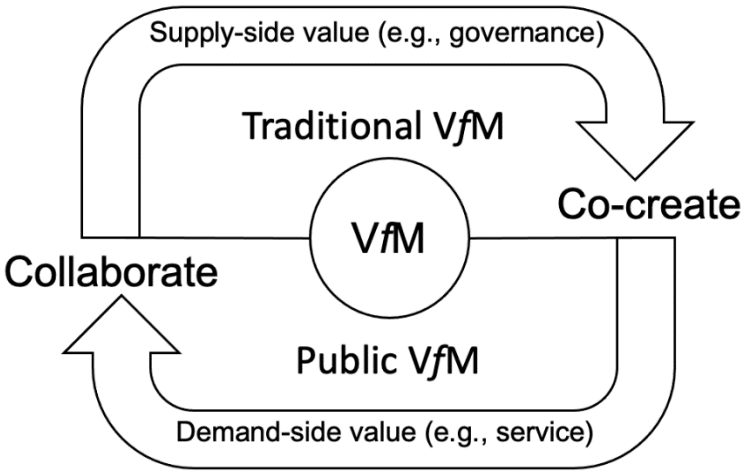



Figure 5.1. The V*f*M concept

Governments are responsible for delivering infrastructure assets and providing public services, such as construction and maintenance of highways, railways and ports. In doing so, they usually outsource parts or all of the work to the private sector to capitalise on its expertise and capabilities (Torres and Pina, 2002). While the role of government may vary in different delivery models, its responsibilities for prudent spending and project success remain. As Burningham and Stankevich (2005) point out, it is patently clear that an unsuccessful project (e.g., poorly maintained roads) represents a waste of resources and does not generate value. This explains the large number of studies that aim to define project success and develop countermeasures to prevent project failures (see, for example, De Wit, 1988; Mcleod *et al*., 2012; Viswanathan *et al*., 2020). However, what constitutes project success and thus, encompasses value is an enduring debate. A growing consensus is that it should be: (1) multi-dimensional (Shenhar *et al*., 1997); and (2) in the context of project, portfolio, and programme (Ika, 2009); and (3) dependent on different stakeholders (Davis, 2017). Hence, the position of the supplier (stakeholder perspective) is adopted to examine the traditional V*f*M (dimension perspective) that materialises over a project's future

lifecycle. It should be noted that the scope of this chapter is not in defining project success, but the value that is associated with projects.

Typically, TCQ, heralded as the 'iron triangle', is adopted to measure project success in the construction sector (Atkinson, 1999). In PPP-related studies, although results differ, time and cost are the most common constructs in measuring performance (i.e., to judge if V*f*M is delivered). Many commentators, including Raisbeck *et al*. (2010) in Australia, have reported that PPPs outperform their public equivalents in both respects and reaffirmed PPPs are an effective route. Ramsey and EI Asmar (2015) also suggested that public clients in the US transport sector can use cost and time as the benchmark to decide the adoption of PPPs. In the UK, Pollock *et al*. (2007) refuted government claims that PPPs improved project performance with regards to time and cost. Assessment of quality, on the other hand, tends to be based upon the prediction and post-inspection of defects of a project (Ma *et al*., 2021). In major transport infrastructure delivery, this preoccupation with non-conformance to standards and requirements has, according to Love *et al*. (2020), impeded the realisation of true benefits and value. Measurable specifications (e.g., quality metrics) have become a convenient (but insufficient) benchmark of PPP performance, representing a retreat to the traditional concept of V*f*M, based simply on TCQ (Doloi, 2012). Although many studies of PPP critical success factors and performance measurement have taken a broader lens, this traditional V*f*M is still most prevalent. For instance, Eadie *et al*. (2013) and Cui *et al*. (2019) confirmed that cost-effectiveness is the most critical factor in manifesting best project value. After decades of research into PPPs, this may still echo insofar as Wettenhall's (2005) point that 'there is nothing new about the mixing

of public-private endeavours'. Quite so, it demonstrates a degree of urgency to complement the traditional V*f*M.

### 5.5.2 Public Value for Money

On the premise that public sectors represent their taxpayers' interests, the literature routinely delves into the relationship between governments and private sectors to ensure PPPs' success. However, it is increasingly recognised that there is a discrepancy between the public sector and the general public (e.g., taxpayers, citizens, community, end-users) in perceiving value (examined in Section 5.4). Hodge and Greve (2010), for example, have identified how, in the context of PPPs, the interests of governments and private sectors are more dominant than those of the public. A conspicuous example is the UK's high speed 2 (HS2) rail project where the government advocates regional economic stimulus whilst the public is protesting against its damage to the environment. The strength of public concern about HS2 is noted by Taylor (2021), who cites an environmental activist: "there are countless people I know who will do what it takes to stop HS2". Accepting, as Crompton (2015) has shown, that public participation does feature in policy decision making and recognising the role of demand-side value in co-creating project V*f*M, public V*f*M, which is supported by 'public' participation in transport, is proposed in the V*f*M framework to form a two-wheel system, as outlined in Figure 5.2. This concurs with Barber (2017), that achieving public V*f*M (i.e., service, environment, distribution, resilience, and social inclusion) requires a shift from inputs to outputs (what will be delivered for transport end-users). It should be pointed out that the five dimensions under the public V*f*M shown in Figure 5.2 are in the context of transport infrastructure, and thus may need to be adapted to be applicable to other contexts. For example,

Historic England (2014), in the field of heritage, emphasises its value in knowledge and sense of identity in addition to economic value. Nevertheless, these five have emerged as the themes that best reflect public (transport) V*f*M based on theories of value, stakeholder theory, and the existing body of literature. Chapter 6 will refine and validate these dimensions based on empirical evidence.

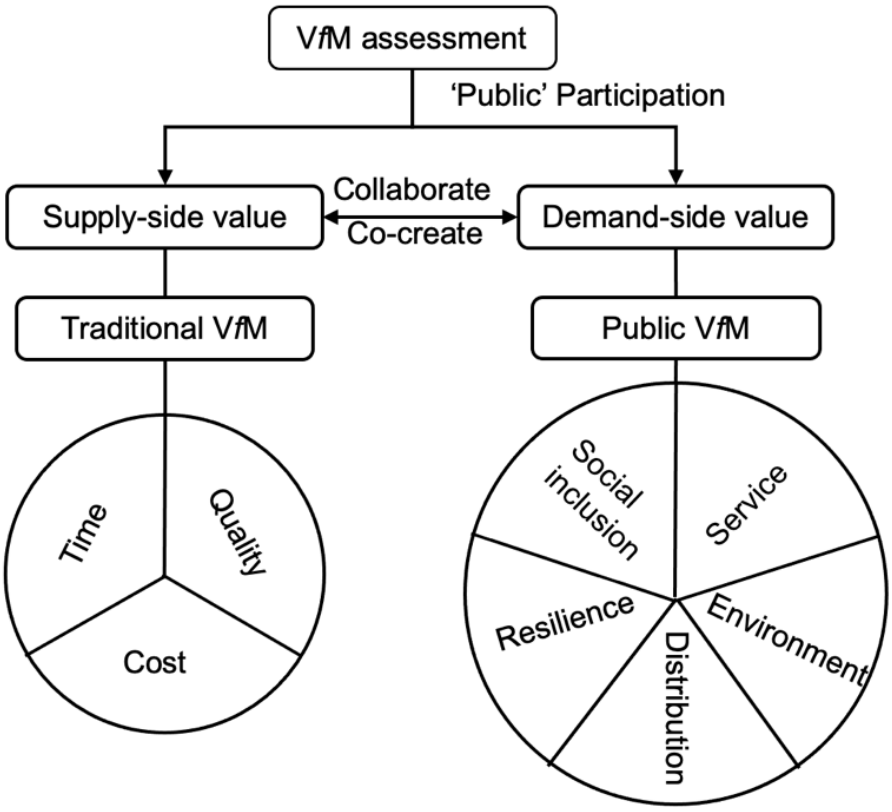



Figure 5.2. The developed V*f*M framework for transport infrastructure projects

*5.5.2.1 Service*

In transport projects, uncertainty of demand risk is recognised to be the critical success factor as low uptake of the service will result in financial unviability, particularly for user-pays mode services (Singh and Kalidindi, 2006; Siemiatycki and Friedman, 2012). Germane examples are Australia's Cross City Tunnel project entering into administration due to the severe demand risk (Johnston and Gudergan, 2007), and

India's Delhi Airport Metro Express, where the passenger uptake was approximately 30,000 per day less than expected (Love *et al*., 2020). In addition to the overoptimistic forecast (i.e., optimism bias) at play (Flyvbjerg, 2007), another point, raised by Burke and Demirag (2015), is the provision of affordable and quality service to its end-users so that the traffic level is at its optimal level. Supporting this is the empirical evidence of Gordon *et al*. (2013), who find that not only the physical quality can enhance transport projects' competitiveness and engender a stable revenue, but also 'soft' services such as staff courtesy and cleanliness. However, Guirao *et al*. (2016) concede that there usually is a gap between the expected service (government perspective) and the actual service (customer perspective). Therefore, by engaging end-users' perception of 'what a good service is', the demand risk can be mitigated, and the spill-over revenue can even compensate for the commonly overrun cost in transport infrastructure. For example, as noted by Zhao *et al*. (2021), the partnering parties in Australia's Lane Cove Tunnel project can share the toll revenue that is beyond anticipated profits due to effective operation of the asset.

*5.5.2.2 Environment*

As stated above, in the UK's HS2 project, communities' concerns over environment issues appear to have been overlooked in the government's decision-making process. This is especially the case in emerging economies. Malvestio *et al*. (2018) illustrate that environmental issues are secondary to political and economic interests in their transport policy, plan and programme, which jeopardises sustainable development. However, transport projects are attested to be having a huge impact on the environment. Taking the UK as an example, the transport sector is the main source of air and noise pollution and accounts for 34% of its carbon dioxide emissions, which

contribute to underlying health problems (Department for Business, Energy & Industrial Strategy, 2020). Consequently, it is self-evident that such aspects of public V*f*M (e.g., environment and health) should be addressed in transport interventions.

Indeed, a series of policies have instilled environmental considerations in PPPs (The World Bank, 2019). More recently, a number of countries have set their zero-carbon goals with the transport sector spearheading these. The UK, aspiring to achieve 'net zero' greenhouse gas emissions by 2050, has launched a package of programmes to decarbonise transport, including, for example, thousands of millions of investments in upgrading all transport types (Department for Transport, 2020b). Yet, despite such policy developments, technology innovations, and risk analyses, prevalence of environmental considerations in transport PPPs appears to have progressed little over the last decade (see, e.g., Grasman *et al*., 2014; Khan *et al*., 2020). To say the least, the UK's policy for the UK Infrastructure Bank, which aims to support the transition to 'net zero', has been heavily criticised. Plimmer (2022) reported that the UK Infrastructure Bank has dedicated millions of pounds of taxpayer money to third party investment funds (e.g., Octopus Sustainable Infrastructure Fund and NextEnergy Capital's solar fund) rather than projects that directly tackle climate change. The 'barrier' arguably lies in the extent of the public's participation in transport decisions to articulate what they value about the environment.

*5.5.2.3 Distribution*

In Figure 5.2, 'distributional impact' comprises intergenerational distribution (temporal effect) and regional distribution (spatial effect). This aims to resolve any transport inequity among the population, such as those who cannot enjoy the benefits

of transport but bear its externalities. However, distributional impact, according to Markovich and Lucas (2011), is only considered after economic and environmental appraisal. The limited attention paid to this key element has prompted appeals for a change in governments' decision making. For instance, from a fairness point of view, an intergenerational redistributive effects model has been proposed by Penyalver *et al*. (2019) to measure the extent to which transport projects entail bills for successive generations. Haddad *et al*. (2019), on the other hand, applied a spatial computable general equilibrium model to show how policies on transport can improve accessibility, income and thus regional equality. Based on this principle, the UK is investing £4.8 billion in its so-called 'Levelling Up' fund to provide the same support in infrastructure (e.g., regeneration and transport) across all four nations (HM Treasury, 2021c).

Nevertheless, this scheme may not transform the situation immediately as the current distributional differential manifested by transport emissions between regions is significant (Department for Transport, 2020b). Even in HM Government's (2022, p.122) latest white paper on 'Levelling Up', it shows the vagueness of government policy by stating 'the spatial pattern of UK Government spending and funding allocations is often unclear…'. What is more, according to Bills and Walker (2017), it is still not fully understood how existing models perform in practice, especially when both temporal and spatial aspects are considered. Hence, it makes integrating an aggregate view of the temporal and spatial effect of transport projects into V*f*M assessment matter.

*5.5.2.4 Resilience*

Transport infrastructure is vulnerable to climate change and extreme weather. Cases can be seen worldwide whereby heavy downpours, snow, winds and heatwaves make transport systems dysfunctional (Markolf *et al*., 2019). The ramification is that people are unable to travel, which results in economic and social loss. As noted by Liu and Song (2020), this chain of effect also jeopardises the role transport plays in the critical infrastructure network to realise the resilient city. Naturally, resilience is brought to the frontline by scholars to study transport systems' capacity to recover from a disruption or a disaster (Liu *et al*., 2019).

Among them, one of the fundamental questions relating to resilience is 'resilience for whom' (Vale, 2014). For end-users, Bešinović (2020) believed that they would want to retain or regain uninterrupted access to, and benefits from their transport service, no matter what the situation. Put simply, the speed of recovery becomes a key indicator in reflecting public satisfaction. Compared with vulnerability analysis, which has become a mature field in resilience, Mattsson and Jenelius (2015) contend that aligning resilience with recovery is still at its infancy. According to the resilience curve proposed by Baroud *et al*. (2014), when confronted with stress (e.g., disruptions caused by a natural hazard or security threat), the functionality of an infrastructure asset rapidly plummets to an undesired point, then gradually recovers to its normal state. To expedite the recovery process of transport networks for the end-users, a sense of resilience is indispensable in transport planning to improve their inherent ability to deal with aforementioned events (Chen and Miller-Hooks, 2012). By considering the resilience dimension, the concern that the benefits of disaster risk reduction are largely overlooked in decision makings (Kunreuther and Michael-Kerjan, 2012) is addressed.

*5.5.2.5 Social inclusion*

Hodgson and Turner (2003) have emphasised the inter-relationship of poverty, inadequate transport planning, and lack of access to key services in problems of 'social exclusion'. Social exclusion, in the context of transport means the lack of transport accessibility that prevents certain people (e.g., the low-income, elderly and disabled) from participating in society through education, employment, health, leisure and cultural activities (Kenyon *et al*., 2002). Those socially excluded are normally characterised by low employability, unstable work, identity loss, violence and poor food and living condition (Stanley and Lucas, 2008). With the growing awareness of social exclusion, the Social Exclusion Task Force of the UK Cabinet Office (formerly known as the Social Exclusion Unit) has pioneered studies on the *status quo* and underlying causes, and proposed the 'accessibility planning' of its future transport schemes (Social Exclusion Unit, 2003).

A longitudinal review of the 'accessibility planning' approach undertaken by Lucas (2012) confirmed its importance in tackling social exclusion but revealed that its adoption in local authorities was not popular and its practicality was questioned. Similarly, Young (2015) revealed that the Social Value Act 2012, in which the consideration of a procurement activity's social impact (e.g., reducing anti-social behaviour or increasing employment) is assimilated, is only being applied selectively: the questions of how and when to include it during the procurement process are ambiguous. In response, the factor of 'social inclusion' is integrated into the V*f*M assessment framework. This plants the idea that transport authorities should evaluate and compare whether a procurement method can provide more accessible transport

service to the disadvantaged and enable them to partake in other key services mentioned above. This is different from the regional distribution (i.e., region to region) as social inclusion focuses more on a specific area.

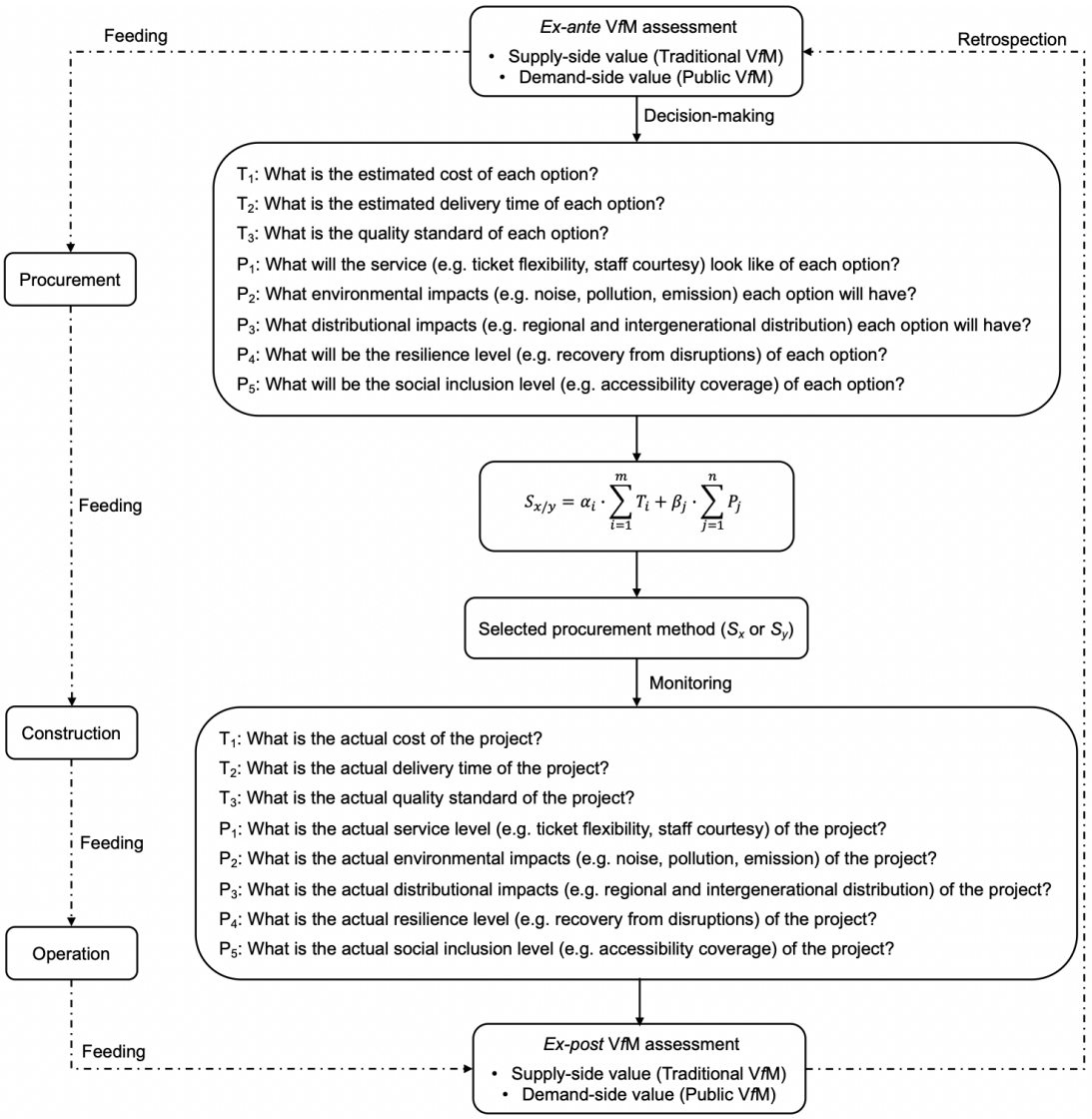
## 5.6 Operationalisation of the Proposed Framework

The epistemology of theories of value implies that value is generated from both the demand side and the supply side. In conjunction with stakeholder theory, it points out a significant ingredient that has been overlooked in the current V*f*M assessment, namely public V*f*M (Figure 5.1). Thus, traditional V*f*M alone is not comprehensive enough to determine an appropriate procurement approach for transport projects. Consequently, a holistic framework is proposed in Figure 5.2 to support a dynamic life-cycle V*f*M assessment. This supplements existing literature (e.g., Shaoul, 2002 and Leigland, 2018) where evidence is provided to demonstrate that current V*f*M assessment is monochrome (i.e., purely cost-focused). However, such a proposition is not simply a matter of abandoning the traditional view of V*f*M. On the contrary, studies addressing qualitative V*f*M assessment re-confirmed that cost is a driving force of V*f*M among others (Yuan *et al*., 2009; Cui *et al*., 2019).

Despite some conformity (i.e., acknowledgement of traditional V*f*M), this new framework differs from others in several ways. For example, instead of categorising measures based on judgement, it provides a theoretical predication and has elaborated on what V*f*M is. Complementing traditional V*f*M, the novel 'public V*f*M' (shown in Figure 5.2) has incorporated 'public' participation in transport to provide a clearer and more comprehensive V*f*M concept. Moreover, current methods apply qualitative V*f*M assessment only to PPP forms of contracts (HM Treasury, 2006; Tsamboulas *et al*.,

2013). In this framework, however, it is the assessment of both PPPs and the traditional procurement approach that ultimately determines the V*f*M, which de-biases preferences over a specific method. Notably, the framework is specific to the transport sector. This is important, as project evaluation should not only be time-sensitive but also should consider variations between sectors (Liu *et al*., 2021).

In order to facilitate the applicability of the proposed framework, a dynamic V*f*M assessment process and its operational guidelines are provided in Figure 5.3. Public participation in government policy has been duly suggested by Newman *et al*. (2004) to accommodate the complex, diverse and dynamic societies. However, they noted that this form of collaboration is constrained by limited opportunity structures and institutional barriers. In PPP forms of infrastructure development, scholars (e.g., Kuronen *et al*., 2010; Torvinen and Ulkuniemi, 2016; Yuan *et al*., 2019) are also calling for the consideration of public interests to create a 'tripartite win' between governments, private consortia and end-users. The advantage, as revealed by Aaltonen and Kujala (2010), is that early engagement with all stakeholders, particularly those who are not bound by the contract (e.g., the general public) can ensure project value realisation. As such, 'public (end-users') participation in transport' in V*f*M assessment is revitalised in the assessment process. That is, demand-side value should be assessed from the viewpoint of end-users to realise public V*f*M. However, this does not mean that traditional V*f*M and public V*f*M are mutually exclusive, as end-users expect projects to be delivered within time, cost-effectively, and at a quality standard as well.




Note: $S_x$ and $S_y$ denote PPPs and the traditional procurement approach, respectively; $\alpha$ and $\beta$ are the weight for each traditional V*f*M (*T*) and public V*f*M (*P*), respectively; and *i* and *j* are the number of questions for *T* and *P*, respectively.

Figure 5.3. The life-cycle V*f*M assessment process

Importantly, both traditional and public V*f*M are assessed in a dynamic manner (i.e., a life-cycle perspective). This is underpinned by the fact that the existing *ex-ante* V*f*M assessment fails to capture how projects perform during operation (i.e., the *ex-post* evaluation). It is commonly seen studies in relation to PPP performance measurement in terms of *ex-post* V*f*M assessment (see, e.g., Yuan *et al*., 2009, Liu *et al*., 2018, Budayan *et al*., 2020), but they do not comply with the criteria outlined in the *ex-ante* V*f*M assessment. While there is a need to consider the new situations emerged

throughout the project lifecycle in the *ex-post* evaluation, such inconsistencies, as Samset and Christensen (2017) argue, would impede the central referencing role the *ex-ante* assessment plays in projects' subsequent decision-makings. In fact, Heald (2003) has stated that the UK' NAO attempted to align *ex-ante* and *ex-post* V*f*M assessment to scrutinise its government's spending. Therefore, in this V*f*M assessment, V*f*M is foreseen as a tool not only for making decisions (*ex-ante* - before starting the investments) as well as a tool for monitoring the (*ex-post*) evaluation of the projects in the operational phase. In short, it is 'what was anticipated' and 'what has happened' that together constitute a holistic V*f*M assessment.

The life-cycle V*f*M assessment at the procurement stage commences with presenting and answering questions regarding the extent to which each procurement method (i.e., PPPs and the traditional procurement approach) can deliver the traditional V*f*M and public V*f*M. By applying the same criteria to both options, the bias towards either the traditional procurement approach (Burger and Hawkesworth, 2011) or PPPs (Bayliss and Van Waeyenberge, 2018) can be potentially curbed. It is then multiplied by the weight of each attribute (see the equation in Figure 5.3) as it is acknowledged there are differences and priorities between governments. This is consistent with Kweun *et al*. (2018), who suggest that V*f*M assessment should be conducted on a project-by-project or case-by-case basis. In doing so, excessively complicated techniques can be avoided, thus providing a pragmatic framework for policy-makers. However, it is noted that the result of each question may rely on individual contributions, such as an environmental impact assessment (see, e.g., Lidskog and Soneryd, 2000).

The upper part of Figure 5.3 is based upon the use of the process at the initial procurement stage. At the construction and operation phases, the original 'questions' on traditional V*f*M and public V*f*M would evolve into 'principles' to monitor and evaluate the progression of the transport projects. Put simply, the same criteria can be used to track if the expected project V*f*M materialises under the selected procurement method. This adheres to Samset and Christensen (2015) who indicate that use of the same criteria in *ex-ante* and *ex-post* evaluation increases the likelihood of project success. The straightforward idea is that at these two stages the focus is on ensuring the project does not deviate from the V*f*M goal no matter which procurement approach. Thus, it is envisaged that the *ex-ante* V*f*M assessment helps determine a procurement approach and the *ex-post* V*f*M assessment evaluates the investment decision, thereby closing the loop. Accordingly, the 'feeding and retrospection' mechanism is embedded to safeguard the V*f*M assessment process. It requires information to be passed down to the next stage as the benchmark and reflects on the life-cycle V*f*M assessment at *ex-post* stage so that more informed decisions can be made for future projects. It makes sense as one cannot know 'what will happen' without pondering 'what transpired in the past' (Weick *et al*., 2005). With that being said, the framework certainly produces an opportunity for governments to collaborate with the 'public' to co-create their traditional V*f*M and public V*f*M, and start to actually accumulate experiences from past projects.

## 5.7 Chapter Summary

This chapter has fulfilled Objective II of this thesis by answering the sub-question '*is there a theoretical lens that can prescribe what should be considered in VfM assessment?*'. Drawing on theories of value and stakeholder theory, it identified that

value is generated in the marketplace (i.e., through supply and demand) and is relative. Following which, a more meaningful V*f*M concept that comprises traditional V*f*M (the government perspective) and public V*f*M (the end-users perspective) was articulated. The pristine V*f*M concept is complemented by a V*f*M framework that details the contents of traditional and public V*f*M, and a life-cycle V*f*M process that guides its operationalisation, respectively. Next, in Chapter 6, the V*f*M framework is refined and validated, and a real-world case is applied in Chapter 7 to demonstrate the V*f*M assessment model.

# CHAPTER 6 RESEARCH FINDINGS AND REFINEMENT OF THE FRAMEWORK

## 6.1 Chapter Introduction

Predicating on the V*f*M framework proposed in Chapter 5, Chapter 6 aims to address the third objective of this study (i.e., refining and validating the proposed V*f*M framework). Primarily, it draws on an analysis of the viewpoints expressed by the senior professionals (i.e., an average of 23-year relevant working experience of infrastructure procurement with the minimum being 13 years) during the interviews, and the responses from the questionnaire surveys. This chapter begins with validating the V*f*M concept developed in Chapter 5, and confirming the V*f*M assessment methods identified in Chapters 3 and 4. It then refines the components of traditional V*f*M and public V*f*M by critically analysing the collected data before arriving at the V*f*M assessment framework. Specifically, the principles of operationalising the validated framework are presented in the end.

## 6.2 Value for Money and its Assessment

It is clear from the interviews that the perception of V*f*M varies across individuals, which reinforces the relative concept of V*f*M identified in Chapter 5. However, unanimously, the existing over-emphasis on cost, be the capital cost or whole-of-life cost, was despised by the interviewees. In one case, Interviewee B described that ‘‘the measure of cost is very narrow, and it allows people to have a distorted view’’. In terms of the lowest cost, Interviewee M, who was working on the V*f*M assessment of a transport project at the time when the interview was undertaken, underscored that ‘‘definitely not the cheapest option, or I definitely wouldn’t say that is the definition

of value for money for me''. Adding on this point, he acknowledged that ''the emphasis on that (*i.e., cost*)[22] has come down in some of the more recent projects''. Notwithstanding this, the V*f*M assessment by which the interviewee abode was 'public sector comparator (PSC)' as it was specified in the latest *Green Book*.

Figure 6.1 outlines all the methods surfaced during the interviews and some of their associated excerpts. PSC (mentioned seven times) and cost-benefit ratio (mentioned three times) were the most frequently adopted V*f*M assessment methods in practice. Others included value engineering and 'off the balance sheet', and for the latter, projects often ended up with PFI as long as they were ''off the books, the public sector books''. This extreme inclination was branded by another interviewee as ''hit and miss'' because some of the projects had to be back on the balance sheet later on as a result of the huge financial risks borne by the public sector. Such methods revealed are in consistency with the V*f*M assessment methods identified in Chapters 3 and 4, and details of how they can be applied can be found there as well.

[22] For clarity purposes, contents in the bracket (in italics) were added to explain the pronouns the interviewees mentioned. This applies throughout this chapter.

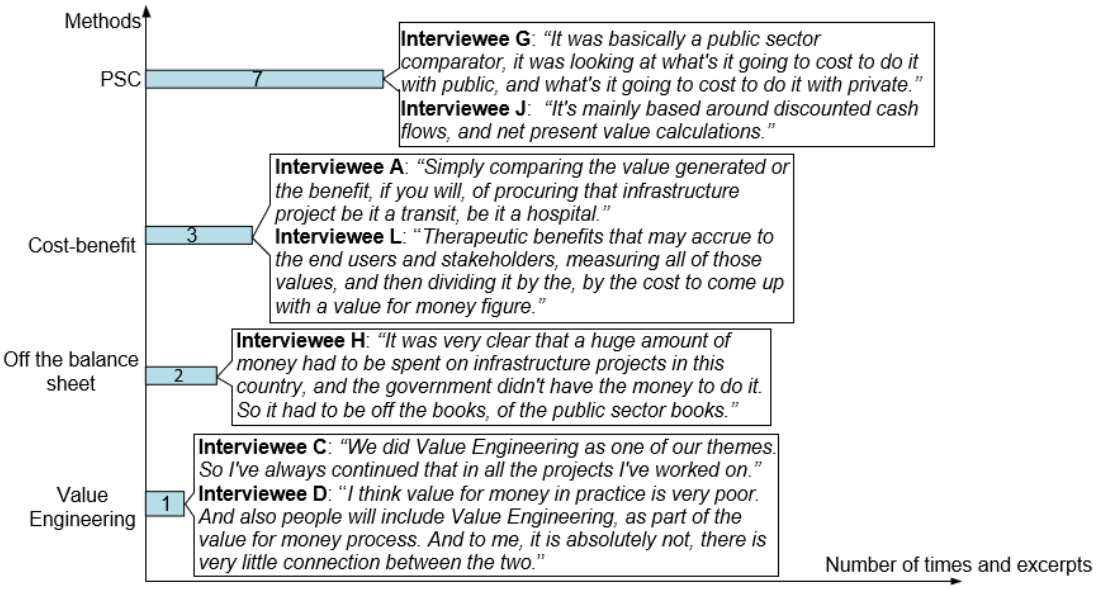



Figure 6.1. Value for Money assessment methods in practice

Despite the myopic focus on cost in practice, a number of directions with regards to a more comprehensive V*f*M concept emerged. In a summative manner, Interviewee G unfolded the evolution of V*f*M, where it initially looked at the simple PSC (but overlooked the hidden costs on the public side), then slowly migrated towards admitting and analysing the subjective part of V*f*M (but overlooked the different perceptions of risks on the public and private side), gradually realised that V*f*M became a tool to justify decisions that had already been made (i.e., ‘‘value for money is evil’’, ‘‘don’t even ask the question’’), and now finally came to terms with ‘‘keeping an open mind and looking at all different aspects’’. Nevertheless, Interviewee K held the view that V*f*M is linked to outputs (e.g., ‘‘to enable X amount of cars to travel between this and this cities’’) and not outcomes because whether or not those X amount of cars actually comes on the road can be affected by other economic factors.

While such a view (Interviewee K) may coincide with the historic concept of V*f*M, many others apparently agree with an evolving V*f*M. For instance, Interviewee L

argued: ‘‘any intelligent client, or educated client will see that, that’s an essential part of moving from this kind of highly transactional output-driven approach to a much more values-driven outcome approach.’’ because it’s about the service the project provides, and not about building. In a triangle analogy, Interviewee F considered both Interviewees K and L, and divided V*f*M into ‘‘planning what you think you’re gonna get’’, ‘‘running the award process’’, and ‘‘managing the contract to make sure you get what the bidders promised you’’. The three pillars were referred to as ‘client intent’ by Interviewee D to understand ‘‘what is the outcome you want? Not the output’’.

However, this outcome can sometimes lead to the conflict between the government and the general public as Interviewee I recalled ‘‘something like that tunnel will deliver economic benefits to the whole of XXX[23], and to XXX, and to XXX (*i.e., people from three regions*), but they (*i.e., the procuring authority*) have no direct interest in the tunnel.’’ Reconciling this point, Interviewee F proposed that ‘‘in the end, though, at a certain point, politics has to take account of what the people want, because otherwise, by whatever means appropriate, there’ll be some kind of pushback. There’ll be different manifestations of that in different locations.’’ The benefits of having the general public’s value in mind, as explained by Interviewee G, are that: (1) the chances of project success will increase as the local community helps understand risks and constraints that the government does not know; and (2) the chances of project being cancelled by the next government decreases as the local community will support it. That way, it concretely shows what Interviewee M called V*f*M - ‘‘using taxpayer money efficiently’’. Adding on this perspective, Interviewee B used the Olympics

[23] For anonymity purposes, any names (e.g., project names) mentioned by the interviewees were replaced with ‘XXX’. This applies throughout this chapter.

project as an example, saying managing the public perception generates ‘‘a feeling in the country, it generates a feeling of wellbeing, a feeling of pride.’’ In that sense, even a massive amount of money has been spent, it is still considered a success.

### 6.3 Traditional Value for Money

The discourse of V*f*M concept above evidently points out the prominence of public V*f*M as it evolves. However, Interviewee D, who has been devoting to helping his public clients understand project outcomes for more than 20 years, contended that ‘‘they will understand a construction project in terms of cost, time, programme, health and safety, but they won’t have a bigger set of metrics that sit around that.’’ This crucial reality confirms the element of traditional V*f*M in the V*f*M framework (see Figure 5.2 in Chapter 5). Figure 6.2 illustrates how traditional V*f*M in terms of cost, quality, and time is understood in practice.

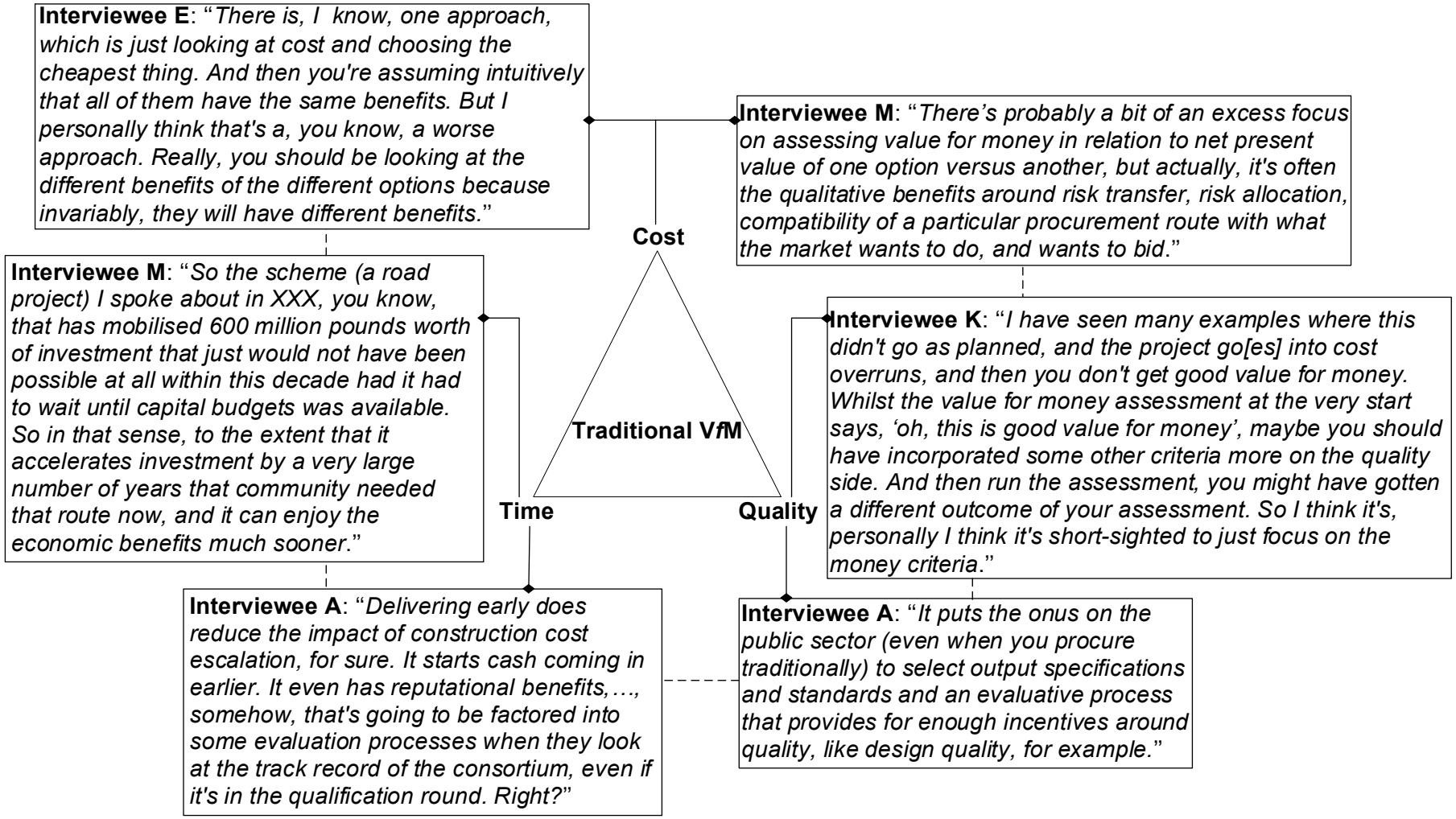



Figure 6.2. The theme of traditional V*f*M and examples

### 6.3.1 Cost

The core of PSC comparison is that if the whole-of-life cost of a PPP approach is lower than the traditional procurement, then PPPs are the value-for-money option. According to Interviewee J, in the appraisal of a transport project, his colleagues at the Cabinet Office challenged the notion that a private finance bid could incredibly cost the construction lower than the traditional procurement, and they debated ‘‘the private finance option is a fixed-price contract, and you’re passing the risks to the private provider, you would expect them to price the construction higher, you know, somewhere between, finger in the air, 10 to 20%, maybe more’’. Supporting this point, Interviewee I noted that only a few PPP projects made proper savings, and others did not. In another instance, even for projects that were not procured via PPPs, Interviewee M stated ‘‘there has been a systematic under appreciation in the public sector of how much risk the public sector carries when it doesn’t do something through PPP. I think it gets hidden. And I think there are some important lessons around transparency of budgeting and costing that come out of PPP approach that are very valuable.’’

Nevertheless, in a V*f*M document shared by Interviewee K, although the Infrastructure Project Authority conceded that it was not good that V*f*M assessment is quite focused on cost aspects, bringing in other aspects would make the already complex cost even more complex. Therefore, in order to get the cost number ‘right’ in V*f*M assessment, as shown in Figure 6.3, the public sector needs to understand the underlying meanings behind the cost number, distinguish between capital and whole-of-life cost, not exaggerate the importance of cost, and be better incentivised to treat cost.

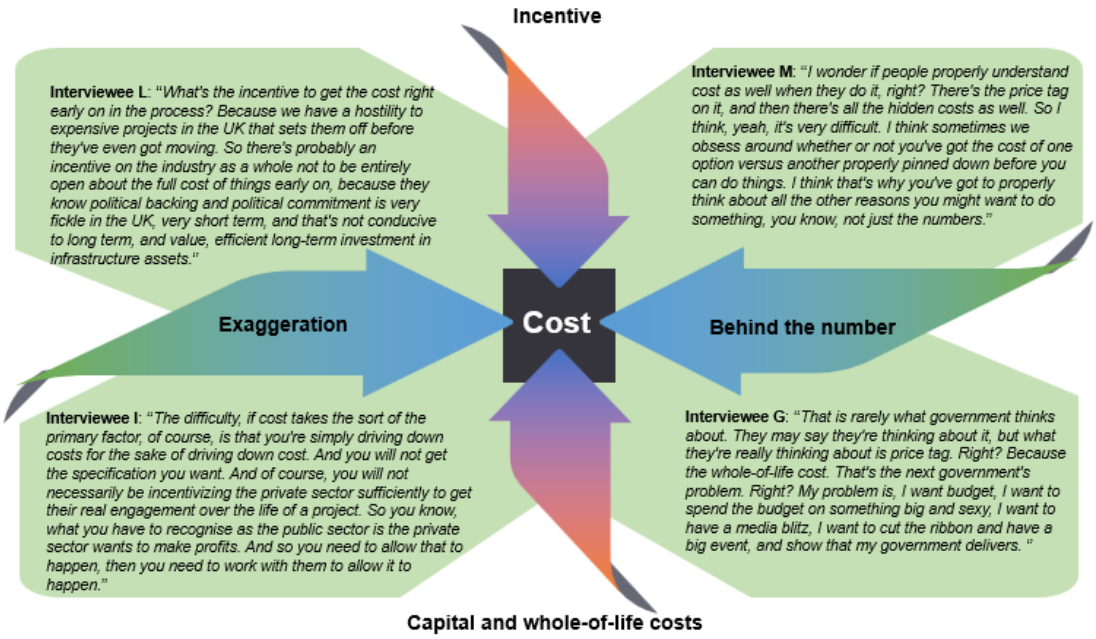



Figure 6.3. Child codes of 'cost' and examples

### *6.3.1.1 Behind the number*

Just because cost is an easily accessible metric to communicate with politicians and the public does not mean what is behind the number should be neglected. In a rail project (around £40 billion) experienced by Interviewee B, they asked ''what benefit could we get from that? Or if I spent £60 billion, do we get a lot more benefit? Or is it just an increase in cost?'' If those questions were not asked, in Interviewee C's view, the focus should at least be on whole-of-life costs (not on capital costs) because he asserted:

*''they completely miss the wider benefits. They're limiting themselves to a very small section of the problem by looking at the whole-life costs. And as I've said, if you look at social benefits of a project, that's nowhere reflected in those figures. So when you're looking at whole-life costs, it's better than just looking at capital costs, but it doesn't look at the wider impacts of the project.''*

Being empathetic, Interviewee H seemed to understand why 'lip services' were paid to ''we won't go for the lowest cost'' as the public sector works under huge budget constraints. This nature was echoed by Interviewee G in that:

*''your department in government will not survive if it cannot attract budget. And to attract budget, you need to justify every expense, and show that the investment that you're making is value for money, i.e., it doesn't cost too much, and cost the right amount.''*

While the reality of budget constraints may be true (and it may never go away), the public sector has to be wary of the manipulation. Otherwise, even the plausible focus on cost can become what Interviewee E called ''just doing the paperwork''. As a result, Interviewee L has observed that ''even the big accountancy firms were kind of making sure that the right numbers come up''. In one example offered by Interviewee C, this 'right' figure can be engineered by ''snip[ing] out the section that causes the problem, and assign[ing] that to some other programme, and say[ing] this has been allowed for elsewhere''. To mitigate such manipulations, being able to understand which cost (capital or whole-of-life cost) is referred to and articulate the impacts arisen from the cost could be useful.

#### *6.3.1.2 Capital and whole-of-life cost*

The imbalanced view of capital and whole-of-life cost in the public sector is explained by Interviewee G in Figure 6.3. Practically, the lack of data exacerbates the situation as Interviewee J, who has examined whole-of-life cost data in the public sector for more than a decade, contested:

*''how we can appraise the whole-life costs of these stages is fanciful really, because the data, we need to do it was, we are not even there. We are not even there to appraise construction costs, let alone add another 30, 40, 50, 60, or 100 years of operational costs onto that at the appraisal stage.''*

Nevertheless, the importance of whole-of-life cost in PFI was made aware back in the 1990s (Interviewee H). It was applauded by Interviewee I as a ''big sea change'' PPP had brought in, because if this attention was not paid, the public sector would have to bear the long-term impact, where the bigger costs lie in PPPs (Interviewee C). Additionally, Interviewee D explained that:

*''if as a client, you are going to continuously prioritise the lowest cost (initial capital cost), and you are going to manage those contracts quite badly. And you are not going to show really any regard beyond your tier one main contractors, then you are going to get a chaotic, fragmented industry.''*

Therefore, to achieve the benefits for the projects' end-users and stakeholders on a whole lifecycle basis, it was suggested that: (1) the knowledge and keenness of the consultant appointed to do the analysis be enhanced (Interviewee C); and (2) sophisticated tools, such as quantitative risk (sensitivity) analysis and reference class forecasting be adopted (Interviewee M). To do so, it requires the need not to exaggerate cost and having in place incentives to get it right.

#### *6.3.1.3 Exaggeration and incentive*

A case in point where cost is exaggerated is the latest *Green Book*, that guides how V*f*M is assessed in the UK. As interviewee M put it:

*''At the end of the day, no matter how your qualitative evaluation looks like, it does come down to cost and net present value, which isn't probably the right way to do it. It should be a balance of both qualitative and quantitative. Maybe, maybe we should be heading in that direction with sort of new guidance that focuses a little bit more on qualitative as well. But, yeah, at the moment, it is very much sort of focused on cost and NPV setting.''*

This waying of assessing V*f*M is considered by Interviewee E, in jest, as ''just doing a cost analysis'' without the value part. It risks the project being underperformed if cost is not correctly understood (as mentioned in Sections 6.3.1.1 and 6.3.1.2). However, as Figure 6.3 shows, there are not even incentives to get it right. In a more general comment, Interviewee J remarked:

*''in the public sector, again, this is very generalist, but is generally true, whether you do good or bad, doesn't matter nearly as much. You might get promotion, if you manage the contract well, and […]. That's great, but that's what the public sector should be doing. […] but I just don't think many public sector contract managers fell confident enough to negotiate that.''*

Understanding the motives behind the exaggeration of cost and the lack of incentives can help formulate a more comprehensive concept of V*f*M and initiate a culture change to facilitate the standard approach to assessing V*f*M, which will be detailed in Sections 6.4 and 6.6.

### 6.3.2 Quality

Quality, one theme of the traditional V*f*M (Figure 6.2), was validated during the interviews. Unexpectedly, while it was initially limited to 'conformance with specifications and standards', there was a consensus that quality is poorly understood in V*f*M assessment. In Interviewee B' words, it is not easy to be communicated in ''a compelling, [and] simple way''. However, on the basis of exploring why this was the case, some new sub-themes, such as quality level (i.e., 'as givens', response to incidents and accidents, innovations and the ability to articulate specifications) and quality sacrifice (Figure 6.4), emerged to help better understand quality.

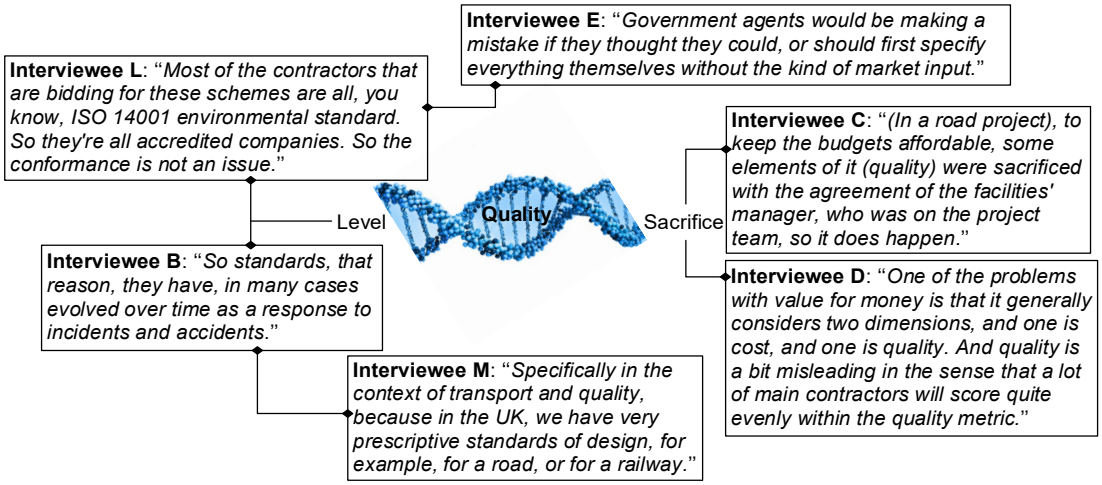



Figure 6.4. Child codes of 'quality' and examples

Due to the strict standards of design (e.g., *Design Manual for Roads and Bridges*) in the UK, Interviewee A, who was involved in drafting V*f*M assessment documents in the UK and Canada, used a 'light switch' analogy. That is, for any procurement route, ''you either meet it *(quality)* or you don't''. In most cases, according to Interviewees L and K, the conformance issue is not a problem because ''some of the road project[s], they'll be straightforward, you know, not too many challenges at the time''. Although quality was not an issue ''at the time'', the transport industry in the UK has witnessed

massive disruptions over the decades. In that sense, Interviewee B contended that ‘‘they (*standards*) have in many cases evolved over time as a response to incidents and accidents’’. On the one hand, some interviewees questioned the level of specifications and standards of the transport sector in the UK by comparing other countries (e.g., the Netherlands), which are discussed in detail in Section 6.4.4 as it relates to the theme of resilience. On the other, the prescriptive nature of standards can often limit the scope for innovation. The upshot, in Interviewee M's experience, is neither PPPs nor the traditional procurement necessarily offers better quality. In the case where there is scope for client-specified specifications, Interviewee E regretted:

*‘‘I was working recently with a rail project that was, you know, they really wanted to be different, and do things differently, and avoid some of the failures of other UK rail projects. But, you know, they couldn't put their finger on exactly what that meant.’’*

Interviewee L accorded with this inability of the clients to clarify specifications, and suggested 'mandatory', 'desirable' and 'discretionary' output specifications. More importantly, this quality can be improved by ‘‘engaging with the stakeholders and end-users to find out what their requirements are’’. Echoing that this lack of early engagement loses the opportunity for V*f*M, Interviewee M pointed out that:

*‘‘where there is a heavier services component, and I'm probably thinking like rail infrastructure, or metro infrastructure or something, then there's probably quite a bit of scope for an operator to add value, because they will look at things through a different lens to a design engineer would be, you know, an operational manager will identify improvements that design engineer just won't, a design engineer will look at*

*design and design code, and they will miss opportunities to do things better from a whole life perspective.''*

Another benefit of including end-users' requirements is avoiding the sacrifice of quality. As illustrated in Figure 6.4, a temporarily functional transport project could embed continuous liability in maintenance and upgrading. In addition, as contractors in any procurement approach could desire profits at the expense of quality, Interviewee F concisely recommended that ''the contract conditions and the specifications give you want you want''. To minimise quality sacrifice, Interviewee H emphasised the contract negotiation:

*''one of the many elements of negotiation that go on is that you need to have this (e.g., the rolling stock, what would that look like? When would that be provided?) in a great deal of detail, because it's going to be operated for 25, 30 years, whatever. And whilst flexibility is built in via the variation process, you need to have a lot of detail about the operational process, and the day-to-day running. So it was a negotiation between what the public sector wanted, what the private sector felt it could provide.''*

### 6.3.3 Time

As the final element of traditional V*f*M (Figure 6.2), time in terms of how quick a transport project is delivered in V*f*M assessment was validated during the interviews. In the context of transport PPPs, due to its ability to mobilise thousands of millions of investments more quickly than the traditional procurement approach, time in this sphere was understood to be a benefit (Figure 6.2). In the meantime, the advantages of a speedy delivery, and the reasons why it is (or not) accelerated have been revealed.

Importantly, as shown in Figure 6.5, this delivery time should be made sense of within the chain of its predecessor (i.e., the time spent before construction) and successor (i.e., the time spent between construction finish and operation start).

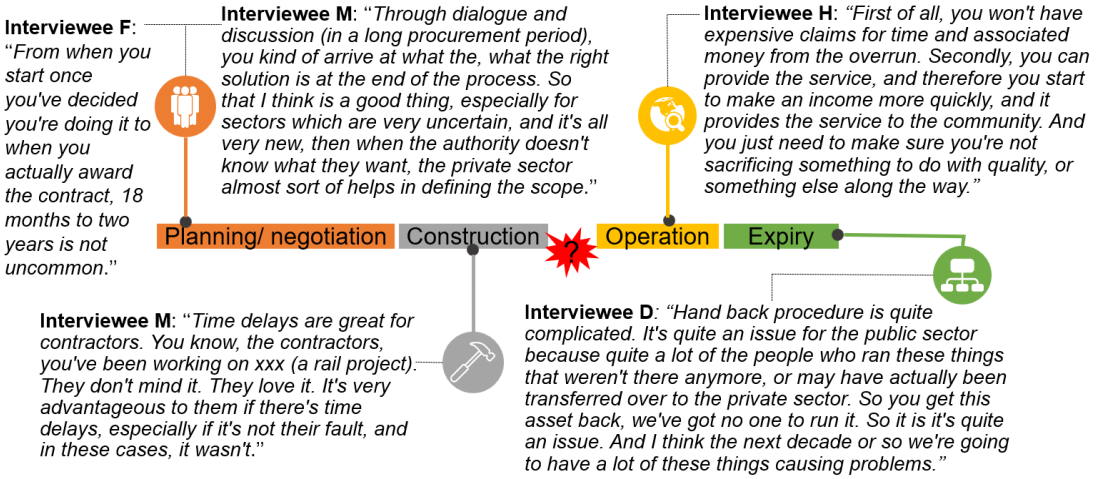



Figure 6.5. Child codes of 'time' and examples

If projects can be delivered on time or even before the expected time (via any procurement approach), the benefits often manifest in project savings and early benefit streams. For instance, Interviewee C made the following remark:

*''So if a government department has an annual allocation of funds, if it can deliver the project quicker, it then has possibly less funding requirements, which generates money which the country can use for other things in the short term. And also, say, I have a road into a town, if I can deliver it six months earlier, that means that any associated developments that were related to that access roads can all start earlier, which is also a benefit to everyone else.''*

Ideally, such benefits of a fast delivery should be generated from an effective and collaborative work between the client and the contractor. However, Interviewee D flagged some reasons that strike an alarm: (1) the programme is not unrealistic; (2) the

project is finished badly and unsafely (e.g., ‘‘like the bridge collapsed in XXX, not so long ago’’); and (3) the risks have not yet transpired. Adding on the reasons why it is quicker, Interviewees F and I encountered at the intersection of politics, where they stated ‘‘politicians want to be able to cut the ribbon on the road before the next election’’. According to Interviewee J, this external driver was more visible in ‘‘major sporting events’’ by which time the assets have to be operational. As is the case, although the financial risks of being late does not fall on the public sector under PPPs, the reputational risk is more prominent. For the private sector, due to this financial risk (i.e., they will not be paid until the construction is finished), Interviewee F reminded the public sector of it being too successful:

*‘‘when they (contractors) bid for the project, they assume a very late date, right? We’re not going to get this done for a long time. And they push and push on government to give a late completion date. And then they get it done really, really quickly, which means they get huge bonus payments.’’*

Contrastingly, every transport project Interviewee E worked on was late. In reality, there are reasons for that, and for transport projects not being sooner (in addition to the common tangle of time, quality and cost). For instance, Interviewee C explained that ‘‘if he *(the contractor)* worked faster, there may be contracts, with this timing of contracts within his own organisation might be disrupted. So it may suit him to take the full duration of his contract’’. This is particular the case when the transport project is in a system. Supporting this, Interviewee G stated:

*‘‘we do a lot of railway projects with mining areas. And so, once the mines are built, the railway becomes very valuable. Until the mines are built, they are not. And so, I think it really depends on the project. It’s not automatically the case that faster is*

*better. And sometimes, you know, you want to deliver a transport project too early, it just sits there. And it may actually cause a problem.''*

Therefore, Interviewee M called for a ''robust and deliverable construction schedule'' after some faster bidders (awarded during procurement) failed to deliver their promises (on time) in recent projects. That necessitates a systematic thinking by framing time into planning/ negotiation, construction and operation. In a major rail project in the UK, Interviewee B said ''XXX was 20 years in the consensus in the planning (*e.g., permissions, consents, and the Parliament approval*) before it even put a spade in the ground''. Another issue during this period of time raised by Interviewee F was that ''how quickly the winning bidder actually delivers the project''. Similarly, Interviewee L considered the time spent on operational hand-over more important:

*''having a smooth transition from the end of construction phase into the operational phase is of more importance, in some ways, than meeting what might be an artificially challenging end date for the construction phase. What's more important is, is to enter into the operational phase in a very organised manner.''*

This leads to the bundling and unbundling of construction and operation contracts in PPPs. In a bundled project, Interviewee I provided an example where two different subsidiary companies (i.e., XXX Construction and XXX Workforce) were responsible for the construction and operation respectively. While they belong to the same parent company, ''they buy and sell all the time, so there's a big difference between the original construction of the original investment arm, and the facilities management arm''. Needless to say, in an unbundled project, Interviewee H put:

*''it's an issue that PFI has been troubled with anyway, which is that even though you have a single SPV that has responsibility to the public sector client for everything, for the design and the build, and the operation. Below the SPV, there will always be a contractor. And then there will be an FM company. And the two of them have different agendas and different drivers. So the contractors are away, once it's done, it's built off.''*

Nevertheless, having this reasonable consideration of time in V*f*M assessment can help the public benefit from the infrastructure faster. As interviewee K said, ''it starts generating revenues if you have a long-term equivalent availability kicking in from completion''. The next section describes how this long-term equivalent availability can be stable by accounting for public V*f*M in V*f*M assessment.

### 6.4 Public Value for Money

In spite of the many new dimensions that need to be considered, the traditional V*f*M demonstration in Section 6.3 clearly corroborates its 'orthodox' position in V*f*M assessment. However, more importantly, as illustrated in Figure 6.6, public V*f*M in terms of service/ functionality, environment, distribution, resilience, and social inclusion that has previously escaped attention, was validated during the interviews. It appeared to be essential that by fostering a long-term thinking from the end-users' perspective, the concept of V*f*M is deemed more meaningful, and V*f*M assessment becomes not only a decision-making tool at the procurement stage, but also a mechanism for safeguarding V*f*M over the project cycle. The simple rationale, as asserted by Interviewee I, who has experienced all stages of PPPs from negotiation to expiry for around 25 years, lies in ''ultimately, we're spending taxpayers' money,

which we are, because it always gets paid off by the taxpayer. Then the question is, what's the benefit to the taxpayer?''.

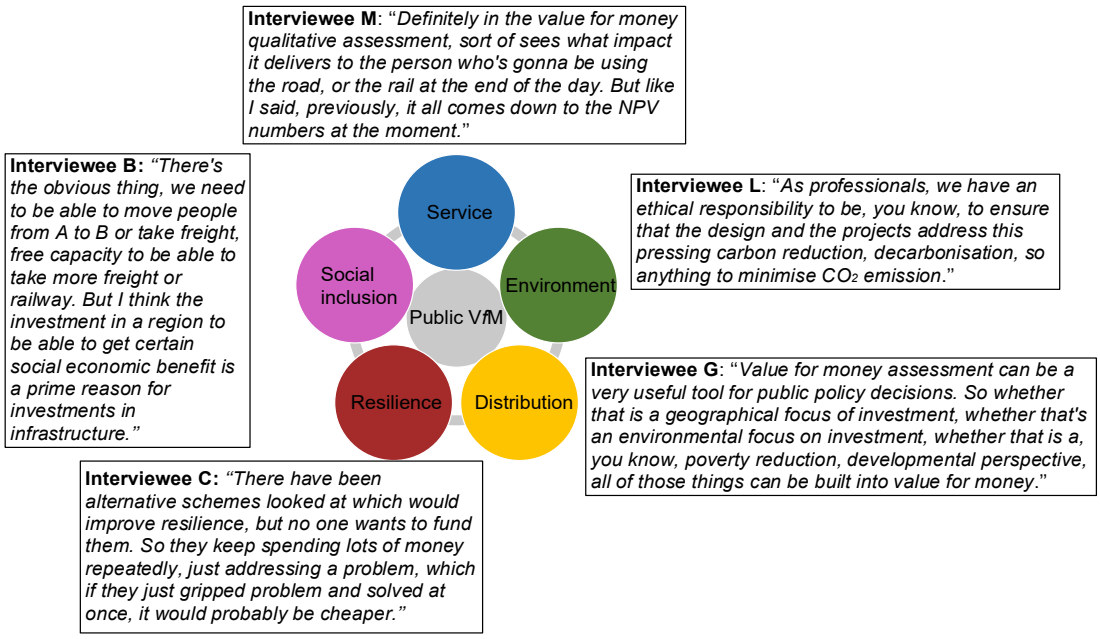



Figure 6.6. The theme of public V*f*M and examples

### 6.4.1 Service

As the basic function of transport projects, end-users rely on it for commuting purposes, which was well recognised during the interviews. When drafting the V*f*M assessment guidance, Interviewee A stated without any hesitation that ''service standards, whether it be as [a] traditional or P3 (*PPP*) procurement have [has] to be clearly and carefully thought about by the public authority, and adjusted over time as citizens' needs change, the user's needs change''. As shown in Figure 6.7, while the last bit (i.e., adjust over time) slightly drifted away to resilience, the consideration of service/ functionality in V*f*M assessment was found to be linked to the end-users' payment for tickets and the collaboration with the private sector.

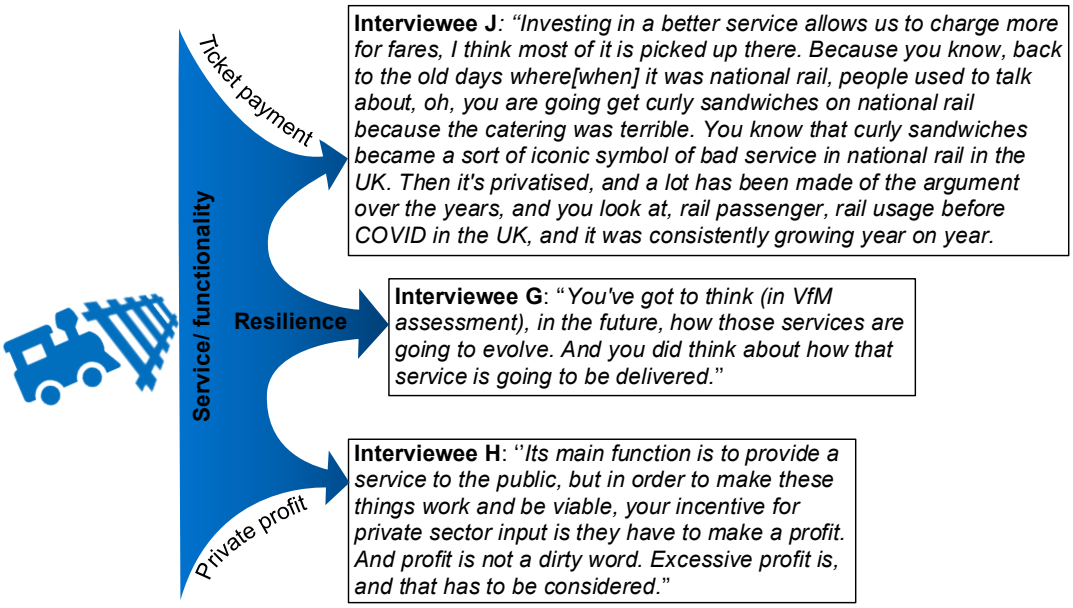



Figure 6.7. Child codes of 'service/ functionality' and examples

It was evidenced from Interviewee K that service/ functionality had not taken centre stage in V*f*M assessment as ''it's always about, okay, you need X amount of Tarmac, X amount of barriers, and X amount of lightnings. And how much is that going to cost?'' Although this could have scored highly in V*f*M assessment through a government procurement exercise, Interviewee C pointed out that it ''left massive, overcrowded and then cancelled rail services for passenger[s]''. Such a scene fails to capture Interviewee M's appeal that V*f*M assessment ''sees what impact it delivers to the person who's gonna be using the road, or the rail at the end of the day''. If metrics of service/ functionality, such as 'on-time departure and arrival', 'good facilities', 'clean toilets' as listed by Interviewee J, were considered, passengers could, firstly ''justifying paying *(for even the expensive ticket)*'', and secondly, they would ''pay for it again, and again, and again if somebody is happy with the service''. Markedly, ''there is value to the individual above and beyond the fair that they pay for a service''.

Realising this, Interviewees B and I have sensed the emergence of service/ functionality in a railway upgrade project and a tunnel project they were working on, respectively. For example, Interviewee I noted that:

*''instead of one tunnel with two lanes, one northbound and one southbound, they created two tunnels (using a PPP model), one northbound, one southbound to take extra traffic to make people's journeys better.''*

To ensure transport projects can deliver the service/ functionality, in addition to the cross-government coordination, namely, ''DfT (*Department for Transport*), MHCLG (*Department for Levelling Up, Housing and Communities*), and BEIS (*Department for Business, Energy and Industrial Strategy*), or different government departments'', Interviewee B reinforced that they ''do hold that rail and train operating companies, train manufacturers to account [accountable]''. This shows the collaboration between public and private sectors in delivering service/ functionality. To do so, as argued by Interviewee H (Figure 6.7), V*f*M assessment needs to allow private partner to make reasonable profits. That, in Interviewee J's view, could be achieved by charging more fares for a better service. With the increasing popularity of public transport, the awareness of resilience is incorporated into this service element. As such, not only ''journey times'' and ''the percentage of time the road is available'' (Interviewee F) matter, but also uncertainties, such as the COVID-19 pandemic (Interviewee A), should be taken into account. This needs to be considered in *ex-ante* V*f*M assessment, because according to Interviewee L, who recently completed a V*f*M review of a road project in Scotland, UK, ''the reality is, once the scheme was completed, it simply move[s] the bottleneck to another part of the system''.

### 6.4.2 Environment

As expected, environment was strongly validated to be part of public V*f*M. Faced with the tardy acuteness of environment in construction (Figure 6.8), it was revealed that governments need to prioritise environment in V*f*M assessment, and consider to what extent environment can be improved by combining cost and innovation.

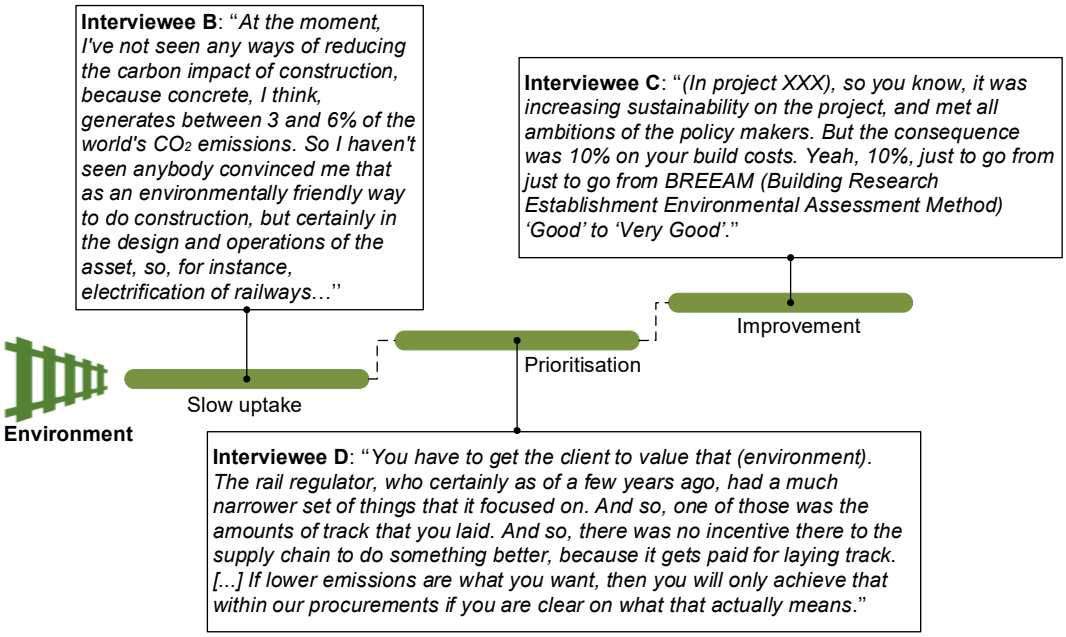



Figure 6.8. Child codes of 'environment' and examples

While Figure 6.8 seems to document the evidence that compared with construction, project operation phase reduces more environment burden, that is not to say that the construction phase cannot mitigate the environmental impact. On the contrary, there are ample opportunities at this stage, but they exist in production techniques. In other words, Interviewee B contended that they ''reduce the amount of carbon produced as a result of manufacturing concrete''. To be more specific, Interviewee B added:

*''I do think there are techniques to reduce carbon emissions during construction. So in building site, waste used to be as high as 15 percent of material wastage on site.*

*But nowadays that has been dripped down. And overall carbon cost of those wasted materials is now in decline in construction.''*

This consideration for early environmental impact reduction in V*f*M assessment was also echoed by Interviewee L to ‘‘look at different types of materials now that would minimise the carbon emissions in the production of the materials’’. However, in order for environment to become a ‘norm’ in practice, there needs to be a change in the public sector’s attitude towards environment. In the UK, for example, Interviewee I mentioned the change of procurement law as a result of Brexit would ‘‘bring in environmental issues into our thinking when planning these projects’’. Alternatively, the upshot of not asking questions regarding environment in V*f*M assessment is, as crudely spoken by Interviewee K, ‘‘you’re (*governments*) going to be stuck’’. Such is the case, the infrastructure projects appraiser (i.e., Interviewee K) proffered:

*‘‘what you want to do in your value for money assessment is to say, okay, run some scenarios, and show us a good case of base case, best case and worst case, and in terms of $CO_2$ emissions, so we’ve got this technology installed, that’s going to reduce our $CO_2$ emissions by X amount. If it works, then that’s the result. If it doesn’t work, and that’s the result. If it works above the base case, like, surpassing our expectations, and that’s the result. And, so then you can then run your value for money assessments around that criteria.''*

In addition, the prioritisation of environment integration into V*f*M assessment could come from project finance providers (if not the government). However, this kind of financier-driven V*f*M assessment may create an advantage for PPPs as Interviewee M has observed that:

*‘‘PPP lenders, and the other sort of the project finance providers under a PPP are increasingly driving and expecting the consortium that they sponsor to embed ESG principles (Environmental, Social, and Governance) in what they do. And they will provide more competitively priced finance for people who can evidence a contribution to those things. And I think that extra scrutiny and due diligence from the funders is something that I think should be of benefit to the PPP options in dealing with some of those things, I don’t think you would get this quite the same scrutiny on the alternative procurement models.’’*

Concurrently, the public sector needs to decide how much environment improvement V*f*M assessment can make. With an infinite desire, Interviewee A contrasted ‘‘a completely solar powered public transit system based on the current technology’’ and asked ‘‘how costly that would be’’. Similarly, some other interviewees (e.g., Interviewees C and J) argued that the private sector would concern that the extra cost in their bid to reduce X amount of carbon would lose a competitive edge. Therefore, according to Interviewee A, it requires both ‘‘standards that are set that are appropriate regarding environmental responsibility’’, which Interviewees E and H considered are quantifiable in V*f*M assessment, and ‘‘a reasonable process for [the] private sector to propose innovations in that (*environment*) area’’.

### 6.4.3 Distribution

Spatial effects of transport infrastructure, in symbiosis with its temporal effects, were validated to form the distribution theme of public V*f*M. For example, Interviewee F, who has been committing to the objective selection of PPPs and the traditional procurement approach for around 27 years, encapsulated that ‘‘distribution has to

come back to the question of a structured process of capital expenditure evaluation and prioritisation between delivery approaches''. Within this summation, the pattern regarding the existence of spatial effects, and in particular, the 'Levelling Up' agenda (i.e., why or why not in certain areas) was shaped. In addition, as shown in Figure 6.9, the temporal consideration in terms of the trade-off between a short-term gain and next generation's liability/ benefits emerged.

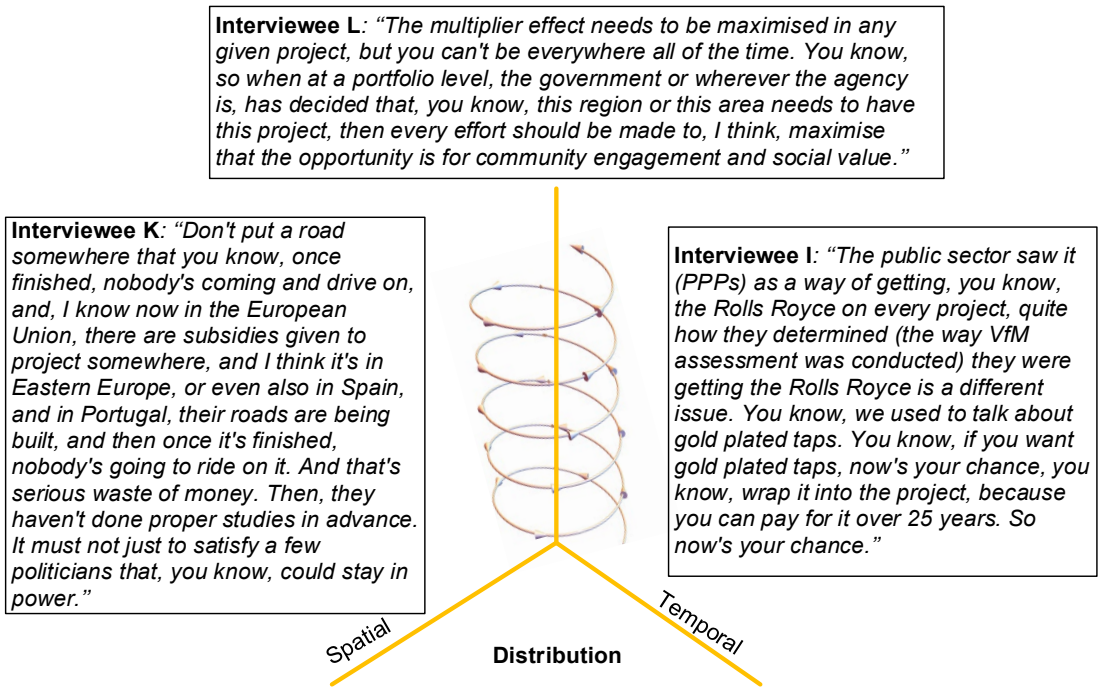



Figure 6.9. Child codes of 'distribution' and examples

### *6.4.3.1 Spatial distribution*

The spatial distribution of transport infrastructure projects indicates that projects should be balanced across the country to stimulate development. As a proxy for this concept, Interviewee C has seen ''no evidence of it (*the UK's 'Levelling Up' agenda*)''. If anything, things in the periphery of the country (e.g., the northeast, northwest and southwest) ''get worse through it (*a major rail project in the name of the 'Levelling Up'*)''. Coincidently, Interviewee D reassured that ''there isn't one consistent view on

what it means'', and projects that are being badged as 'Levelling Up' are not really 'Levelling Up' as they ''happen to be projects that are taking place in an area that needs to level up''. Although the 'Levelling Up' is debatable, it certainly shows that governments need to collectively consider whether or not projects should be initiated in already developed areas in V*f*M assessment. The upshot of treating each project separately, as argued by Interviewee B, is that ''unless you invest in the north, you're never gonna break out of that cycle'', in which ''it is easier to make a cost benefit argument in [the] south because the productivity of people in [the] south is much higher than is people in the north''.

Acknowledging that there will always be regions that do not benefit greatly from infrastructure expenditure, Interviewee I contended that this collective consideration in V*f*M assessment depends on ''whether you can get that multiplier up to 10 (*more than the existing multiplier effect*)''. In other words, according to Interviewee L, it risks a fiasco for all people ''if the returns on those investments in other regions [were] lower than they would have been for additional investment in London or the southeast''. Adding another evidence to support the additional investment, Interviewee J explained:

*''that distribution already happens through the funding (distributing the tax revenues), […], and you know, you look at the Barnett formula that the allocation to XXX for their fiscal funded envelope, they get more money per capita from areas that have higher economic output.''*

However, as the responsible agent of V*f*M assessment, Interviewee D highlighted that governments should balance off against ''areas where actually you are investing to

create growth, rather than to sustain growth''. Reinforcing this point, for regions that have been deprived of sufficient investments for decades, Interviewee I gave an example where:

*''something like a much better functioning road tunnel will probably generate more than that in terms of economic growth, and job opportunities, and things like that. And, you know, potential inward investment as a result of, you know, more investment in the ports.''*

In a similar vein, elaborating on the rail project Interviewee C mentioned, Interviewee J remarked:

*''you think about the investments that you're not making, because you've committed to invest in XXX, it just seems very easy to say, let's do this one big investment whereas lots of little investments (in other regions) might be a better value for money.''*

Therefore, despite the political consideration in the spatial distribution, it is equally essential that governments better understand the challenges and where investment will work when answering the questions posed in V*f*M assessment.

*6.4.3.2 Temporal distribution*

The temporal distribution of transport infrastructure projects indicates that projects can incur future payment liabilities. In the existing V*f*M assessment, this was accounted in the discount rate. For instance, Interviewee J admitted that ''we use the discount rate to look at the cost of capital. And that has implications for cost of finance and future tax liabilities.'' However, as pointed out by Interviewee E, it remains the

concern of the government to use the right discount rate[24], which ‘‘should kind of account for the benefits to future generations. But you know, also take into account the fact that people generally prefer to get benefits sooner rather than later’’.

Assuming that the projects will still be beneficial to the society (e.g., quality, service, and environment), Interviewee K used the mortgage comparison to support that ‘‘it’s something that multiple generations will have to pay for it, but I’m benefiting from it’’. More specifically, Interviewees B and J accorded that ‘‘we’re still benefiting from the railway infrastructure that Victorians put in’’, and similarly, generations to come ‘‘will benefit from the railway and road infrastructure projects that we’re putting down today’’. To some extent, this is in consistency with one of the rationales for PPPs that PPPs are ‘pay as you use’ rather than ‘pay as you build’. Nevertheless, governments need to avoid the ‘Rolls Royce’ tradition (Figure 6.9), and Interviewee M argued that:

*‘‘particularly when you overlay the climate lens, it’s not entirely fair to ask all the future generations to pay for very large sums of investment needed to undo all the damage that’s been caused by excessively polluting investment of the past.’’*

As such, similar to the distribution questions (Chapter 5) that should be considered in V*f*M assessment, Interviewee D suggested that governments ask ‘‘what’s the transformation that we are paying for? And how do we know if it’s been successful? And if it is successful, how can we translate that into future projects? If it is less successful, what can we take from that and learn?’’. With that in mind, it is less likely to witness the scene exemplified by Interviewee C where ‘‘the next generation is

[24] This is especially the case when the generation feels that they are not treated fairly. For example, Interviewee I believed that ‘‘the trouble is no generation is ever going to feel that they’d be treated fairly. They're just not. I think you’re never gonna win that argument anyway, are you? Which is why we have governments who make those decisions for us because the public would never agree’’.

paying for the badly built railways, which have got to be patched up and paid for out of local council revenues''. That way, in Interviewee D's opinion, it is more likely that the current generation has ''the ability to hold your head high, and look future generations in the eye''.

### 6.4.4 Resilience

In the light of frequent disruptions (e.g., delays and cancellations due to flooding and strong winds) to transport services in the UK, the element of resilience in V*f*M assessment was validated during the interviews. As illustrated in Figure 6.10, with the increasing awareness of resilience in mind, the procuring authority then needs to understand the concept of resilience, and more importantly, contemplate how that can be translated into terms and conditions in the contract of the procurement approach.

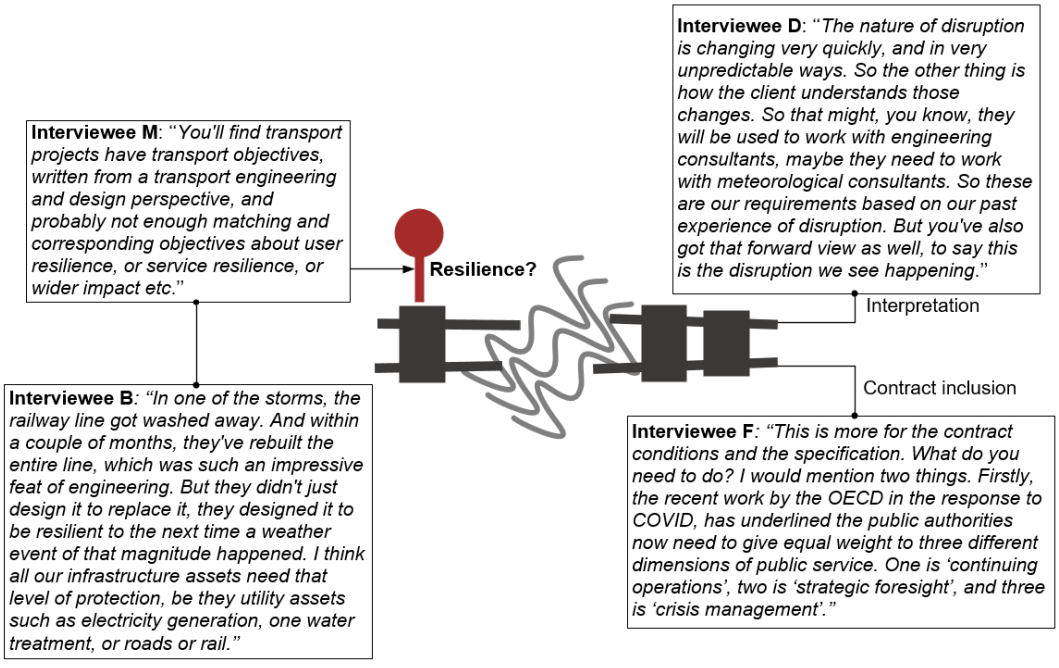



Figure 6.10. Child codes of 'resilience' and examples

The long-term public V*f*M in relation to resilience was re-emphasised by Interviewee I as ''in 20, 30, 40 years' time, and we're seeing now the very real issues about not

having the correct infrastructure in place, and not having the resilience''. In the case of a railway line that was closed for 16 weeks due to sea flooding, Interviewee C stated that ''while they strengthen[ed] the track and rebuilt it. There's nothing given to resilience at all''. Rather than grip the problem and solve it once and for all, the managing authority chose to solve the same problem repeatedly. Therefore, Interviewee C championed that:

*''we want to spend this money on this rail track resilience project, because look[ing] at the savings over a long period of time, it's going to save you, say I spend 60,000 pounds each time the rails closed, and then the businesses down the line lose 300,000 pounds each time it's closed. If you look at the number of days in a year, and the number of years that happens, it's quite easy to justify spending 30 million on a project (for it to be resilient). But I don't think we're sort of adept at thinking of it and that bigger picture approach.''*

Despite the fact that other countries have delays and disruptions as well, their (e.g., Canada, France, and the Netherlands) transport services were considered more resilient by Interviewees C, F, G, and H. Contrasting with Canada, Interviewee F remarked:

*''it snows in Canada several feet, and business carries on as normal, but in England, it comes over the top of your shoes and everything stops. So we have no resilience preparation. The railways are probably the most affected. You're aware, we've been aware of it for 100 years, but we don't spend money on it.''*

In addition to the under-funded infrastructure in the UK, Interviewee H explained that the resilience problem originated from when Brunel (i.e., Isambard Kingdom Brunel)

built the railway and incursions began to happen, and ‘‘everyone just accepts that’’. However, as extreme weather patterns appear to be more frequent, it relies on the governments to ‘‘change national design requirements or technical specifications’’ (Interviewee G), and thus projects can ‘‘sustain 50-year events or 100-year events or, or 1000-year events’’ (Interviewee A). This specific level of specification depends on how governments interpret resilience (Figure 6.10), because it is possible that, according to Interviewee H, ‘‘it was designed to the best level at the time, but then things have moved on, and what was acceptable is not acceptable now’’. Therefore, this interpretation of resilience needs to be made clear in the contract, and Interviewee A explained:

*‘‘because part of the value for money assessment is the risk weighting and performance under, you know, performance under force majeure or performance under supervening events or are stipulated in the project agreement. And so performance under severe weather might be under at a certain threshold, might be the performance standards either apply, or they don’t apply or are modified.’’*

If V*f*M assessment reasonably anticipates that projects should be sufficiently resilient to a certain degree of adverse weather[25] but cannot be executed when that weather actually happens, Interviewee H stated that ‘‘they’re often penalties in the contract in relation to the failure to provide a service’’. If unexpected events loom such as COVID-19 that has made some transport services financially vulnerable, the public sector’s acknowledgement of building resilience into contracts could, according to

[25] This forecast can be done by engaging with consultants, end-users, contractors, meteorologists etc. as shown in Figure 6.10. Alternatively, according to Interviewee L, this can be achieved by ‘‘first of all deciding on a risk-based approach, what is the critical infrastructure? So identify what it is, and then to assess the likelihood, and risk of that becoming, and the greater impact of it failing. And then that needs to be built into the procurement considerations for any form of, whether it's PFI or other forms of contracting, you know, all forms of procurement’’.

Interviewee I, ‘‘make those public services more resilient going forward’’. This is because those events have ‘‘created a whole new raft of, of contractual provisions that are now going into all future contracts’’. Moreover, this practice has the implicit benefit of end-users’ willingness to pay if, as argued by Interviewee E, ‘‘you knew that the chance of cancellation was 50% lower’’.

### 6.4.5 Social Inclusion

Social inclusion extends the fundamental role (i.e., functionality/ service) transport infrastructure plays to include accessing other key services such as employment, health, and education. This concept of social inclusion is cognate with Interviewee K’ point that ‘‘building a transport system just for the sake of it to go, you know, is pointless’’ because V*f*M assessment should be ‘‘doing some proper joined-up thinking with what the people do necessarily, you know, what’s at the end when they get off at the end of their journey’’. In this regard, the interviews (Figure 6.11) have also validated that social inclusion can manifest itself as public engagement and policy distribution in V*f*M assessment, which in turn stimulate the economic development in that region. In a nutshell, Interviewee B considered that ‘‘the investment in a region to be able to get certain social economic benefit is a prime reason for investments in infrastructure’’.

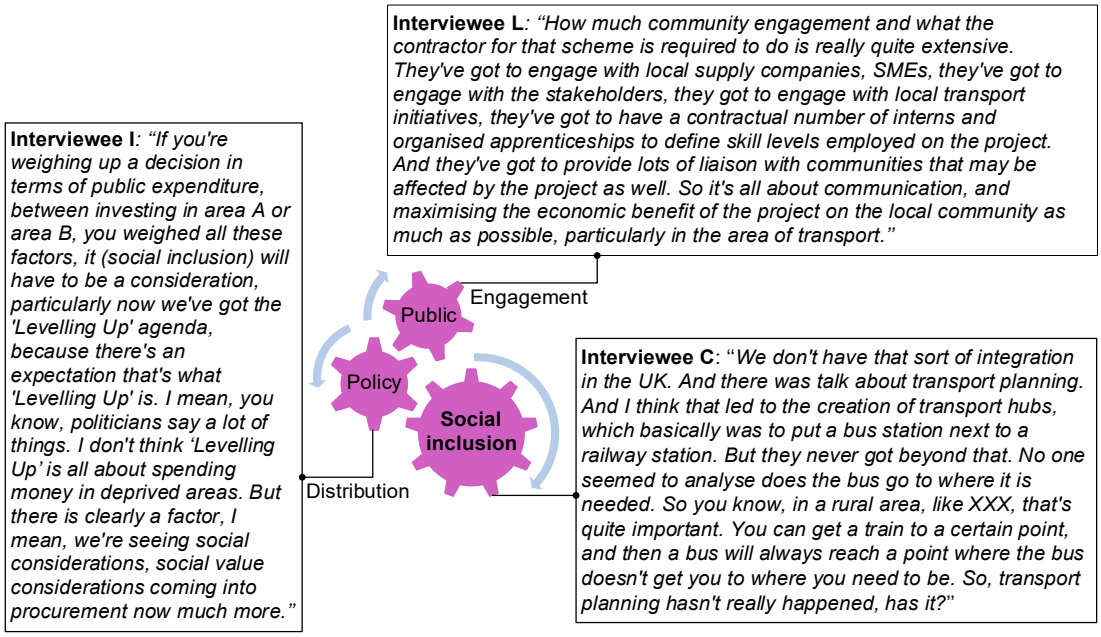



Figure 6.11. Child codes of 'social inclusion' and examples

As stated in Chapter 5, social inclusion mentioned here is not the same as distribution, or due to the public policy nature, in Interviewee E' word, ''it's another kind of distribution''. Social inclusion's focus on a specific region rather than spatial distribution was verified by other interviewees as well. Pertaining to a rail upgrade project, Interviewee B stated:

*''when we do XXX Upgrade, Network Rail holds the largest piece of brownfield site in the country in XXX, because it's part of the railway marshalling yards. So if they build this and get the infrastructure right, then they can build loads more housing, loads more industry and shops and things like that. […] So the barriers to get a job over the other side of the Pennines are a lot less than they perhaps are at the moment.''*

Contrasting with the rail upgrade project, Interviewee C provided a case where a new public transport scheme's intention to attract footfall failed as a result of the lack of

accessible routes, and the ones that were available took longer (i.e., two hours for public transport versus 25 minutes for private cars). To some extent, this serves as the 'black swan' event that demonstrates the low uptake of *Social Value Act 2012* (as mentioned in Chapter 5). Hence, Interviewee C summarised that:

*''the transport planning goal fails, because it wasn't really joined up. It was two separate plans. It was the commercial plan of the private bus operators, and it was the government plan of the hubs for transport. And it just didn't connect, you know, just didn't work for people.''*

One of the reasons for the 'failure' of transport planning in social inclusion, as explained by Interviewee J, was that ''vast majority of their variance (*social inclusion*) is well beyond the control of the investor at a single infrastructure asset level''. It therefore, forces the public sector to think strategically at the regional level as to which procurement brings a ''balanced [and] prosperous economy for everybody''. Interviewee M continued that this policy distribution can also reduce the ''wider costs associated with persistent social exclusion''. Helping this policy down to the ground requires public engagement. This was simply reasoned by Interviewee G, stating ''keeping the local community close and happy. We'll help you manage political risk and change of government risk, all those kinds of things''. However, the gap, according to Interviewee D, was that ''what the government wants to do is invest to create economic growth. What the public wants to do is travel from A to B in a convenient, comfortable way. And the two don't necessarily align''. Therefore, there is a balance of the social inclusion (in terms of policy distribution) to strike between economic development and public engagement. When considering this balance in V*f*M assessment and reflecting on a water transport case, Interviewee F provoked:

*''whether or not the building of a road will allow economic development in an area where otherwise wouldn't have happened? And also whether business supply chains can be facilitated? […] there is a plan to build a bridge or a tunnel, and whereas water transport is slow, the building of a road link or a rail link could easily facilitate the economic development either side of the stretch of water. […] does the construction of a road divert traffic from local roads? So what is the environmental benefits of diverting traffic to a single road?*

Now that traditional V*f*M (i.e., cost, quality, and time) and public V*f*M (i.e., service/ functionality, environment, distribution, resilience, and social inclusion) have been validated to be indispensable ingredients of V*f*M assessment, and more importantly, how these themes (and sub-themes) can be accounted for in the context of transport infrastructure has been uncovered, the next section seeks to understand the relationship between them so that a comprehensive V*f*M assessment model can be formulated.

## 6.5 Relationship between the Variables in Value for Money Assessment

As mentioned in Chapter 2, the questionnaire survey data were analysed through the Analytical Hierarchy Process technique to quantify the relationship between variables in V*f*M assessment that have been validated above. The first step was to transform the responses into matrices, and an example is provided in Table 6.1. Although the scale of responses may differ, in this instance, it is a vivid illustration (Table 6.1) of how public V*f*M should be paid more attention in V*f*M assessment while preserving the traditional cost comparison. At the end of the first step, a total of 31 matrices were generated.

Table 6.1. An example of the pairwise comparison matrix[26]

| | C | T | Q | S | E | R | D | I |
|---|---|---|---|---|---|---|---|---|
| Cost | 1 | 6 | 1 | 1 | 1 | 1 | 1 | 1 |
| Time | 1/6 | 1 | 1/7 | 1 | 1/9 | 1/7 | 1/6 | 1/9 |
| Quality | 1 | 7 | 1 | 5 | 1/3 | 1/2 | 1/2 | 1/5 |
| Service | 1 | 1 | 1/5 | 1 | 1/5 | 1 | 1/3 | 1/3 |
| Enviro. | 1 | 9 | 3 | 5 | 1 | 1 | 3 | 1 |
| Resilience | 1 | 7 | 2 | 1 | 1 | 1 | 1 | 1/3 |
| Distr. | 1 | 6 | 2 | 3 | 1/3 | 1 | 1 | 1 |
| Inclusion | 1 | 9 | 5 | 3 | 1 | 3 | 1 | 1 |

Based on the individual responses (i.e., 31), the second step was to calculate the aggregated pairwise comparison matrix using Equation (2.1) as shown in Chapter 2. Similar to Equation (2.2) (see Chapter 2), the result of this process is displayed in Table 6.2. Notably, conforming to the common practice, the results of each cell were kept to two decimals.

Table 6.2. The aggregate matrix of V*f*M assessment variables

| | C | T | Q | S | E | R | D | I |
|---|---|---|---|---|---|---|---|---|
| Cost | 1.00 | 1.82 | 0.71 | 0.59 | 0.41 | 0.56 | 0.75 | 0.49 |
| Time | 0.55 | 1.00 | 1.00 | 0.43 | 0.40 | 0.27 | 0.38 | 0.56 |
| Quality | 1.41 | 1.00 | 1.00 | 1.47 | 0.65 | 1.00 | 1.05 | 0.86 |
| Service | 1.70 | 2.35 | 0.68 | 1.00 | 0.42 | 1.18 | 1.20 | 1.09 |
| Enviro. | 2.46 | 2.49 | 1.54 | 2.38 | 1.00 | 0.79 | 1.73 | 2.24 |
| Resilience | 1.78 | 3.70 | 1.00 | 0.85 | 1.26 | 1.00 | 1.00 | 0.83 |
| Distr. | 1.33 | 2.61 | 0.95 | 0.84 | 0.58 | 1.00 | 1.00 | 0.56 |
| Inclusion | 2.04 | 1.78 | 1.17 | 0.92 | 0.45 | 1.20 | 1.78 | 1.00 |

By using Equations (2.3) and (2.4) as shown in Chapter 2, the third step resulted in each variable's priority in V*f*M assessment. Thus, the principal eigenvector of the matrix was attained as:

[26] For formatting purposes, full names of the variables in the first row were abbreviated to their first letter. For example, 'C' is short for 'cost', and 'I' is short for 'inclusion' (i.e., social inclusion). This arrangement is applied to Table 6.2 as well.

$$P_{VfM_i=}\begin{pmatrix}0.08\\0.06\\0.12\\0.13\\0.20\\0.15\\0.12\\0.14\end{pmatrix}(i=1,2,\dots,8) \tag{6.1}$$

That means the priorities of cost, time, quality, service, environment, resilience, distribution, and social inclusion in V*f*M assessment were 0.08, 0.06, 0.12, 0.13, 0.20, 0.15, 0.12, and 0.14, respectively.

The final step of the AHP process was checking the consistency of the responses so that the results are reliable. As stipulated in Equation (2.7) (see Chapter 2), the largest eigenvalue ($\lambda_{max}$) of the matrix (Table 6.2, $(a'_{ij})_{8\times8}$) was computed as follows:

$$(a'_{ij})_{8\times8}\cdot P_{VfM_i=}\begin{pmatrix}1&1.82&0.71&0.59&0.41&0.56&0.75&0.49\\0.55&1&1&0.43&0.40&0.27&0.38&0.56\\1.41&1&1&1.47&0.65&1&1.05&0.86\\1.7&2.35&0.68&1&0.42&1.18&1.20&1.09\\2.46&2.49&1.54&2.38&1&0.79&1.73&2.24\\1.78&3.7&1&0.85&1.26&1&1&0.83\\1.33&2.61&0.95&0.84&0.58&1&1&0.56\\2.04&1.78&1.17&0.92&0.45&1.2&1.78&1\end{pmatrix}.$$

$$\begin{pmatrix}0.08\\0.06\\0.12\\0.13\\0.20\\0.15\\0.12\\0.14\end{pmatrix}=\begin{pmatrix}0.6791\\0.5271\\1.0102\\1.0493\\1.6835\\1.2417\\0.9548\\1.1563\end{pmatrix} \tag{6.2}$$

Then, each element of the right-hand side column of Equation (6.2) was divided by its respective $P_{VfM_i}$ to get the following eigenvalues:

$$\lambda_{max\,(1)}=\frac{0.6791}{0.08}=8.0762 \tag{6.3}$$

$$\lambda_{max\,(2)} = \frac{0.5271}{0.06} = 8.5380 \tag{6.4}$$

$$\lambda_{max\,(3)} = \frac{1.0102}{0.12} = 8.3190 \tag{6.5}$$

Similarly, $\lambda_{max\,(4)}$, $\lambda_{max\,(5)}$, $\lambda_{max\,(6)}$, $\lambda_{max\,(7)}$, and $\lambda_{max\,(8)}$ were calculated to be 8.2511, 8.3734, 8.4026, 8.1562, and 8.2704, respectively.

Therefore, $\lambda_{max} = \frac{8.0762+8.5380+8.3190+8.2511+8.3734+8.4026+8.1562+8.2704}{8}$

$$= 8.2995 \tag{6.6}$$

According to Equation (2.6) (see Chapter 2), the value of the consistency index (*C.I.*) was yielded to be:

$$C.I. = (8.2995\text{-}8) / (8\text{-}1) = 0.043 \tag{6.7}$$

As there were eight variables in the matrix, the random consistency index was set to be 1.41 using the reference value provided in Table 2.11 (as shown in Chapter 2). With the values of the consistency index (i.e., 0.043) and the random consistency (i.e., 1.41), the consistency ratio (*C.R.*) was calculated by adopting Equation (2.5) (see Chapter 2):

$$C.R. = 0.043 / 1.41 = 0.03 \tag{6.8}$$

Given that a value of the consistency ratio lower than 0.10 is deemed reliable (Saaty, 1980), the results presented in Equation (6.1) were subsequently validated. Therefore, the relationship between the variables in V*f*M assessment was quantitatively finalised in Figure 6.12.

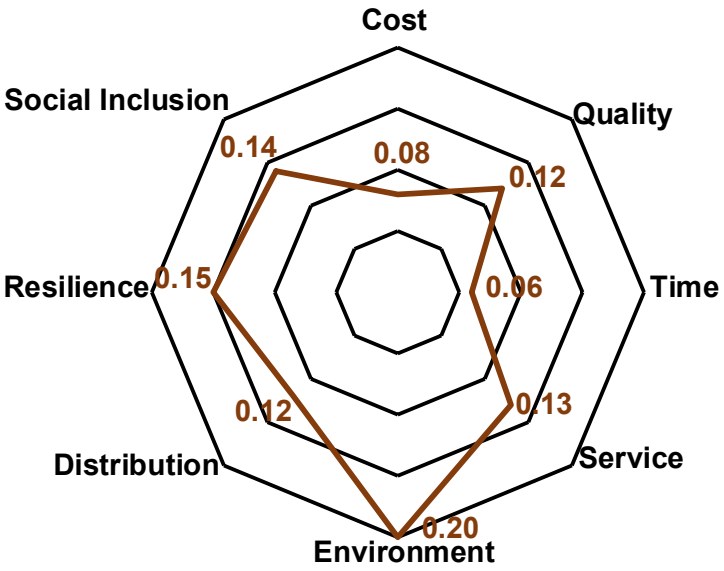



Figure 6.12. The relationship between variables in V*f*M assessment

It is crystal clear that cost still assumes a place in V*f*M assessment, but its importance is dented compared with other elements of public V*f*M. This injects empirical evidence to the rationale of the existence of both traditional and public V*f*M in the proposed V*f*M framework in Chapter 5. With time being given the lowest priority, it also corroborates the interviews that delivering fast may not naturally engender advantages, and warrants the necessary planning and negotiation time in transport infrastructure interventions. Among the public V*f*M being identified, the issue of environment has been accentuated, underlining again the innovation of a particular procurement approach to mitigating transport projects' environmental impacts. In addition, the predisposition that public V*f*M and traditional V*f*M are not exclusive is confirmed by the equal priority placed on quality (part of traditional V*f*M) and distribution (part of public V*f*M). It is consistent with the interviews that a project with good quality will improve the next generation's willingness to pay.

Taken together the findings of interviews and questionnaire surveys, the V*f*M assessment framework is refined as Figure 6.13 (as opposed to Figure 5.3 in Chapter 5). The life-cycle V*f*M assessment is standardised to encompass an *ex-ante* assessment for decision-making and an *ex-post* assessment for monitoring to clear the ambiguity concerning the role of V*f*M in any procurement approach (the fourth point of department in Chapter 3). The next section discusses how it is operated.

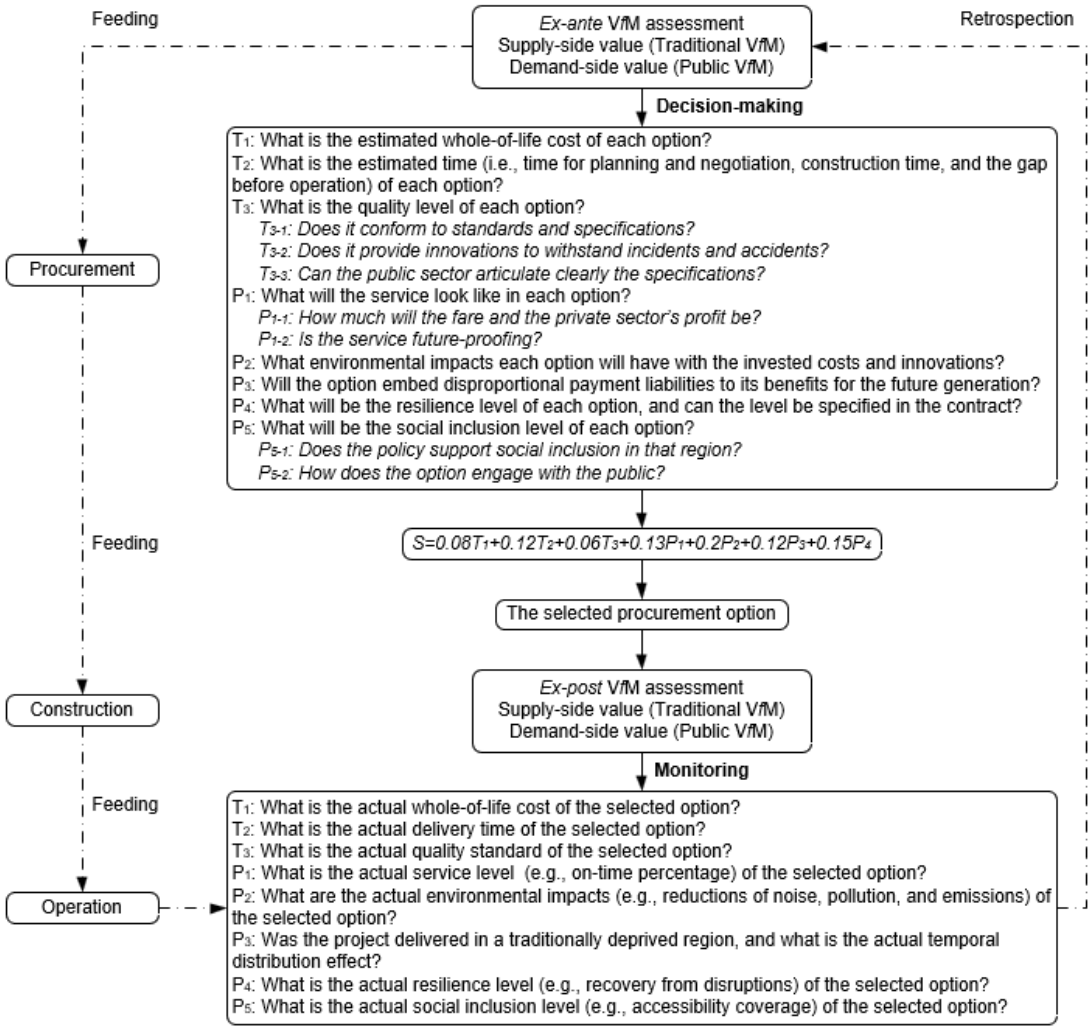



Figure 6.13. The life-cycle V*f*M assessment framework

## 6.6 Operationalisation of the Validated Framework

### 6.6.1 The Standard Approach

Chapter 5 has identified that the concept of V*f*M remains nebulous in the existing literature. A recent example is the '*Transforming Infrastructure Performance: Roadmap to 2030*' released by the UK's Infrastructure and Projects Authority (2021a). Although it envisaged ''value for money and outcomes are prioritised and maximised through far greater coordination at all levels (p.18)'', the question '*what are value for money and outcomes?*' has not been clearly addressed. Theoretically, according to theories of value examined in Chapter 5, this can be countered by combining the demand-side value (as represented by traditional V*f*M) and supply-side value (as represented by public V*f*M). Practically, the lack of consideration for public V*f*M is well evidenced during the interviews. If anything, it is treated, in Interviewee I's view, as ''additional benefits'' because they ''don't necessarily accrue to the authorities during the project''.

Although Interviewees D and I acknowledged local councillors and civil servants' effort to accounting for people's concerns in infrastructure, this conflict between governments and the public, as observed by Interviewee F, has created ''a problem of trusting government, certainly in the Europe and the United States''. The repercussions of neglecting public V*f*M are ''different manifestations of pushback in different locations'' (Interviewee F) and at least a ''considerably change to your proposals'' (Interviewee D). Although it is a complex issue, public V*f*M is generally considered to be equally important to traditional V*f*M by 17 survey respondents. The remaining 14 respondents even considered it more important than traditional V*f*M on a scale of 2 to 9 (definitions of the scale can be found in Chapter 2). Therefore, this

standard approach to assessing V*f*M closes the gap by providing a consistent way of considering V*f*M. In addition, by presenting the questions and the approachable equation in Figure 6.13, it fulfils the vision, according to Interviewee G who has worked with different governments and international organisations, that governments ‘‘want V*f*M to be consistent and robust, and you want it to be so transparent so everybody knows what the rules are, and how to approach it, and how to do the analysis’’. Once agreed, it is also considered by Interviewee C as ‘‘a major step forward (for the industry)’’.

This is not to declare that the proposed V*f*M framework is flawless. Although the standardisation has similar benefits as the standard contract form, which helped ‘‘avoid having to renegotiate these (*contract terms*) from the ground up every single time’’ (explained by Interviewee H), Interviewee G contended that ‘‘you need to evolve based on changing context and information’’. Supporting this sector-responsive and project-responsive assessment, Interviewee F suggested V*f*M assessment should be ‘‘done on a case-by-case basis’’. Therefore, it needs reiteration here that the findings were interpreted in the context of transport infrastructure projects, and thus may need adaption to be applied to other sectors (see the research scope in Chapter 1). Nevertheless, within the transport context, the model, which determines the relationship between the variables, allows the flexibility of assigning different weights to them. This accords with Interviewee I’s point that ‘‘it’s (*VfM assessment*) what weighting you apply to it (*variables*)’’. It also satisfies Interviewee J, because as an economist, he needs ‘‘to see a number, if not a number, a categorisation, a ranking of what’s more or less valuable’’.

Additionally, by asking the questions listed in Figure 6.13, it can help the public sector change the old style the contractors behave in, which is, as indicated by Interviewee K, ‘‘if you don’t ask the question, you’re not going to get the answer’’. Clearly, asking such questions requires the public sector to be equipped with necessary client skills, and these can be acquired through the feeding and retrospective mechanism embedded with the framework.

As this study approached its end, a principle of value-based decision making was published in June 2022 by The British Standards Institution (BSI, 2022). Since this principle aims to enable clients and policymakers to make and implement value-based decisions, it is a clear basis for comparison with the model developed in this study. Clearly, both approaches share the mission to drive value out of projects. Nevertheless, the principle, based on the natural, human, social, and produced capitals (i.e., the ‘four capital approach’), was designed to suit all types of assets (regardless of size, complexity, or chosen procurement strategy). In comparison, the V*f*M decision making model proposed here is tailored to the transport sector, and the choice between PPPs and the traditional procurement method at the project inception stage, although both models assess each value variable during the operation stage. As mentioned above, V*f*M has been standardised as a dyad of demand-value (end-users) and supply-value (governments as project sponsors), while the ‘four capital approach’ still ambiguously defines value for clients and their stakeholders.

In terms of the technical enactment, the ‘four capital approach’ adds an additional degree of credibility to the V*f*M decision making model in this study as both models unanimously choose to place different emphases on the value objectives (i.e., V*f*M

variables in this study). However, they differ in that the 'four capital approach' continues to subjectively rate the outcome drivers (used to achieve the objectives) on a scale of 1-5, while the V*f*M decision model developed in this study uses actual performance metrics to represent V*f*M variables (see Chapter 7). Therefore, it is reasonable to argue that the subjective rating for both the objectives and outcome drivers in the 'four capital approach' can be subjected to criticism (e.g., by being open to manipulation). In summary, there are similarities and differences, but both models rely on the determination of project decision makers to bring V*f*M to the public, and to do so by learning from both models.

### 6.6.2 The Feeding and Retrospective Mechanism

While no questions were prepared regarding the public sector's capability to perform V*f*M assessment, seven interviewees out of the 13 interviews undertaken touched upon this issue, highlighting the procuring bodies' inadequacy of client skills. In a humorous way, Interviewee L, who has spent most of his career time (around 29 years) explaining procurement principles to the public sector, stated that ''you might as well be talking to XXX *(a coffee shop employee)* that's serving you coffee in Costa''. More specifically, by comparing with the private sector, Interviewee J very generally pointed out that ''their (the public sector) administration and documentation, and sort of contractual monitoring is nearly as intense''. Even in the case of a design and build project (not to mention PPPs), Interviewee D recalled:

*''a lot of clients stripped out that technical capacity, under the impression that, the thing is that those technical teams did under design and build would better sit with contractors. And that's created a situation where most clients are not very good*

*construction clients, [and they] moved into a position where their skill base is very poor.''*

Without the technical capacity at the public sector's side, it often outsources V*f*M assessment to consultants by exploiting their knowledge and keenness. However, Interviewee C defied the overreliance on consultants because decision makings based on their inputs can be disappointing if ''you appoint someone who's very new to it, you don't get an awful lot out of the exercise''. In this case, Interviewee F proffered that public bodies need to ask themselves, firstly, ''why and whether they've got the resources to actually manage the procurement process effectively'', and secondly, ''whether this is the right time to bring the project to market (*to avoid being exploited by bidders/ consultants*)''. If the project is decided to be put on the market to select a procurement approach, another skill the public sector needs is ''using the expertise of the supply chain'' as suggested by Interviewee B. As a result, this supply chain needs to consider the bundling of construction and operation, or using what Interviewee L called ''plain vanilla'' to separate them for simplicity. In the meantime, when all the client skills are honed, there needs to be an awareness of clients being too dominant to innovate. In transport V*f*M assessment, Interviewee M concerned:

*''we take projects far, too far down a detailed design in the UK under the guise of getting planning and getting environmental permits, but I actually think it represents a sort of institutionalised desire for control in UK government. In transport planning bodies, the industry is run by engineers, engineers want to know about every nut and bolt. Do they need to know about every nut and bolt when they're doing a procurement? No, that's the job of the person that is procuring, they could decide some of that. So I think we go a bit too far down the route of closing down scope for*

*innovation under both procurement routes in the UK, because we design everything to death in the UK.''*

With an understanding of the standard approach to V*f*M assessment (Section 6.6.1), the above discussion shows that the public sector needs to acquire such skills as contractual monitoring, technical capacity, resources allocation, spotting knowledgeable and keen consultants, and supply chain before the decision making starts. As such, the retrospective mechanism exists to provide lessons learnt from past projects to update the skills reservoir, whereas the feeding mechanism can strengthen the decisions made to monitor project progress, and remedies can be made in cases where the initial decision has a 'fault'. By closing the learning loop (within and beyond the project), this feeding and retrospective mechanism was applauded by Interviewees D, E, F, K and M. For instance, Interviewee K put it directly:

*''So learning not only, it was in portfolio procurement or strategic procurement, so there's a whole portfolio of projects, so that I learned from one to the following, the next, and so forth, and the portfolio, but also learn as each project goes through its asset life.''*

A by-product of this mechanism can be a culture change that inherently drives the public sector to rethink V*f*M. The present culture, according to Interviewee I, is that the public sector does not ''understand what quality really means'' as ''cost is easy to get your head round''. By learning from the standard concept of V*f*M proposed above, it is possible to ''develop true collaboration, trust, and a genuine understanding of the user's requirements'', which is still absent as argued by Interviewee L. Sometimes, the present culture can degenerate into a blame culture where, as stated by Interviewee

F, no one is ‘‘going to admit mistakes, and a blind coach is one where people pretend there wasn’t any mistakes without responsibility’’. The mechanism may not turn the blame culture over immediately, but the client skills obtained through the mechanism can reduces the possibility of ‘mistakes’. In order for the mechanism to unleash such potential, it should be implemented alongside the standard V*f*M assessment by aligning the *ex-ante* and *ex-post* assessment.

### 6.6.3 The Ex-ante and Ex-post Value for Money Assessment

Another contribution of the V*f*M assessment framework is the alignment of the *ex-ante* and *ex-post* V*f*M assessment. Evidently, the proposed V*f*M assessment does no more than just selecting a procurement approach at the front end. For example, the *ex-ante* V*f*M assessment in the framework serves the same purpose as DeCorla-Souza (2014) by providing a decision-making model. This can be applied to circumstances where, as Interviewee G stated, ‘‘if you really want your value for money to say yes or no to an issue with numbers behind it’’. By virtue of the feeding and retrospective mechanism, the shortcoming of lacking competent client skills in this ‘yes or no’ practice to get concrete and quantifiable numbers can potentially be rectified. However, it also complements the existing assessment (e.g., Ismail *et al*., 2012) by considering public V*f*M. In this sense, it concurs with Interviewee B that ‘‘the opportunity for most influence is upfront to drive value add to the project’’. To secure the value upfront, the addition of public V*f*M also addresses Interviewee C’s observation that ‘‘too much focus is given to the early stage of the project. And we look at the costs, the capital costs, we look at the funding requirement cost, we look at how quickly we can deliver it into service’’.

The necessity for the *ex-post* V*f*M assessment lies in the fact that only at this stage the public sector knows whether they have delivered the promise made at the beginning (Hodge and Greve, 2017). This is what Interviewee K contended ‘‘value for money assessment happens once a project is actually built’’. Although the intentions (summarised by Interviewee E) are monitoring ‘‘are you on track to deliver the benefits that you said you would deliver?’’ and ‘‘have you delivered the benefits that you said you would deliver?’’, Interviewee D’s 20-year experience has shown that the *ex-post* V*f*M assessment tends to be a case of ‘‘there’s the agenda, tick through the agenda, and move on’’. To address this, the framework proposes the same questions that will be asked to eschew intentional deviations (or the ‘box-ticking’ practice), and this is supported by the AHP-underpinned model to be run again to check the result. Institutionally, the culture change emanated from the feeding and retrospective mechanism can ensure the *ex-ante* V*f*M assessment and *ex-post* V*f*M assessment comparable. Having in place the institutional mindset can also solve the ‘‘staff turnover issue’’ raised by Interviewee J that impedes the execution of the *ex-post* V*f*M assessment. This way, the ‘rule of thumb’ is the successor still has to obey the regulation even though the previous project manager has left.

The consistent criteria in the *ex-ante* V*f*M assessment and *ex-post* V*f*M assessment do not mean that they cannot be flexible. Being pragmatic, Interviewee M buttressed re-assessment of V*f*M at different points, and stated:

*‘‘we wanted to achieve this and those, but is that appropriate? Should we look at setting different criteria? I think it’s okay to do that so long as you do it on an informed basis, and you document why you’ve changed it. And you know, you can’t go through a business case process with a set of objectives, procure something*

*predicated on delivering something, and then later down the line, change your mind about what you wanted, and be fair in assessing value for money at that point, you know, you've got to provide a fair basis against which to judge.''*

This degree of flexibility can be allowed by modifying the priority initially assigned to the assessment variables (i.e., cost, time, quality, service, environment, distribution, resilience, and social inclusion) while injecting new themes emerged over the project cycle. However, this modification should not become a practice of abandoning the whole thing and starting over as it downgrades the *ex-ante* V*f*M assessment. Therefore, there should perhaps be more 'injections' than 'modifications' in the *ex-post* V*f*M assessment to do more and better. At the very least, mandatory variables can be identified in the *ex-ante* V*f*M assessment so that those stay perpetual. In line with the feeding and retrospective mechanism, the 'modifications' take place when, as suggested by Interviewee D:

*''you might not be perfectly in compliance, that you know, there will be inconsistencies. There will be things that go wrong. We're all human. But that's where the learning loops come in.''*

According to Interviewee K, this 'fault' tolerance property of the *ex-post* V*f*M assessment can be encouraging for the public sector ''to not repeat the same errors or fall into the same traps''. The problem may not be solved once for all as V*f*M assessment *per se* is a complex issue that has plagued the academia and industry for a long time. Nevertheless, the V*f*M assessment framework validated here can enable a fresh thinking of how V*f*M can be assessed in the context of transport infrastructure

project by providing a standard approach, institutionalising the feeding and retrospective mechanism, and aligning the *ex-ante* and *ex-post* V*f*M assessment.

## 6.7 Chapter Summary

This chapter has fulfilled Objective III of this thesis by answering the sub-questions '*what is the public sector's understanding of VfM assessment?*' and '*what is the relationship between the variables in VfM assessment?*'. Drawing on interview data and a thematical analysis, three themes of traditional V*f*M, namely cost, quality, and time, and five themes of public V*f*M, namely service, environment, distribution, resilience, and social inclusion, were criticised, analysed, and validated by discussing their respective sub-themes (as illustrated in Figures 6.2 to 6.11). As a minor output of this process, the interviews also confirmed PSC and cost-benefit analysis, which were identified in Chapters 3 and 4 to be the popular (existing) V*f*M assessment methods. Capitalising on questionnaire survey data and the AHP technique, the quantitative relationship between the assessment variables (i.e., cost, quality, time, service, environment, distribution, resilience, and social inclusion) was identified to be 0.08, 0.06, 0.12, 0.13, 0.20, 0.15, 0.12, and 0.14 (as illustrated in Figure 6.12). Taken together, the V*f*M assessment framework proposed in Chapter 5 was subsequently refined and validated (as illustrated in Figure 6.13). Markedly, the importance of a standard approach and the feeding and retrospective mechanism underpinned by the consistent *ex-ante* and *ex-post* V*f*M assessment was highlighted for the V*f*M assessment framework to be operationalizable.

# CHAPTER 7 EMPIRICAL APPLICATION

## 7.1 Chapter Introduction

With the developed model in Chapter 6, Chapter 7 aims to address the fourth objective of this study (i.e., applying the developed V*f*M assessment model to a real-world infrastructure project). Based on the open accessibility of published articles, news, reports, pictures and videos, project documents, and interviews conducted with management officials, this chapter reports a light rail transit project in North East England. The Tyne & Wear Metro was branded as 'Britain's first modern light rail system'. The application begins with introducing the background of the project, and explaining why it was selected and the data sources. Through an illustrative case study approach, this chapter then concentrates on how the Metro's procurement method was determined and how its value for money was delivered thereafter.

## 7.2 Background and Data Sources of the Case Project

The case project is the 'Tyne and Wear Metro' (referred to as 'the Metro' hereinafter in this chapter), which was constructed in 1974 with 75% of the building cost coming from central government, was opened in 1980 in phases, and has been fully in operation in Newcastle upon Tyne, Gateshead, North Tyneside, South Tyneside, and the City of Sunderland since 2002. As depicted in Figure 7.1, there are currently two lines of the Metro with a total of 60 stations, covering 48.2 miles of track. While the project carried more than 60 million passenger journeys in the first year of full operation in 1984, it now runs with around 37 million passengers per year. As a cornerstone of Tyne and Wear's public transport that affects people's daily life in that region, its operator – Nexus (the trading name), a public body of the Tyne and Wear

Passenger Transport Executive, has set out the objective of the Metro and Local Rail Strategy (Northeast Combined Authority and Nexus, 2016) to achieve value for money (V*f*M). This paves the way for the developed model of this study to examine the Metro's V*f*M.

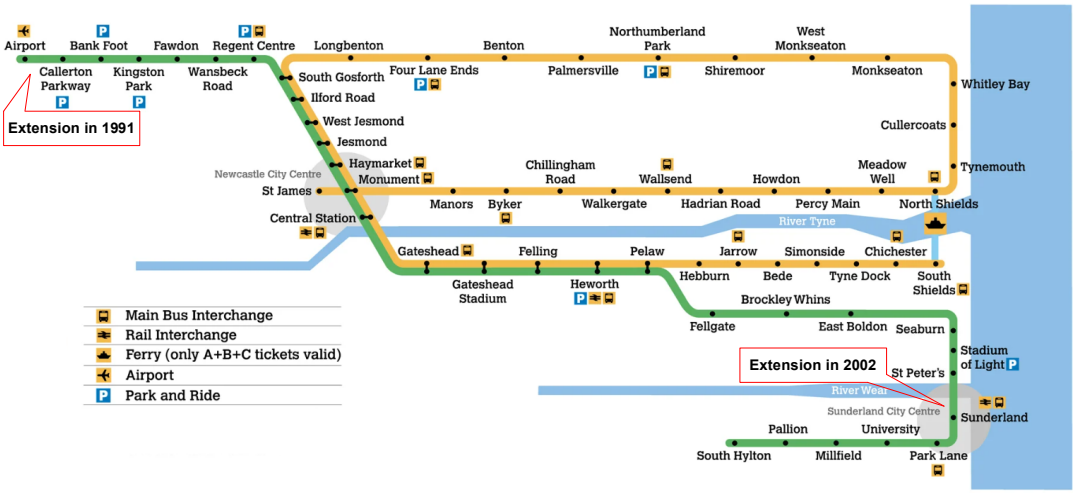



Figure 7.1. The map of Tyne and Wear Metro

(Source: https://www.nexus.org.uk/metro, with researcher edits)

The main reasons for the Metro to be selected as a testbed for the developed model were: (1) V*f*M was envisaged as one of the objectives but was not articulated; (2) the project has undergone both concessions and public ownership[27]; and (3) data accessibility. The limited understanding of V*f*M in the Metro project was illustrated in two aspects. First, similar to the common preconception revealed by the interviews (Chapter 6), V*f*M of this project was equivalated to lowest cost. For example, the Metro and Local Rail Strategy stated ''on-going operating costs also need to be kept to a minimum to deliver value for money''. Second, expectations from governance, V*f*M, and passenger benefits of future operation of the Metro were not clear. As such,

[27] 'Concessions' and 'public ownership' were treated as 'PPPs' and 'the traditional procurement approach' in this chapter, respectively.

by applying the V*f*M assessment model developed in this study to the Metro project, it is of interest to the public sector (i.e., Nexus) to reflect on the procurement decision and ensure V*f*M in going forward (i.e., operation and maintenance of the existing two lines, and the way the potential corridor extension – Figure 7.2 – will be procured and managed).

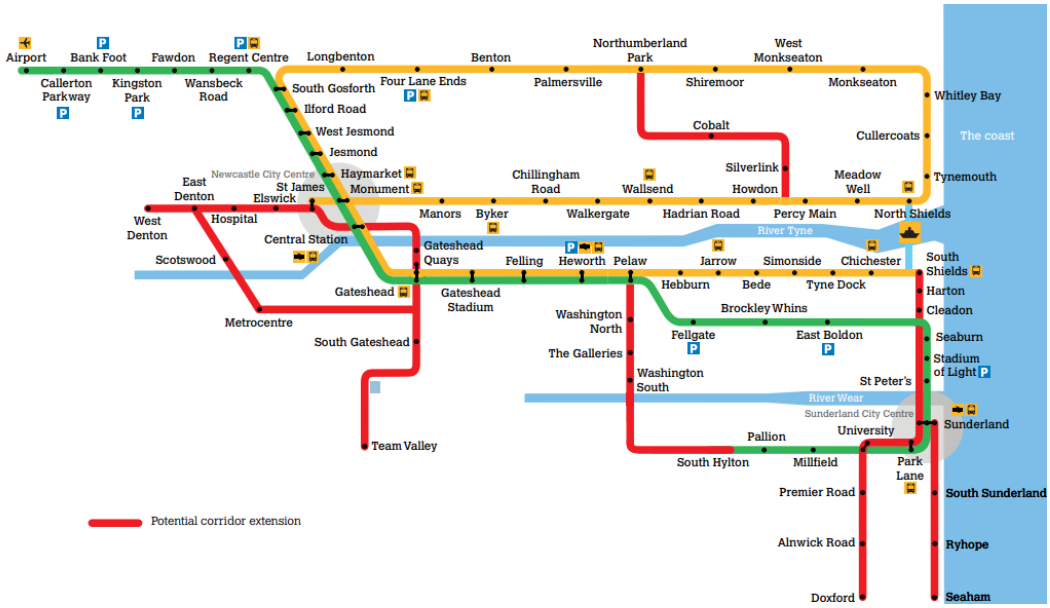



Figure 7.2. Potential corridor extension of the Metro

(Source: Nexus's Metro Strategy 2030 document, https://www.nexus.org.uk/sites/default/files/Metro%20Strategy%202030%20summary%20document.pdf)

To do so, data collected in Table 7.1 were analysed using the developed model to compare with the procurement decision and examine the status of V*f*M at the point of enquiry. This was supported by interviews undertaken with project management officials for the Metro case study. At this juncture, it should be pointed out that results drawn here are not conclusive and should be cautiously referenced by the public operator. For example, one interviewee (in the Metro case study) mentioned that there were fluctuations in performance between years. Nevertheless, this illustrative case

study demonstrates how the model can be applied in practice and serves as a tool for the public operator to rethink the Metro's V*f*M assessments in the future. According to Hayes *et al*. (2015), the purpose of such an illustrative case study is to bridge the gap in the understanding of the researched subject (e.g., V*f*M assessment in this research) between the researcher and the target audience (e.g., the public sector operator - Nexus), providing a common language with which to discuss V*f*M.

Table 7.1. Main data sources for the case study[28]

| Types | Title | Documentary sources |
|---|---|---|
| Government report | Metro and Local Rail Strategy | North East Combined Authority |
| Audited report | Nexus annual reports and accounts | Nexus |
| News | North East News: Tyne and Wear Metro | ChronicleLive |
| Academic articles | Tyne and Wear Metro delays | Xuan and Marinov (2016) |
| Investigation report | Rail accident report: near miss with track workers at Pelaw North Junction | Rail Accident Investigation Branch |
| Investigation report | Rail accident report: near miss incident at Seaburn station platform | Rail Accident Investigation Branch |
| Government committee meeting | Tyne and Wear Sub Committee Agenda Pack | North East Combined Authority, Transport North East (Tyne and Wear) Sub-Committee |
| Government report | Monitoring Nexus' Performance | North East Joint Transport Committee, Tyne and Wear Sub-Committee |
| Government research and analysis | Government GHG conversion factors for company reporting: methodology paper for emission factors | Department for Business, Energy & Industrial Strategy |

[28] Additional data sources are provided in Appendix VI.

### 7.3 Value-for-Money Decision-making for the Case Project

Before April 2010, the Metro was in public ownership and run by Nexus. This was the case even when the rail network in the UK was privatised in 1996. However, as part of the £350 million 'Metro: all change' programme to modernise the Metro infrastructure (e.g., track replacement, stations improvement, and new ticket machines), the Government explicitly required V*f*M (i.e., *via* privatisation) to be accounted for in the system. As a result, DB Regio, a subsidiary of German state-owned firm - Deutsch Bahn, was selected to operate the Metro network under a concession contract (a specific type of PPPs) from 2010 to 2017. While Nexus could exercise the right to extend the contract for another two years, it took over the operation responsibility after the contract expired in March 2017 because it was not ''delivering the outcomes for passengers'' that the contractual parties had expected. The Metro has remained under Nexus's control since then despite this being initially considered a two-year 'transition' for a new contract. Against this contextual backdrop, it can be seen that the concession contract signed with DB Regio Tyne and Wear Ltd was demanded by the Department of Transport as some form of 'exchange' for the £350 million capital investment. Thus, it remains unknown whether a V*f*M assessment would support this decision.

With this in mind, interviews with a senior official who experienced the privatisation decision-making of the Metro were undertaken to examine the V*f*M practice. As part of the interviews, a questionnaire survey (see Appendix IV) was conducted. As mentioned in Chapter 2, compared with the main data collection process (for Chapter 6) where pairwise comparison was performed at the middle layer (i.e., 'criteria' in Figure 7.3), this round continued to the bottom layer (i.e., 'alternatives' in Figure 7.3)

for the case study to understand how the procurement decision was made. At this lowest level, the official was asked to compare to what extent (on a scale of 1 to 9 as in Chapter 2) 'concessions' were better than 'public ownership' (or *vice versa*) in satisfying the criteria (i.e., cost, quality, time, service, environment, distribution, resilience, and social inclusion). Figure 7.3 shows the V*f*M hierarchy for the Metro project.

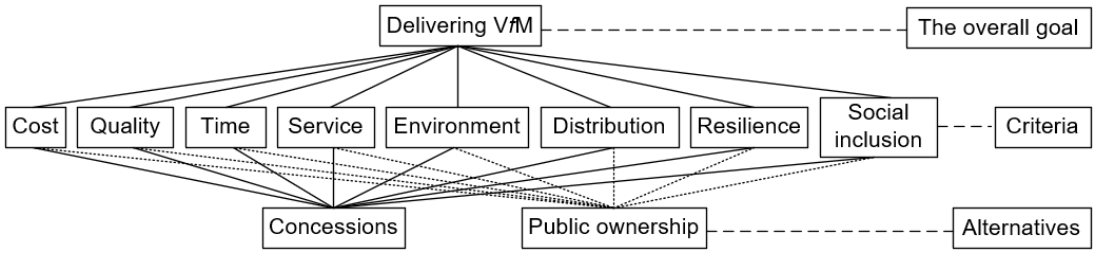



Figure 7.3. The V*f*M hierarchy for the Metro project

The questionnaire survey data collected through the interviews were then analysed through the Analytical Hierarchy Process (AHP) technique. As with the model developed in Chapter 6, the aim of this stage was to make a decision about the preferred procurement approach for the Metro that could potentially enable V*f*M to be delivered. The first step was to transform the responses into a matrix. Subsequently, there were one matrix describing the result of pairwise comparison between the 'criteria', and eight matrices describing the results of pairwise comparison between the 'alternatives', which are presented in Tables 7.2 and 7.3, respectively.

Table 7.2. The pairwise comparison matrix for criteria of the Metro project[29]

| | C | T | Q | S | E | R | D | I |
|---|---|---|---|---|---|---|---|---|
| Cost | 1 | 6 | 1 | 1 | 1/7 | 7 | 1/7 | 1/7 |
| Time | 1/6 | 1 | 1/5 | 1/7 | 1/8 | 2 | 1/8 | 1/6 |
| Quality | 1 | 5 | 1 | 1/5 | 1/7 | 6 | 1/5 | 1/6 |
| Service | 1 | 7 | 5 | 1 | 1 | 7 | 1/3 | 1 |

[29] For formatting purposes, full names of the variables in the first row were abbreviated to their first letter. For example, 'C' is short for 'cost', and 'I' is short for 'inclusion' (i.e., social inclusion). This arrangement is applied to other tables in this chapter as well.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Enviro. | 7 | 8 | 7 | 1 | 1 | 7 | 1 | 1 |
| Resilience | 1/7 | 1/2 | 1/6 | 1/7 | 1/7 | 1 | 1/6 | 1/7 |
| Distr. | 7 | 8 | 5 | 3 | 1 | 6 | 1 | 1 |
| Inclusion | 7 | 6 | 6 | 1 | 1 | 7 | 1 | 1 |

Table 7.3. The pairwise comparison matrices for alternatives of the Metro project[30]

| *C* | CONC. | PO | *T* | CONC. | PO |
|---|---|---|---|---|---|
| CONC. | 1 | 6 | CONC. | 1 | 8 |
| PO | 1/6 | 1 | PO | 1/8 | 1 |

| *Q* | CONC. | PO | *S* | CONC. | PO |
|---|---|---|---|---|---|
| CONC. | 1 | 1/7 | CONC. | 1 | 8 |
| PO | 7 | 1 | PO | 1/8 | 1 |

| *E* | CONC. | PO | *R* | CONC. | PO |
|---|---|---|---|---|---|
| CONC. | 1 | 6 | CONC. | 1 | 1/8 |
| PO | 1/6 | 1 | PO | 8 | 1 |

| *D* | CONC. | PO | *I* | CONC. | PO |
|---|---|---|---|---|---|
| CONC. | 1 | 1/4 | CONC. | 1 | 1/4 |
| PO | 4 | 1 | PO | 4 | 1 |

By using Equations (2.3) and (2.4) as shown in Chapter 2, the second step was to elicit each criterion's priority in V*f*M assessment. Thus, the principal eigenvector of the matrix was attained as:

$$P_{VfM_i}= \begin{pmatrix} 0.0712 \\ 0.0222 \\ 0.0557 \\ 0.1458 \\ 0.2263 \\ 0.0194 \\ 0.2442 \\ 0.2152 \end{pmatrix} (i = 1, 2, \dots, 8) \quad (7.1)$$

$P_{VfM_i}$ means the priorities of cost, time, quality, service, environment, resilience, distribution, and social inclusion in V*f*M assessment of the Metro were 0.0712, 0.0222,

[30] For formatting purposes, the full names of concessions and public ownership were abbreviated to 'CONC.' and 'PO', respectively, in this table.

0.0557, 0.1458, 0.2263, 0.0194, 0.2442, and 0.2152, respectively. These were kept to four decimal places to show the nuances between V*f*M variables of the Metro.

This was followed by the calculation of the priority of the alternatives against each criterion, and is provided in Table 7.4.

Table 7.4. The priority of the alternatives against each criterion

| | C | T | Q | S | E | R | D | I |
|---|---|---|---|---|---|---|---|---|
| CONC. | 0.8571 | 0.8889 | 0.1250 | 0.8889 | 0.8571 | 0.1111 | 0.2000 | 0.2000 |
| PO | 0.1429 | 0.1111 | 0.8750 | 0.1111 | 0.1429 | 0.8889 | 0.8000 | 0.8000 |

The third step of the AHP process was checking the consistency of the responses so that the results are reliable. Theoretically, the reliability needs to be checked for all nine matrices in Tables 7.2 and 7.3. However, as there were only two items in each matrix of Table 7.3, the results presented in Table 7.4 were naturally consistent. Therefore, the following section investigates the reliability of Table 7.2. As stipulated in Equation (2.7) (see Chapter 2), the largest eigenvalue ($\lambda_{max}$) of the matrix ($(a'_{ij})_{8\times8}$) in Table 7.2 was computed as follows:

$$(a'_{ij})_{8\times8} * P_{VfM_i} =$$

$$\begin{pmatrix} 1 & 6 & 1 & 1 & 0.1429 & 7 & 0.1429 & 0.1429 \\ 0.1667 & 1 & 0.2 & 0.1429 & 0.125 & 2 & 0.125 & 0.1667 \\ 1 & 5 & 1 & 0.2 & 0.1429 & 6 & 0.2 & 0.1667 \\ 1 & 7 & 5 & 1 & 1 & 7 & 0.3333 & 1 \\ 7 & 8 & 7 & 1 & 1 & 7 & 1 & 1 \\ 0.1429 & 0.5 & 0.1667 & 0.1429 & 0.1429 & 1 & 0.1667 & 0.1429 \\ 7 & 8 & 5 & 3 & 1 & 6 & 1 & 1 \\ 7 & 6 & 6 & 1 & 1 & 7 & 1 & 1 \end{pmatrix} *$$

$$\begin{pmatrix} 0.0712 \\ 0.0222 \\ 0.0557 \\ 0.1458 \\ 0.2263 \\ 0.0194 \\ 0.2442 \\ 0.2152 \end{pmatrix} = \begin{pmatrix} 0.6397 \\ 0.1995 \\ 0.5005 \\ 1.3096 \\ 2.0332 \\ 0.1746 \\ 2.1940 \\ 1.9331 \end{pmatrix} \quad (i = 1, 2, 3, .., 8) \qquad (7.2)$$

Then, each element of the right-hand side column of Equation (7.2) was divided by their respective $P_{VfM_i}$ to get the following eigenvalues:

$$\lambda_{max\,(1)} = \frac{0.6397}{0.0712} = 8.9839 \tag{7.3}$$

$$\lambda_{max\,(2)} = \frac{0.1995}{0.0222} = 8.9871 \tag{7.4}$$

$$\lambda_{max\,(3)} = \frac{0.5005}{0.0557} = 8.9856 \tag{7.5}$$

Similarly, $\lambda_{max\,(4)}$, $\lambda_{max\,(5)}$, $\lambda_{max\,(6)}$, $\lambda_{max\,(7)}$, and $\lambda_{max\,(8)}$ were calculated to be 8.9822, 8.8945, 8.9977, 8.9844, and 8.9828, respectively.

Therefore, $\lambda_{max} = \frac{8.9839+8.9871+9.9856+8.9822+8.8945+8.9977+8.9844+8.9828}{8}$

$$= 8.9860 \tag{7.6}$$

According to Equation (2.6) as shown in Chapter 2, the value of the consistency index (*C.I.*) for the matrix in Table 7.2 was yielded to be:

$$C.I. = (8.9860\text{-}8) / (8\text{-}1) = 0.1409 \tag{7.7}$$

As there were eight variables in the matrix in Table 7.2, the random consistency index was set to be 1.41 using the reference value provided in Table 2.11 as shown in Chapter 2. With the values of the consistency index (i.e., 0.1409) and the random consistency (i.e., 1.41), the consistency ratio was calculated by adopting Equation (2.5) (see Chapter 2). Given that a value of the consistency ratio lower than 0.10 is deemed reliable (Saaty, 1980), the results presented in Equation (7.1) are subsequently

validated. Therefore, the relationship between the variables in V*f*M assessment of the Metro is visualised in Figure 7.4.

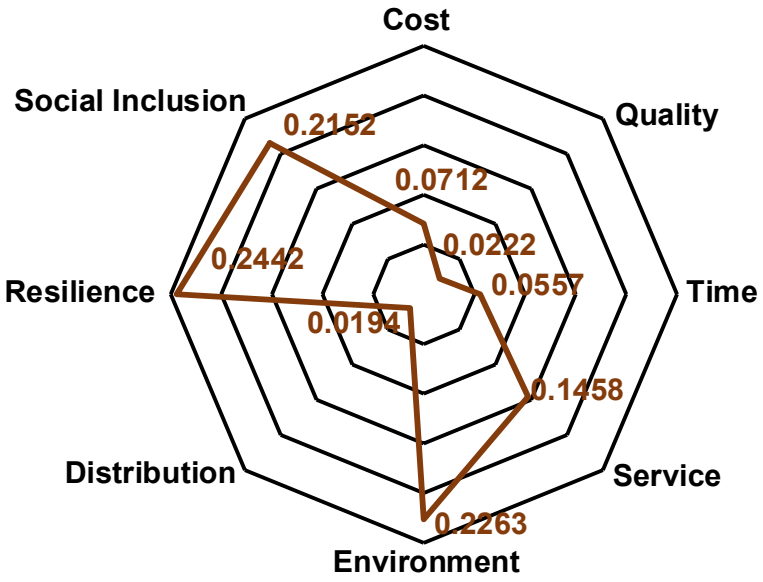



Figure 7.4. The relationship between variables in V*f*M assessment of the Metro

The results of Figure 7.4 show that overall, public V*f*M of the Metro was considered more important than traditional V*f*M. This is consistent with the results of Chapter 6 where the importance of public V*f*M is demonstrated, and the argument of Chapter 5 that public V*f*M and traditional V*f*M together create a more meaningful concept of V*f*M. In particular, environment, resilience, and social inclusion were placed in the top priority group due to the increasing awareness of end-users' experience and environmental change. In the Metro study reported here, one interviewee emphasised that 'public ownership' may be better situated to take end-users' perceptions into account while 'concessions' were adept at resilience-related issues. Adding on this point, another interviewee (for the illustrative case study) used the '2022 heatwave' as an example, and supported concessions as the private sector would bear the responsibility of recovering the Metro's functionality more quickly (due to the risk

transfer arrangement in PPPs). However, it remains to be seen how the traditional V*f*M and public V*f*M actually performed under public ownership or concessions.

The final step of the V*f*M decision-making for the case project was to compare the total V*f*M gains of the two procurement options. This was achieved by multiplying each column of Table 7.4 by the priority of the corresponding criterion, and then adding across each row. In other words, the potential V*f*M of the concession option ($VfM_{CON}$) for the Metro was perceived as:

$$VfM_{CON} = 0.0712*0.8571+0.0222*0.8889+0.0557*0.1250+0.1458*0.889+ 0.2263*0.8571+0.0194*0.1111+0.2442*0.2000+0.2152*0.2000=0.5053 \quad (7.8)$$

Repeating the same procedure for the public ownership option, its potential V*f*M ($VfM_{PO}$) was:

$$VfM_{PO} = 0.0712*0.1429+0.0222*0.1111+0.0557*0.8570+0.1458*0.1111+ 0.2263*0.1429+0.0194*0.8889+0.2442*0.8000+0.2152*0.8000=0.4947 \quad (7.9)$$

Clearly, concessions became the desirable approach to run the Metro project although the difference between the two approaches was deemed marginal. The result was consistent with the actual decision made at that time, which in turn demonstrates the feasibility and effectiveness of the developed model. In reality, DB Regio won the 2011 Light Rail Awards - 'operator of the year' accolade for its excellence in operating the Metro in the first year. This was complemented by the faster delivery (i.e., five months ahead of schedule) of the £30 million refurbishment work of the Metro commissioned by DB Regio in 2015. More importantly, instead of the political decision to embrace privatisation (as part of the deal of the 'Metro: all change'

programme), it shows that the developed model confirms that traditional V*f*M and public V*f*M could justify a concession contract for the Metro, reinforcing the interviewees' (of the interviews conducted in Chapter 6) argument that a rationale is still needed to support political decisions. Nevertheless, it should be pointed out the advantages of concessions over public ownership were not very obvious. This again is consistent with the prolonged advocation of 'nationalisation' of the Metro after it was 'privatised' in 2010. In addition, interviews conducted for the case study confirmed that ''there are no plans for PPPs at the moment'' although they are legally possible. The next section illustrates how V*f*M of the Metro can be examined over the long term.

### 7.4 Value-for-Money Monitoring for the Case Project

Since the Metro has been renationalised in 2017, there is a need for the public sector to understand whether V*f*M has improved. This became more relevant as it awarded a £362 million contract (up to 35 years) to Stadler in 2020, a Swiss train builder, to deliver and maintain 46 new Metro trains to ''transform performance and passenger experience''. Hence, this section focuses on the V*f*M monitoring of the Metro by applying the developed model. Firstly, eight questions, which were extracted from the model (see Figure 6.16 in Chapter 6), about the traditional V*f*M and public V*f*M in relation to the Metro were prepared. Preliminary ranges of answers to these questions were also listed in Table 7.5. This practice of prescribing a quantified metric to assessment variables is common in infrastructure related scholarship. Liyanage and Villalba-Romero (2015) assigned numeric scale (e.g., 1 to 5, -2 to 2) and binary scale (i.e., yes or no) to performance measures of transport projects (procured via PPPs). More recently, attempting to assess the success of public projects, the model

developed by Volden and Welde (2022) gave a score of 1 to 6 (1 indicated a failure and 6 was highly successful) to all evaluation criteria, including efficiency, effectiveness, other impacts, relevance, sustainability, and benefit-cost efficiency. Nevertheless, the developed model (in the step of V*f*M monitoring) advanced previous works in that it not only evaluated the performance of individual criterion but also provided a bird's eye view of the V*f*M of the Metro in general. Details of this are illustrated as follows.

Table 7.5. V*f*M monitoring questions and preliminary answers for the Metro

| Level of V*f*M | V*f*M questions | Quantified metric | Benchmark |
|---|---|---|---|
| Traditional V*f*M | What is the actual operation and maintenance cost of public ownership? | The amount of cost | The less, the better |
| | What is the actual delivery time of public ownership? | Frequency of on-time arrival | The higher, the better |
| | What is the actual quality standard of public ownership? | The number of defects | The less, the better |
| Public V*f*M | What is the actual service level of public ownership? | The customer satisfaction rate | The higher, the better |
| | What are the actual environmental impacts of public ownership? | The amount of carbon emissions, methane, and nitrous oxide | The less, the better |
| | Was the project delivered in a traditionally deprived region?; and what is the actual temporal distribution effect? | Yes/ No; The amount of debt | Yes; The less, the better |
| | What is the actual resilience level of public ownership? | The number of closures (e.g., excess headway minutes) | The less, the better |
| | What is the actual social inclusion level of public ownership? | The area of accessibility (e.g., the amount of patronage) | The higher, the better |

Secondly, drawing on the data presented in Table 7.1, a quantitative answer (on a scale of -1 to 1 in a continuous manner) was gathered for the V*f*M questions. This was

achieved through the use of dimensionless quantity. Specifically, the value of the quantified metrics was determined by Equation (7.10).

$$V_{QM} = (QM_{CON} - QM_{PO}) / QM_{CON} \quad (7.10)$$

Where $V_{QM}$ denotes the value of each metric; $QM_{CON}$ is the V*f*M under the concession contract; and $QM_{PO}$ is the V*f*M under public ownership. As a result, the case study reported in Table 7.6 the individual V*f*M performance of each variable. To appropriately interpret the results, the following caveats should be noted:

- Data were separated collected for the periods of concessions and public ownership, and the year 2017 was the boundary.
- Data were analysed on a yearly basis as situations can be different each year. For example, expenditure data of the Metro in 2016/ 17 and 2017/ 18 were used for the evaluation of cost.
- Being punctual meant that the Metro trains arrived within three minutes of their scheduled time.
- While it may be ideal to measure the number of defects happened during each period for quality, this was not adopted because: (1) the data were difficult to be acquired from Nexus; and (2) if any, the UK's Rail Accident Investigation Branch updated the Metro's information only until 2020. Instead, the same type of quality incidents (i.e., two 'near miss' incidents that happened during concessions and public ownership, respectively) investigated by the same institution (i.e., 'Rail Accident Investigation Branch') was chosen for analysis.

- Since the Metro was constructed and operated in the traditionally infrastructure-deprived region[31], the spatial distribution effect was considered the same for both concessions and public ownership. Therefore, the binary question for this was answered with a 'Yes' and was excluded from the calculation.
- For the variables – 'time', 'service', and 'temporal distribution', a negative value shows an improvement in V*f*M. For others, a positive value shows an improvement in V*f*M.

Table 7.6. V*f*M monitoring results for individual variables of the Metro

| Level of V*f*M | V*f*M questions | V*f*M variables | Results |
|---|---|---|---|
| Traditional V*f*M | What is the actual operation and maintenance cost of public ownership? | Cost | $\frac{95-93.3}{95}=1.79\%$ |
| | What is the actual delivery time of public ownership? | Time | $\frac{82.8\%-85.1\%}{82.8\%}=-2.78\%$ |
| | What is the actual quality standard of public ownership? | Quality | $\frac{7-4}{7}=42.86\%$ |
| Public V*f*M | What is the actual service level of public ownership? | Service | $\frac{7.7-7.8}{7.7}=-1.30\%$ |
| | What are the actual environmental impacts of public ownership? | Environment | $\frac{92.26-107.83}{92.26}=-16.88\%$ |
| | Was the project delivered in a traditionally deprived region?; and what is the actual temporal distribution effect? | Distribution | $\frac{(-18855)-(-21740)}{-18855}=-15.30\%$ |
| | What is the actual resilience level of public ownership? | Resilience | $\frac{246864-204447}{246864}=-17.18\%$ |
| | What is the actual social inclusion level of public ownership? | Social inclusion | $\frac{37.7-36.4}{37.7}=-3.45\%$ |

[31] According to Transport for the North (see https://transportforthenorth.com/northernbudget/), it is asking for commitment for the Government for the 'Northern Budget', which covers a £7 billion Northern Infrastructure Pipeline, £39 billion Northern Powerhouse Rail, and £1 billion Transport for the North over the next 3 years.

Therefore, based on the analysed data (Table 7.6), the Metro (under public ownership) showed an enhanced traditional V*f*M in terms of cost, time, and quality. In comparison, the performance of public V*f*M was nuanced, which reinforced the perceptions revealed in the interviews (Chapter 6), as improvements were observed in service/ functionality and distribution whereas a decreasing trend was obvious in environment, resilience, and social inclusion. Validity of these results (visualised in Figure 7.5) was reflected in several schemes Nexus had launched to stimulate progress in environment, and social inclusion. For example, in 2020, the purchase of 46 new trains estimated a reduction of 30% energy consumption. In 2021, Nexus set out visions in such aspects as 'assistance for customers', 'alternative accessible transport', 'customer information', 'tickets and fares', 'at the station', 'on the train', 'making connections', and 'disruption to facilities and services' to promote accessibility. The most significant decline in resilience also coincided with the realities where the Metro had to frequently suspend services to recover from disruptions. A case in point was the heatwave in 2022 where the Metro was forced to limit its speed to 30 kilometres per hour and a number of routes were closed due to overhead wires sagging. This highlighted the onus of the new trains to survive extreme weather patterns.

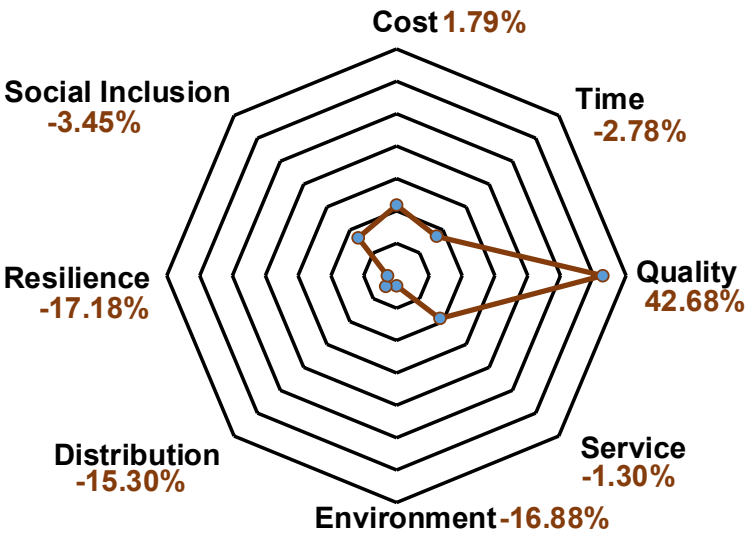



Figure 7.5. The individual performance of V*f*M variables for the Metro

Finally, an aggregate V*f*M monitoring of the Metro was generated by using the developed model, and was compared with the V*f*M decision-making in Section 7.3. According to the model in Figure 6.13 (see Chapter 6), the V*f*M of the Metro ($VfM_{monitoring}$) approximated to:

$$VfM_{monitoring} = 0.0712*1.79\%+0.0222*2.78\%+0.0557*42.86\%+0.1458*1.3\%$$
$$-0.2263*16.88\%+0.0194*15.3\%-0.2442*17.18-0.2152*3.45=-0.0596 \quad (7.11)$$

This clearly shows that the Metro under public ownership at the point of inquiry had an overall V*f*M decline of 5.96%. However, for traditional V*f*M, there was an overall V*f*M gain of 2.58%, which is consistent with the economic value of the Metro (Transport North East, 2022), stating that each passenger journey could register £8.5[32] to the North East region. Nevertheless, as the Metro regressed in some aspects of public V*f*M (i.e., environment, resilience, and social inclusion), it needs progress in

[32] This was concluded in 2019, and considered the impact of the Metro and Local Rail network. In 2010, the £350 'Metro: all change' programme stated that every pound investment on the Metro renewal would generate £8 to the local economy in ''supporting city centre business, reducing congestion and driving workforce flexibility''.

the domain of communities and environment to fully unlock the wider benefits that may worth up to £8.5 for every passenger journey. Connecting this *ex-post* V*f*M monitoring to the *ex-ante* V*f*M decision, it reveals the signs of deviation as there was a difference of 7.02%. Furthermore, if this *ex-post* V*f*M was compared with the alternative option in 2010 (i.e., public ownership rather than the concession contract with DB Regio), the result would indicate that the positive margin of concessions could increase by 4.9%, consolidating the conjecture that governments may not always do well in representing the general public's interests (i.e., environment, resilience, and social inclusion in this case study), as they claim to. Together, they reinforce the relative V*f*M concept proposed in Chapter 5 because there are variations across different procurement approaches and even within the same approach. More importantly, this demonstrates the importance of *ex-post* V*f*M monitoring to manage the project as the advantages of a particular approach do not automatically materialise. Therefore, with the new train fleet and expansion of the Metro in the future, the V*f*M decision-making and monitoring should be ongoing by exploiting the model illustrated above.

## 7.5 Chapter Summary

This chapter has fulfilled Objective IV of this thesis by answering the sub-question '*how can VfM be better assessed for transport infrastructure projects?*'. Drawing on interviews and publicly available documents (e.g., reports and news), an illustrative case study of the Metro was conducted to demonstrate the applicability and feasibility of the developed model. In terms of V*f*M decision-making for the case project, the model clarified the relationship between variables of traditional V*f*M and public V*f*M to be 0.0712, 0.0222, 0.0557, 0.1458, 0.2263, 0.0194, 0.2442, and 0.2152 (Figure 7.4).

On this basis, the model confirmed the decision made in 2010 to embrace concessions with DB Regio (although the advantage was marginal). However, this was supported by taking account of a wider range of V*f*M variables rather than a political decision. For V*f*M monitoring of the Metro, a nuanced result unfolded that is consistent with the interviews in Chapter 6, observing improvements under public ownership in the dimension of traditional V*f*M while individual performance of environment, resilience and social inclusion in the dimension of public V*f*M decreased. By comparing with existing examples, the developed model has demonstrated its capacity to measure both traditional and public V*f*M, analyse V*f*M for each variable and the overall V*f*M, and account for the *ex-ante* and *ex-post* V*f*M. The characteristics of projects differ, and thus the results drawn here may not be conclusive. However, this case study has provided a stepwise model for the public sector to assess the V*f*M of their infrastructure projects, and can provoke reflections about how V*f*M has deviated from the decision making.

# CHAPTER 8 CONCLUSIONS AND RECOMMENDATIONS

## 8.1 Chapter Introduction

Public Private Partnerships (PPPs) have long been lauded by governments as a value-for-money alternative to provide infrastructure and its services. Yet, this 'value for money' (V*f*M) practice has been tantamount to selecting the lowest capital cost approach and rarely based on the whole-of-life cost. Despite the fact that persistent budget constraints and pressing demands for infrastructure provisions may have rationalised this routine, cost underestimation is not uncommon in PPP types of projects. The poor understanding of V*f*M by the public sector therefore has damaged their and PPPs' reputation in infrastructure delivery.

On this basis, this thesis has hitherto examined the 'why?', 'what?' and 'how?' questions of V*f*M in infrastructure procurement. Here, Chapter 8 aims to make sense of this study's contributions by connecting with the research aim and objectives set out in the introductory chapter. The research questions are also revisited before presenting the contributions.

## 8.2 Reflecting on the Research Aim and Objectives

Adopting a sequential exploratory research strategy guided by the paradigm of pragmatism, the following conclusions have been made in relation to the research aim and objectives:

Objective I: *Establishing the state-of-the-art VfM assessment practices in global PPP markets and evaluating them in the light of common critical reactions*

The concept of V*f*M is not new, and the assessment of V*f*M in the area of infrastructure procurement often refers to the selection of a specific procurement approach between PPPs and the traditional procurement route. Due to different jurisdictional contexts, the approaches to assessing V*f*M differ in PPP markets across the world. Therefore, Objective I sought to understand the meaning of V*f*M, and when and how it is assessed by placing it into the institutional characteristics of the UK, Australia, and China, which have been considered mature PPP markets.

It was found in Chapter 4 that the drivers to PPP adoption shaped their definitions of V*f*M in each country. However, there was discrepancy rather than consistency between V*f*M definitions and V*f*M assessments. Diving deeper, such a discrepancy was explained by their individual context in terms of the social, economic, and political characteristics. In light of the suspension of PFI and PF2 – specific forms of PPPs – in the UK, the impetus to look for new ways of private participation in infrastructure is intense. Strong evidence was noted in the launch of the UK Infrastructure Bank and the cursory V*f*M assessment guidance in the *Green Book*. Identifying the problems of V*f*M assessment as such in the UK by comparing with its counterparts offers a springboard to explore how V*f*M should be assessed to determine a procurement approach and enable V*f*M to be delivered via the selected approach.

Objective II: *Proposing a new VfM concept based on value and stakeholder theories, and developing a comprehensive framework for assessing VfM*

While V*f*M assessment is prevalent in practice, the literature is replete with criticisms of its shortcomings such as asymmetry in cost comparison, contentious discount rate, undefined components, subjective assumptions and inaccurate estimate, and time-

consuming and non-standardised process (Section 3.3 in Chapter 3). This became more evident in the bumpy trajectory of the development of V*f*M assessment guidance in the UK (Sections 4.3 and 4.4 in Chapter 4). Therefore, Objective II sought to theoretically introduce a new V*f*M concept and propose a comprehensive framework for assessing V*f*M by inquiring about theories of value and stakeholder theory.

It was found in Chapter 5 that value is generated in the marketplace (i.e., through supply and demand) and is relative. Subsequently, a more meaningful V*f*M concept consisting of traditional V*f*M (government perspective) and public V*f*M (end-users perspective) was introduced. On this basis, a V*f*M assessment framework applying the same criteria in *ex-ante* and *ex-post* V*f*M assessment to determine an appropriate procurement option for transport projects and ensure V*f*M is delivered throughout their lifecycle was proposed. It serves the purpose of guiding action and paves the way for policy makers to think more clearly about V*f*M when assessing it.

Objective III: *Refining and validating the proposed VfM framework*

The proposed V*f*M framework contains a requisite model that concentrates on 'form' and 'content', whose goal, according to Phillips (1984), was to ''help construct a new reality, to create a future''. Thus, it remains to be tested whether the content (i.e., the assessment variables and their relationship) and form (i.e., questions to be asked and mechanisms to be implemented) are adequate for problem owners (i.e., the public sector) to rethink V*f*M assessment.

The validation results generated from interviews and questionnaire surveys were synthetically presented in Figure 6.13 (see Chapter 6). It was found in Chapter 6 that

the public sector is short of an in-depth understanding of what V*f*M is regardless of its ubiquitous appearance in infrastructure policy. This was evidenced in the overwhelming use of a public sector comparator (PSC) that is rooted in the net present value discounting technique (see Figure 6.1 in Chapter 6). It was also validated that traditional and public V*f*M should co-constitute the V*f*M assessment. Importantly, this refinement process (summarised in Figures 6.2 to 12 in Chapter 6) revealed the sub-themes of cost, quality, and time (as protected by traditional V*f*M), and the sub-themes of service, environment, distribution, resilience, and social inclusion (as protected by public V*f*M). and the feeding and retrospective mechanism is important in aligning *ex-ante* and *ex-post* V*f*M assessment to make a decision about which approach is suitable for procuring transport infrastructure projects, and monitor whether the V*f*M is delivered.

Objective IV: *Applying the developed VfM assessment model to a real-world infrastructure project*

To demonstrate the applicability and feasibility of the developed V*f*M assessment model, the Tyne and Wear Metro, which was branded as 'Britain's first modern light rail system' was chosen as an illustrative case study. This project stated V*f*M as one of its objectives, but this was not clearly articulated. Moreover, the project has undergone both concessions and public ownership. By virtue of published articles, news, reports, pictures and videos, project documents, and interviews conducted with management officials, the V*f*M decision-making and monitoring were separately examined and then compared against each other. As a result, this case study has provided a stepwise model for the public sector to assess the V*f*M of their

infrastructure projects, and can provoke reflections about how V*f*M has deviated from the decision making.

Aim: *Developing a decision-making model for public sector bodies to better understand and assess VfM of their transport infrastructure projects.*

Spending the taxpayer's money would, in principle mean that governments have to justify what values can be gained from the expenditure. After decades of infrastructure development via PPPs, the public sector should have been armed with knowledge of V*f*M by comparing PPPs and the traditional procurement. However, it is commonplace for infrastructure projects to be delivered through the lowest possible capital cost approach without taking into account their wider impacts. With the experience accumulated from past projects, the public sector in the UK is at a juncture to address the general public's demand for V*f*M in its infrastructure interventions. Only when V*f*M is appropriately understood and assessed is the taxpayer more likely to be satisfied with governments' decisions.

Against this backdrop, the aim to develop a decision-making tool for public sector bodies to better understand and assess V*f*M of their transport infrastructure projects was fulfilled by taking stock of four specific objectives mentioned above. It firstly identified the problems with the existing V*f*M assessment through a systematic review of relevant literature (Chapter 3), and confirmed the V*f*M assessment practices in the global PPP market by a comparative study of the UK, Australia, and China (Chapter 4). Secondly, a new V*f*M concept and corresponding V*f*M assessment framework were proposed by a theoretical analysis of theories of value and stakeholder theory (Chapter 5). Thirdly, the developed V*f*M assessment framework was refined and validated by a

thematical analysis of interview data and an analytical hierarchy process (AHP) of questionnaire survey data (Chapter 6). Finally, the decision-making model was applied to a real-world infrastructure project to showcase its feasibility (Chapter 7). Coupling with the implications for procurement policy, this developed decision-making model is deemed robust and useful for the public sector to rethink V*f*M when procuring transport infrastructure projects in the future.

## 8.3 Answering the Research Questions

In the process of achieving the research aim and objectives, the research questions have simultaneously emerged, evolved, and been answered. Specifically, a mixed methods research design was employed to address the research question '*how should VfM be assessed by the public sector in the context of transport infrastructure projects*?'. Within the central research question, the qualitative sub-questions 1, 2, and 3 were answered in Chapters 3, 5, and 6, respectively, the quantitative sub-question 4 was answered in Chapter 6, and the mixed methods sub-question 5 was answered in Chapter 7. The next section summarises how these questions have been addressed.

Sub-question 1: *What is the status quo of VfM assessment?*

A total of 88 articles were systematically identified in Chapter 3 to locate existing V*f*M assessment methods, which include PSC, Monte Carlo simulation, Outline Business Case, PPP – VALUE, Multi-Criteria Analysis, Multiobjective Bayesian Network, and Cost-Benefit analysis. After the intellectual evolution of V*f*M assessment was illustrated using the algorithmic historiography, their characteristics in terms of strengths, weaknesses, opportunities, and threats were analysed (Section 3.3.4 in Chapter 3). The *status quo* of V*f*M assessment was revealed as: (1) there were no

consistent ways of defining and considering V*f*M; (2) the V*f*M assessment methods were controversial and should be advanced; (3) the context within which V*f*M is assessed mattered; and (4) an understanding of the role of V*f*M after a procurement approach is selected was lacking.

Sub-question 2: *Is there a theoretical lens that can prescribe what should be considered in VfM assessment?*

Theoretically, theories of value and stakeholder theory have reasonably prescribed the components of V*f*M assessment. By examining the philosophical (i.e., value in relation to normativity, intrinsicality, desires, emotions, relativity, pleasure, and hedonism) and economic (i.e., the labour theory of value, the marginal theory of value, and the consumption theory of value) disciplines of V*f*M, they stipulate that: (1) cost by no means is the sole determinant of V*f*M; (2) V*f*M is a relative concept, and in the subject (value holder) domain, it should represent the interests of the government (supplier) and the end-users (consumer) that pay for the service. In the time domain, the assessment should be time-proof; and (3) elements considered in V*f*M assessment should encompass not only the quantitative value but also the socially recognised value that contribute to the final good of the society. In addition, stakeholder theory confirms that the general public is a key stakeholder of PPP projects. Together, they reject the current practice of V*f*M assessment that is focused on the cost comparison of PPPs and the traditional procurement.

Sub-question 3: *What is the public sector's understanding of VfM assessment?*

Deploying the purposive sampling (with a focus on snowball sampling), 13 senior professionals with an average working experience of infrastructure procurement for

around 23 years in the public sector were identified to induce an understanding of V*f*M assessment through semi-structured interviews. It was clear that managing the public perception of transport projects is important in the realisation of V*f*M, which matched the theoretical deduction. With regards to traditional V*f*M, the public sector was accustomed to exaggerating cost in V*f*M assessment, was less incentivised to get the cost right (e.g., capital and whole-of-life cost), and was not familiar with the implications behind the cost number. While quality can be subscribed to conformance with specifications standards, this was often treated as 'givens' and could be extended to include 'response to incidents and accidents' and 'innovations and the ability to articulate specifications'. With cost being overly emphasised, this quality level could also be compromised. For the time dimension, instead of focusing on the construction time, it should be understood in combination with the planning and negotiation time, and the time between construction finish and operation start.

Public V*f*M, which had not been ingrained in V*f*M assessment, was understood in respect of transport projects' service/ functionality, environment, distribution, resilience, and social inclusion. Achieving the commuting purpose, the service and functionality of transport projects should be collaboratively designed with the private sector over the long term so that end-users are willing to pay for the fare. Environment should be prioritised in V*f*M assessment and considered in conjunction with the cost and innovation. Apparently, the public sector needs to balance investments between areas, and this can be accounted in their short-term gain and future payment liabilities. For resilience in V*f*M assessment, the selected approach needs to be able to include its interpretation of resilience level into the contract. Social inclusion is emphasised with

regards to the policy's intention to create growth and engage the general public (e.g., the affected community).

Sub-question 4: *What is the relationship between the variables in VfM assessment?*

Using the AHP technique, 31 respondents (each with experience in at least 1 transport infrastructure project) were identified to understand the relationship between the variables in V*f*M assessment through a questionnaire survey. It was revealed that 17 respondents considered public V*f*M to be equally important to traditional V*f*M, whereas 14 others considered it to be even more important. With a reliability ratio of 0.03, which was lower than the benchmark 0.10, the priorities of cost, time, quality, service, environment, resilience, distribution, and social inclusion in V*f*M assessment were 0.08, 0.06, 0.12, 0.13, 0.20, 0.15, 0.12, and 0.14, respectively.

Sub-question 5: *How can VfM be better assessed for transport infrastructure projects?*

Based on an illustrative case study approach, the developed model assessed the V*f*M of the Tyne and Wear Metro project at the *ex-ante* and *ex-post* stages. This was realised by analysing data collected from interviews to first illuminate the relationship between variables in V*f*M assessment, and second to compare to what degree the procurement approach (i.e., PPPs or the traditional procurement method) can better satisfy cost, time, quality, service, environment, distribution, resilience, and social inclusion. The result was then compared with the decision made in reality to reinforce the political orientation. Aligning the *ex-ante* and *ex-post* V*f*M assessment, the proposed model monitored the V*f*M status of the project by analysing documentary data collected at two periods, namely, concessions and public ownership. In doing so, the developed

model has demonstrated its capacity to measure both traditional and public V*f*M, analyse V*f*M for each variable and the overall V*f*M, and account for the *ex-ante* and *ex-post* V*f*M.

## 8.4 Making Sense of the Contributions

Having achieved the research aim and objectives and answered the research questions, contributions of this study have to be made sense in theory and in practice so that progress in V*f*M assessment can be made.

### 8.4.1 Theoretical Contributions

The concept of V*f*M in the context of infrastructure procurement is ambiguous or at best is biased towards cost. The existing literature routinely referred to HM Treasury's (2006) definition of V*f*M, which was narrowed down to cost and quality. The first contribution of this study is that it extends this definition and proposes that traditional V*f*M and public V*f*M co-create a more meaningful V*f*M concept. Based on theories of value and stakeholder theory, it articulates the value holder by arguing that value is comprised of the supply-side value and the demand-side value. This is important because existing literature often conducted lines of inquiry on V*f*M assessment methods without looking fundamentally at what V*f*M was and whose V*f*M they were assessing. Challenging the predisposition that governments represent the interests of the general public, the new public V*f*M ingredient brings to the fore that V*f*M should also be assessed from the perspective of the project end-users.

Under the auspices of HM Treasury's (2006) definition of V*f*M, research about V*f*M assessment in the existing literature primarily focused on the PSC (Section 3.3.3 in

Chapter 3). Criticising the cost comparison of PSC, another strand of studies examined the quality part by outlining a series of V*f*M-related factors due to quality's 'inclusiveness of everything'. The second contribution of this study is that it advances a consistent V*f*M assessment and channels it into the transport sector. This acknowledges the different characteristics of different sectors and the degree of consistency within that specific sector. More importantly, it depicts what should be considered for each assessment criterion in V*f*M assessment rather than just lumping all criteria together.

A final theoretical contribution of this study is that it extends the *ex-ante* V*f*M assessment to include *ex-post* V*f*M assessment by developing a model that can be tailored to suit the procuring body's and the project's needs. V*f*M assessment in the existing literature was mainly conducted at the inception stage to select a procurement approach for projects. While defining project value at the front-end is instrumental, there is a need to inspect whether such values have deviated as projects progress. By expanding the *ex-ante* V*f*M assessment to the *ex-post* stage using consistent criteria, this study contributes to the development of a life-cycle V*f*M assessment framework. In line with the growing consensus that value is understood in project-based settings (Zerjav *et al*., 2021), this framework can be adapted to accommodate not only the project's situations (e.g., accessibility) but also the project client's priority (e.g., environment).

### 8.4.2 Practical Contributions

The contribution to practice of this study is twofold as it provides a more holistic understanding of V*f*M in infrastructure procurement and presents a V*f*M assessment

model that can be readily utilised by the public sector for their transport infrastructure projects.

The public sector has long been suffering from the lack of a common definition of V*f*M. The immediate evidence was Construction Leader Council's (2018, p.4) call for ''an industry-wide definition of value that takes into account more than capital cost''. Therefore, this study's first contribution to practice lies in that it produces a consistent definition of V*f*M and thus enhances its understanding by the public sector that procures infrastructure projects. Faced with the sluggish movement of the construction industry professions, disseminating this definition can capture wider attention and cultivate a common language of V*f*M, thus removing the barriers to understanding next time when V*f*M is on the horizon.

Complementing the V*f*M definition is a V*f*M assessment model that forged the second contribution to practice of this study. This addresses two gaps in practice: (1) HM Treasury was long overdue for updating the V*f*M assessment guidance (NAO, 2018); and (2) a systematic V*f*M evaluation of operation PFI projects by departments is not available (NAO, 2011). In this sense, this developed model can act as a manual (illustrated by a case study in Chapter 7) instructing how the V*f*M variables should be assessed and how the relationship between them can be balanced. With the support of the model's operationalisation principles (explained in Chapter 6), it assesses whether V*f*M has been delivered and thus prepares the public sector for embracing the expiry of their PFI projects in the next decade. For future projects that involve private participation, this model helps the public sector rethink V*f*M. Despite the fact that this

decision-making is sometimes political, the interviews confirmed that it still has to be rationalised by V*f*M assessment, and this model just does so.

# REFERENCES

Aaltonen, K. and Kujala, J., 2010. A project lifecycle perspective on stakeholder influence strategies in global projects. *Scandinavian Journal of Management*, *26*(4), pp.381-397.

Valipour, A., Yahaya, N., Noor, N.M., Valipour, I. and Tamošaitienė, J., 2019. A SWARA-COPRAS approach to the allocation of risk in water and sewerage public–private partnership projects in Malaysia. *International Journal of Strategic Property Management,* 23(4), pp.269-283.

Abdel Aziz, A.M., 2007. Successful delivery of public-private partnerships for infrastructure development. *Journal of Construction Engineering and Management*, *133*(12), pp.918-931.

Abudayyeh, O., Zidan, S.J., Yehia, S. and Randolph, D., 2007. Hybrid prequalification-based, innovative contracting model using AHP. *Journal of Management in Engineering*, *23*(2), pp.88-96.

Ackerman, F. and Heinzerling, L., 2002. Pricing the priceless: cost-benefit analysis of environmental protection. *University of Pennsylvania Law Review*, *150*, pp.1553-1584.

Ackerman, F., 2008. Critique of cost-benefit analysis, and alternative approaches to decision-making. *A report to Friends of the Earth England, Wales and Northern Ireland*. Friends of the Earth, London.

Ahmad, I. and Minkarah, I., 1988. Questionnaire survey on bidding in construction. *Journal of Management in Engineering*, *4*(3), pp.229-243.

Ahmad, S., Connolly, C. and Demirag, I., 2020. Toward an understanding of strategic control at a distance in public service delivery. *Accounting, Auditing & Accountability Journal*, *34*(3), pp.558-590.

Akintoye, A., Hardcastle, C., Beck, M., Chinyio, E. and Asenova, D., 2003. Achieving best value in private finance initiative project procurement. *Construction Management and Economics*, *21*(5), pp.461-470.

Akintoye, A., Hardcastle, C., Beck, M., Chinyio, E. and Asenova, D., 2003. Achieving best value in private finance initiative project procurement. *Construction Management and Economics*, *21*(5), pp.461–470.

Aldrete, R., Bujanda, A. and Valdez, G.A., 2012. Valuing public-sector revenue risk exposure in transportation public–private partnerships. *Transportation research record*, *2297*(1), pp.88-96.

Aldrich, H. and Herker, D., 1977. Boundary spanning roles and organization structure. *Academy of Management Review*, *2*(2), pp.217-230.

Almarri, K. and Boussabaine, H., 2017. The influence of critical success factors on value for money viability analysis in public–private partnership projects. *Project Management Journal*, *48*(4), pp.93-106.

Amaratunga, D., Baldry, D., Sarshar, M. and Newton, R., 2002. Quantitative and qualitative research in the built environment: application of "mixed" research approach. *Work Study*, *51*(1), pp.17-31.

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

Anago, J.C., 2022. How do adoption choices influence public private partnership outcomes? Lessons from Spain and Portugal transport infrastructure. *International Journal of Managing Projects in Business*, *15*(3), pp.469-493.

APMG PPP Certification Guide, 2016. *PPP introduction and overview*. Available at: https://ppp-certification.com/sites/www.ppp-certification.com/files/documents/chapter-1-ppp-introduction-and-overview.pdf (Accessed: 7-5-2022).

Arvidsson, A., 2009. The ethical economy: Towards a post-capitalist theory of value. *Capital & Class*, *33*(1), pp.13-29.

Atkinson, R., 1999. Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria. *International Journal of Project Management*, *17*(6), pp.337-342.

Attride-Stirling, J., 2001. Thematic networks: an analytic tool for qualitative research. *Qualitative Research*, *1*(3), pp.385-405.

Australian Government, 2019. *Delivering for Australians: a world-class Australian Public Service: the Government's APS reform agenda*. Available at: https://pmc.gov.au/sites/default/files/publications/delivering-for-australians.pdf (Accessed: 13/3/2021).

Australian Government, 2021. *Infrastructure Investment Program*. Available at: https://investment.infrastructure.gov.au/ (Accessed: 11-2021).

Autumn Statement, 1992. *Autumn Statement: Column 998*. Available at: https://publications.parliament.uk/pa/cm199293/cmhansrd/1992-11-12/Debate-1.html (Accessed: 12-5-2019).

Bain, R., 2010. Public sector comparators for UK PFI roads: Inside the black box. *Transportation*, *37*(3), pp.447-471.

Baker, D.I., 1974. Competition and Regulation: Charles River Bridge Recrossed. *Cornell Law Review*, *60*(2), pp.159-182.

Baker, S.E. and Edwards, R., 2012. *How many qualitative interviews is enough*?. Available at: https://eprints.ncrm.ac.uk/id/eprint/2273/4/how_many_interviews.pdf (Accessed: 23-4-2022).

Ball, R. and King, D., 2006. The private finance initiative in local government. *Economic Affairs*, *26*(1), pp.36-40.

Ball, R., Heafey, M. and King, D., 2001. Private finance initiative–a good deal for the public purse or a drain on future generations?. *Policy & Politics*, *29*(1), pp.95-108.

Barber, M., 2017. *Delivering better outcomes for citizens: practical steps for unlocking public value*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/660408/PU2105_Delivering_better_outcomes_for_citizens_practical_steps_for_unlocking_public_value_web.pdf (Accessed: 12-11-2020).

Barlow, J., Roehrich, J. and Wright, S., 2013. Europe sees mixed results from public-private partnerships for building and managing health care facilities and services. *Health Affairs*, *32*(1), pp.146-154.

Baroud, H., Barker, K. and Ramirez-Marquez, J.E., 2014. Importance measures for inland waterway network resilience. *Transportation Research Part E: Logistics and Transportation Review*, *62*, pp.55-67.

Barton, R., Aibinu, A.A. and Oliveros, J., 2019. The value for money concept in investment evaluation: Deconstructing its meaning for better decision making. *Project Management Journal*, *50*(2), pp.210-225.

Bayliss, K. and Van Waeyenberge, E., 2018. Unpacking the public private partnership revival. *The Journal of Development Studies*, *54*(4), pp.577-593.

Bellofiore, R., 1989. A monetary labor theory of value. *Review of Radical Political Economics*, *21*(1-2), pp.1-25.

Bešinović, N., 2020. Resilience in railway transport systems: a literature review and research agenda. *Transport Reviews*, *40*(4), pp.457-478.

Biernacki, P. and Waldorf, D., 1981. Snowball sampling: Problems and techniques of chain referral sampling. *Sociological Methods & Research*, *10*(2), pp.141-163.

Bills, T.S. and Walker, J.L., 2017. Looking beyond the mean for equity analysis: Examining distributional impacts of transportation improvements. *Transport Policy*, *54*, pp.61-69.

Blanc-Brude, F., Goldsmith, H. and Valila, T., 2006. *Ex ante construction costs in the European road sector: a comparison of public-private partnerships and traditional public procurement*. Economic and Financial Report, European Investment Bank.

Blanc-Brude, F., Goldsmith, H. and Välilä, T., 2009. A comparison of construction contract prices for traditionally procured roads and public–private partnerships. *Review of Industrial Organization*, *35*(1), pp.19-40.

Boardman, A.E. and Vining, A.R., 2012. The political economy of public-private partnerships and analysis of their social value. *Annals of Public and Cooperative Economics*, *83*(2), pp.117-141.

Bohari, A.A.M., Skitmore, M., Xia, B., Teo, M. and Khalil, N., 2020. Key stakeholder values in encouraging green orientation of construction procurement. *Journal of Cleaner Production*, 270, 122246.

Bovis, C.H., 2008. PPP in the Transport Sectors. *European Public Private Partnership Law Review*, *3*(2), pp.70-82.

Boyer, E.J. and Van Slyke, D.M., 2019. Citizen attitudes towards public–private partnerships. *The American Review of Public Administration*, *49*(3), pp.259-274.

Boyer, E.J., 2019. How does public participation affect perceptions of public–private partnerships? A citizens' view on push, pull, and network approaches in PPPs. *Public Management Review*, *21*(10), pp.1464-1485.

Boyer, E.J., Van Slyke, D.M. and Rogers, J.D., 2016. An empirical examination of public involvement in public-private partnerships: Qualifying the benefits of public involvement in PPPs. *Journal of Public Administration Research and Theory*, *26*(1), pp.45-61.

Marzouk, M., Amer, O. and El-Said, M., 2013. Feasibility study of industrial projects using Simos' procedure. *Journal of Civil Engineering and Management*, 19(1), pp.59-68.

Bramer, W.M., Rethlefsen, M.L., Kleijnen, J. and Franco, O.H., 2017. Optimal database combinations for literature searches in systematic reviews: a prospective exploratory study. *Systematic Reviews, 6*(1)**,** pp.245-256.

Braun, V. and Clarke, V., 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), pp.77-101.

Broadbent, J. and Laughlin, R., 2004. Striving for excellence in public service delivery: experiences from an analysis of the private finance initiative. *Public Policy and Administration*, *19*(4), pp.82-99.

Bryer, R.A., 1994. Why Marx's labour theory is superior to the marginalist theory of value: the case from modern financial reporting. *Critical Perspectives on Accounting*, *5*(4), pp.313-340.

Bryman, A., 2004. *Social research methods (2nd ed.)*. Oxford University Press, New York.

Bryman, A., 2007a. The research question in social research: what is its role?. *International Journal of Social Research Methodology*, *10*(1), pp.5-20.

Bryman, A., 2007b. Barriers to integrating quantitative and qualitative research. *Journal of Mixed Methods Research*, *1*(1), pp.8-22.

Bryman, A., 2008. The end of the paradigm wars. In Alasuutari, P., Bickman, L. and Brannen, J. (ed.) *The SAGE Handbook of Social Research Methods*, SAGE Publications, London, pp.13-25.

Budayan, C., Okudan, O. and Dikmen, I., 2020. Identification and prioritization of stage-level KPIs for BOT projects–evidence from Turkey. *International Journal of Managing Projects in Business*. *13*(6), pp.1311-1337.

Buhr, W., 2003. What is infrastructure? (No. 107-03). Volkswirtschaftliche Diskussionsbeiträge.

Burger, P., and Hawkesworth, I., 2011. How to attain value for money: Comparing PPP and traditional infrastructure public procurement. *OECD Journal on Budgeting*, *11*(1), pp.91–146.

Burke, R. and Demirag, I., 2015. Changing perceptions on PPP games: Demand risk in Irish roads. *Critical Perspectives on Accounting*, *27*, pp.189-208.

Burke, R. and Demirag, I., 2017. Risk transfer and stakeholder relationships in public private partnerships. *Accounting Forum*, 41(1), pp. 28-43.

Burnett, M., 2012. The Current Private Finance Initiative (PFI) Reform in the United Kingdom–How Should It Be Measured?. *European Procurement & Public Private Partnership Law Review*, *7*(2), pp.118-128.

Burningham, S and Stankevich, N., 2005. Why road maintenance is important and how to get it done. *Transport Notes Series; No. TRN 4*. World Bank, Washington, DC.

Butcher, L., 2018. *Passenger rail services in England*. Available at: https://researchbriefings.files.parliament.uk/documents/SN06521/SN06521.pdf (Accessed: 1-12-2021).

Bykvist, K., 2015. Value and time. In Hirose, I. and Olson, J. (ed.) *The Oxford handbook of value theory*, Oxford University Press, New York.

Cabinet Office, 2017. *Public summary of sector security and resilience plans*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/678927/Public_Summary_of_Sector_Security_and_Resilience_Plans_2017__FINAL_pdf___002_.pdf (Accessed: 12-7-2022).

Calahorra-Jimenez, M., Molenaar, K., Torres-Machi, C., Chamorro, A. and Alarcón, L.F., 2020. Structured approach for best-value evaluation criteria: US design–build highway procurement. *Journal of Management in Engineering*, *36*(6), p.04020086.

Carbonara, N., Costantino, N., Gunnigan, L. and Pellegrino, R., 2015. Risk management in motorway PPP projects: empirical-based guidelines. *Transport Reviews*, *35*(2), pp.162-182.

Carley, K.M., Hummon, N.P. and Harty, M., 1993. Scientific influence: An analysis of the main path structure in the Journal of Conflict Resolution. *Knowledge*, *14*(4), pp.417-447.

Carpintero, S. and Petersen, O.H., 2014. PPP projects in transport: evidence from light rail projects in Spain. *Public Money & Management*, *34*(1), pp.43-50.

Casady, C.B. and Baxter, D., 2020. Pandemics, public-private partnerships (PPPs), and force majeure| COVID-19 expectations and implications. *Construction Management and Economics*, *38*(12), pp.1077-1085.

Chan, A.P., Lam, P.T., Chan, D.W., Cheung, E. and Ke, Y., 2009. Drivers for adopting public private partnerships—Empirical comparison between China and Hong Kong special administrative region. *Journal of Construction Engineering and Management*, *135*(11), pp.1115-1124.

Chan, A.P.C., Lam, P.T.I., Chan, D.W.M., Cheung, E. and Ke, Y., 2009. Drivers for Adopting Public Private Partnerships—Empirical Comparison between China and Hong Kong Special Administrative Region. *Journal of Construction Engineering and Management*, *135*(11), pp.1115–1124.

Chang, Z. and Phang, S.Y., 2017. Urban rail transit PPPs: Lessons from East Asian cities. *Transportation Research Part A: Policy and Practice*, *105*, pp.106-122.

Chang, Z., 2013. Public-private partnerships in China: A case of the Beijing No.4 Metro line. *Transport Policy*, *30*, pp.153-160.

Chang, Z., 2014. Financing new metros - The Beijing metro financing sustainability study. *Transport Policy*, *32*, pp.148-155.

Chen, B., Mao, C.K. and Hu, J.L., 2015. The optimal debt ratio of public–private partnership projects. *International Journal of Construction Management*, *15*(3), pp.239-253.

Chen, C., Hubbard, M. and Liao, C.S., 2013. When public–private partnerships fail: Analysing citizen engagement in public–private partnerships–cases from Taiwan and China. *Public Management Review*, *15*(6), pp.839-857.

Chen, L. and Miller-Hooks, E., 2012. Resilience: an indicator of recovery capability in intermodal freight transport. *Transportation Science*, *46*(1), pp.109-123.

Chen, Z., Daito, N. and Gifford, J.L., 2016. Data review of transportation infrastructure public–private partnership: A meta-analysis. *Transport reviews*, *36*(2), pp.228-250.

Cheng, Z., Ke, Y., Lin, J., Yang, Z. and Cai, J., 2016. Spatio-temporal dynamics of public private partnership projects in China. *International Journal of Project Management*, *34*(7), pp.1242-1251.

Cherkos, F.D. and Jha, K.N., 2021. Drivers of road sector Public-Private Partnership adoption in new and inexperienced markets. *Journal of Construction Engineering and Management*, *147*(3), pp.04020186.

Cherryholmes, C.H., 1992. Notes on pragmatism and scientific realism. *Educational Researcher*, *21*(6), pp.13-17.

Cheung, E., Chan, A.P. and Kajewski, S., 2009. Enhancing value for money in public private partnership projects: Findings from a survey conducted in Hong Kong and Australia compared to findings from previous research in the UK. *Journal of Financial Management of Property and Construction*, *14*(1), pp.7-20.

Cheung, S.O., Lam, T.I., Leung, M.Y. and Wan, Y.W., 2001. An analytical hierarchy process based procurement selection method. *Construction Management & Economics*, *19*(4), pp.427-437.

Chiang, L.Y., Earl, G., Liu, B., Reid, S. and Roca, E., 2022. Risk analysis in social housing delivery: A public–private partnerships approach. *Australian Journal of Public Administration*. pp.1-22.

Chou, J.S. and Pramudawardhani, D., 2015. Cross-country comparisons of key drivers, critical success factors and risk allocation for public-private partnership projects. *International Journal of Project Management*, *33*(5), pp.1136–1150.

Chung, D., 2016. Risks, challenges and value for money of public–private partnerships. *Financial Accountability & Management*, *32*(4), pp.448-468.

Committee of Public Accounts, 2011. *Lessons from PFI and other projects*. Available at: https://publications.parliament.uk/pa/cm201012/cmselect/cmpubacc/1201/1201.pdf (Accessed: 13-5-2022).

Competition and Markets Authority, 2018. *Rail franchises: guidance for bidders*. Available at: https://www.gov.uk/government/publications/rail-franchises-questions-and-answers (Accessed: 12-7-2022).

Construction Leadership Council (2018). *Procuring for value*. Available at: https://www.constructionleadershipcouncil.co.uk/wp-content/uploads/2018/07/RLB-Procuring-for-Value-18-July-.pdf (Accessed: 11-9-2020).

Construction Leadership Council, 2018. *Procuring for value*. Available at: https://www.constructionleadershipcouncil.co.uk/wp-content/uploads/2018/07/RLB-Procuring-for-Value-18-July-.pdf (Accessed: 11-9-2020).

Contreras, C., 2014. Value for money: To what extent does discount rate matter?. *Revista de Economía Aplicada*, *22*(66), pp.93-112.

Cordelli, C., 2013. How privatization threatens the private. *Critical Review of International Social and Political Philosophy*, *16*(1), pp.65-87.

Coulson, A., 2008. Value for money in PFI proposals: a commentary on the UK treasury guidelines for public sector comparators. *Public Administration*, *86*(2), pp.483-498.

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

Crompton, A., 2015. Runaway train: public participation and the case of HS2. *Policy & Politics*, *43*(1), pp.27-44.

Crotty, M., 1998. *The foundations of social research*. SAGE Publications, California.

Cruz, C.O. and Marques, R.C., 2011. Contribution to the study of PPP arrangements in airport development, management and operation. *Transport Policy*, *18*(2), pp.392-400.

Cruz, C.O. and Marques, R.C., 2013. Infrastructure public-private partnerships: Decision, management and development. Springer, Heidelberg.

Cruz, C.O. and Sarmento, J.M., 2020. Traffic forecast inaccuracy in transportation: A literature review of roads and railways projects. *Transportation*, *47*(4), pp.1571-1606.

Cui, C., Liu, Y., Hope, A. and Wang, J., 2018. Review of studies on the public–private partnerships (PPP) for infrastructure projects. *International Journal of Project Management*, *36*(5), pp.773-794.

Cui, C., Liu, Y., Hope, A. and Wang, J., 2018. Review of studies on the public–private partnerships (PPP) for infrastructure projects. *International journal of project management*, *36*(5), pp.773-794.

Cui, C., Wang, J., Liu, Y. and Coffey, V., 2019. Relationships among value-for-money drivers of public–private partnership infrastructure projects. *Journal of Infrastructure Systems*, *25*(2), pp.04019007.

Cullity, G., 2015. Neutral and relative value. In Hirose, I. and Olson, J. (ed.) *The Oxford handbook of value theory*, Oxford University Press, New York.

Darko, A., Chan, A.P.C., Ameyaw, E.E., Owusu, E.K., Pärn, E. and Edwards, D.J., 2019. Review of application of analytic hierarchy process (AHP) in construction. *International Journal of Construction Management*, *19*(5), pp.436-452.

Davis, K., 2017. An empirical investigation into different stakeholder groups perception of project success. *International Journal of Project Management*, *35*(4), pp.604-617.

de Albornoz, V. and Soliño, A., 2015. Is there room for a PPP secondary market? Financial analysis of PPP transport sector. *Journal of Management in Engineering*, *31*(5), pp.0000327.

de Albornoz, V.A.C., Soliño, A.S., Galera, A.L. and Álvarez, J.M.I., 2021. Bankrupt PPPs: Is it really so bad? Case study of R-3 and R-5 toll motorways in Spain. *Transport Policy*, *114*, pp.78-87.

De Schepper, S., Dooms, M. and Haezendonck, E., 2014. Stakeholder dynamics and responsibilities in Public–Private Partnerships: A mixed experience. *International Journal of Project Management*, *32*(7), pp.1210-1222.

de Vaus, D., 2001. *Research design in social research*. SAGE Publications, London.

de Vaus, D., 2002. *Surveys in social research (5th ed.)*. Routledge, Australia.

De Wit, A., 1988. Measurement of project success. *International Journal of Project Management*, *6*(3), pp.164-170.

DeCorla-Souza, P. and Farajian, M., 2017. Evaluation of a nontraditional approach to fund, finance, and manage metropolitan freeways. *Transportation Research Record*, *2670*(1), pp.33-41.

DeCorla-Souza, P. and Lee, D.B., 2017. Evaluating the Potential Economic Efficiency of Project Delivery Options. *Transportation Research Record*, *2606*(1), pp.115-121.

DeCorla-Souza, P., 2014. New Tool to Understand Value-for-Money Analysis Concepts in Evaluating Public–Private Partnership Options. *Transportation Research Record*, *2450*(1), pp.99-108.

DeCorla-Souza, P., 2018. Development of a Transparent Framework for Pre-Procurement Evaluation of Public–Private Partnership Project Delivery Options. *Transportation Research Record*, *2672*(4), pp.1-12.

DeCorla-Souza, P., Ham, M. and Timothy, D., 2016. Illustration of a Framework for Benefit–Cost Evaluation of Highway Concession Proposals. *Transportation Research Record*, *2597*(1), pp.52-59.

DeCorla-Souza, P., Lee, D., Timothy, D. and Mayer, J., 2013. Comparing public–private partnerships with conventional procurement: Incorporating considerations from benefit–cost analysis. *Transportation research record*, *2346*(1), pp.32-39.

DeCorla-Souza, P., Lee, D.B., Sullivan, M. and Timothy, D., 2017. A Benefit-Cost Analysis Framework for Evaluation of Highway Public-Private Partnership Projects. In *Advances in Public-Private Partnerships* (pp. 257-274). Reston, VA: American Society of Civil Engineers.

Demirag, I., Khadaroo, I., Stapleton, P. and Stevenson, C., 2011. Risks and the financing of PPP: Perspectives from the financiers. *The British Accounting Review*, *43*(4), pp.294-310.

Denzin, N.K. and Lincoln, Y.S. eds., 1994. *Handbook of Qualitative Research*. SAGE Publications, California.

Department for Business, Energy & Industrial Strategy, 2020. *2019 UK greenhouse gas emissions, provisional figures*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/875485/2019_UK_greenhouse_gas_emissions_provisional_figures_statistical_release.pdf (Accessed: 11-12-2020).

Department for Business, Energy & Industrial Strategy, 2021. *Future funding for nuclear plants*. Available at: https://www.gov.uk/government/news/future-funding-for-nuclear-plants#:~:text=The%20Nuclear%20Energy%20(Financing)%20Bill,water%2C%20gas%20and%20electricity%20networks (Accessed: 12-3-2022).

Department for Business, Energy & Industrial Strategy, 2022. *Policy paper: Contracts for Difference*. Available at: https://www.gov.uk/government/publications/contracts-for-difference/contract-for-difference (Accessed: 12-3-2022).

Department for Transport, 2013. *Value for Money Assessment: Advice Note for Local Transport decision-makers*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/267296/vfm-advice-local-decision-makers.pdf (Accessed: 1-12-2018).

Department for Transport, 2017. *Value for Money Framework: Moving Britain Ahead*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/908296/value-for-money-framework-document.pdf (Accessed: 11-12-2018).

Department for Transport, 2020a. *News story: Rail franchising reaches the terminus as a new railway takes shape.* Available at: https://www.gov.uk/government/news/rail-franchising-reaches-the-terminus-as-a-new-railway-takes-shape (Accessed: 7-3-2022).

Department for Transport, 2020b. *Decarbonising transport: setting the challenge*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/932122/decarbonising-transport-setting-the-challenge.pdf (Accessed: 23-3-2021).

Department for Transport, 2020c. *Rail update: Emergency Recovery Measures Agreements*. Available at: https://www.gov.uk/government/speeches/rail-update-emergency-recovery-measures-agreements (Accessed: 12-3-2022).

Department for Transport, 2021a. *News story: Rail passenger service contracts market engagement day announced.* Available at: https://www.gov.uk/government/news/rail-passenger-service-contracts-market-engagement-day-announced (Accessed: 7-3-2022).

Department for Transport, 2021b. *Guidance: Passenger service contracts*. Available at: https://www.gov.uk/guidance/passenger-service-contracts (Accessed: 7-3-2022).

Department for Transport, 2021c. *Guidance: Passenger service contracts*. Available at: https://www.gov.uk/guidance/passenger-service-contracts (Accessed: 12-3-2022).

Department for Transport, 2022. *DfT payments to passenger rail operators under emergency agreements and national rail contracts*. Available at: https://www.gov.uk/government/publications/dft-payments-to-passenger-rail-operators-under-emergency-agreements (Accessed: 1-2-2022).

Department of Infrastructure and Regional Development, 2008a. *National guidelines for infrastructure project delivery: National PPP Guidelines Overview*. Australian Government, Canberra ACT.

Department of Infrastructure and Regional Development, 2008b. *National guidelines for infrastructure project delivery: Volume 4 Public Sector Comparator Guidance*. Australian Government, Canberra ACT.

Department of Infrastructure and Regional Development, 2013. *National guidelines for infrastructure project delivery: Volume 5 Discount Rate Methodology*. Australian Government, Canberra ACT.

DiCicco-Bloom, B. and Crabtree, B.F., 2006. The qualitative research interview. *Medical Education*, *40*(4), pp.314-321.

Doloi, H., 2012. Understanding impacts of time and cost related construction risks on operational performance of PPP projects. *International Journal of Strategic Property Management*, *16*(3), pp.316-337.

dos Reis, C.J.O. and Gomes, R.C., 2022. Public value creation and appropriation mechanisms in public–private partnerships: How does it play a role?. *Public Administration*, pp.1-23.

Eadie, R., Millar, P. and Toner, L., 2013. Public private partnerships, reevaluating value for money. *International Journal of Procurement Management*, *6*(2), pp.152-169.

Edgar, V.C., Beck, M. and Brennan, N.M., 2018. Impression management in annual report narratives: The case of the UK private finance initiative. Accounting, *Auditing and Accountability*, *31*(6), pp.1566-1592.

Edwards, P., J. Shaoul, A. Stafford and L. Arblaster., 2004. *Evaluating the Operation of PFI in Roads and Hospitals, ACCA Research Report 84.* Available at: http://image.guardian.co.uk/sys-files/Society/documents/2004/11/24/PFI.pdf (Accessed: 13-3-2019).

El-Gohary, N.M., Osman, H. and El-Diraby, T.E., 2006. Stakeholder management for public private partnerships. *International Journal of Project Management*, *24*(7), pp.595-604.

Engel, E., Fischer, R. and Galetovic, A., 2018. The joy of flying: Efficient airport PPP contracts. *Transportation Research Part B: Methodological*, *114*, pp.131-146.

European Investment Bank, 2015. *Value for money assessment: review of approaches and key concepts*. Available at: https://www.eib.org/attachments/epec/epec_value_for_money_assessment_en.pdf (Accessed: 3-7-2018).

European Investment Bank, 2022. *Market update: review of the European PPP market in 2021*. Available at: https://www.eib.org/attachments/publications/epec_market_update_2021_en.pdf (Accessed: 7-5-2022).

European PPP Expertise Centre, 2012. *United Kingdom – England: PPP units and related institutional framework.* Available at: https://www.eib.org/attachments/epec/epec_uk_england_ppp_unit_and_related_institutional_framework_en.pdf (Accessed: 13-5-2022).

European PPP Expertise Centre, 2015. *Value for money assessment: review of approaches and key concepts.* Available at: https://www.eib.org/attachments/epec/epec_value_for_money_assessment_en.pdf (Accessed: 12-11-2020).

European PPP Expertise Centre, 2022. *What is a public-private partnership*. Available at: https://www.eib.org/epec/find-out-more/faq (Accessed: 28-1-2022)

Ewing, A.C., 1948. *The Definition of Good*. Macmillan, New York.

Falch, M. and Henten, A., 2010. Public private partnerships as a tool for stimulating investments in broadband. *Telecommunications Policy*, *34*(9), pp.496-504.

Fantozzi, F., Bartocci, P., D'Alessandro, B., Arampatzis, S. and Manos, B., 2014. Public–private partnerships value in bioenergy projects: Economic feasibility analysis based on two case studies. *Biomass and Bioenergy*, *66*, pp.387-397.

Feak, B.C. and Swales, M.J, 2009. *Telling a Research Story: Writing a Literature Review.* The University of Michigan Press, Michigan.

Federal Highway Administration, 2012. *Value for money assessment for Public-Private Partnerships: a primer*. Available at: https://www.fhwa.dot.gov/ipd/pdfs/p3/p3_value_for_money_primer_122612.pdf (Accessed: 12-2019).

Feng, H., Grifoll, M., Yang, Z. and Zheng, P., 2021. Latest challenges to ports in public-private partnership: Case of Dandong port (China)'s bankrupt. *Transport Policy*, *110*, pp.293-305.

Feng, Y., Guo, X., Wei, B. and Chen, B., 2021. A fuzzy analytic hierarchy process for risk evaluation of urban rail transit PPP projects. *Journal of Intelligent & Fuzzy Systems*, *41*(4), pp.5117-5128.

Feng, Z., Zhang, Y., Zhang, S. and Song, J., 2018. Contracting and renegotiating with a loss-averse private firm in BOT road projects. *Transportation Research Part B*, *112*, pp.40-72.

Fink, A., 2005. Conducting research literature reviews: from the internet to paper (2nd ed.). SAGE Publications, California.

Flanagan, R., 2014. Whole life thinking and engineering the future. *Frontiers of Engineering Management*, *1*(3), pp.290-296.

Flyvbjerg, B. and Bester, D.W., 2021. The cost-benefit fallacy: Why cost-benefit analysis is broken and how to fix it. *Journal of Benefit-Cost Analysis*, *12*(3), pp.395-419.

Flyvbjerg, B., 2008. Curbing optimism bias and strategic misrepresentation in planning: Reference class forecasting in practice. *European planning studies*, *16*(1), pp.3-21.

Flyvbjerg, B., Dkamris Holm, M.K. and Buhl, S.L., 2004. What causes cost overrun in transport infrastructure projects? *Transport Reviews*, *24*(1), pp.3-18.

Freeman, M., Groom, B. and Spackman, M., 2018. *Social discount rates for cost-benefit analysis: A report for HM Treasury*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/685904/Social_Discount_Rates_for_Cost-Benefit_Analysis_A_Report_for_HM_Treasury.pdf (Accessed: 16-9-2018).

Freeman, R.E., 2010. *Strategic management: A stakeholder approach*. Cambridge University Press, Cambridge.

Freeman, R.E., Harrison, J.S., Wicks, A.C., Parmar, B.L. and De Colle, S., 2010. *Stakeholder theory: The state of the art*. Cambridge University Press, Cambridge.

Gage, N.L., 1989. The paradigm wars and their aftermath a "historical" sketch of research on teaching since 1989. *Educational Researcher*, *18*(7), pp.4-10.

Garfield, E., Pudovkin, A.I. and Istomin, V.S., 2003. Why do we need algorithmic historiography?. *Journal of the American Society for Information Science and Technology*, *54*(5), pp.400-412.

Garrido, L., Gomez, J., de los Ángeles Baeza, M. and Vassallo, J.M., 2017. Is EU financial support enhancing the economic performance of PPP projects? An empirical analysis on the case of Spanish road infrastructure. *Transport policy*, *56*, pp.19-28.

Garvin, M. J., 2010. Enabling development of the transportation public-private partnership market in the United States. *Journal of Construction Engineering and Management*, *136*(4), pp.402–411.

Gerard, H. and Kearns, J., 2011. *The Australian Economy in the 2000s*. Reserve Bank of Australia, Sydney.

Ghazinoory, S., Abdi, M. and Azadegan-Mehr, M., 2011. SWOT methodology: a state-of-the-art review for the past, a framework for the future. *Journal of Business Economics and Management*, *12*(1), pp.24-48.

Girmscheid, G., 2009. NPV model for evaluating the economic efficiency of municipal street maintenance by private providers. *Journal of Construction Engineering and Management*, *135*(8), pp.701-709.

Global Infrastructure Hub - Oxford Economics, 2017. *Global infrastructure outlook: infrastructure investment needs 50 countries, 7 sectors to 2040*. Available at: https://www.oxfordeconomics.com/recent-releases/Global-Infrastructure-Outlook (Accessed: 30/1/2022).

Global Infrastructure Hub, 2021. *Infrastructure Monitor 2021*. Available at: https://cdn.gihub.org/umbraco/media/4374/gihub_v9.pdf (Accessed: 7/2/2022).

Gopalkrishna, N. and Karnam, G., 2015. Performance analysis of national highways public private partnerships in India. *Public Works Management & Policy*, *20*(3), pp.264-285.

Gordon, C., Mulley, C., Stevens, N. and Daniels, R., 2013. Public–private contracting and incentives for public transport: Can anything be learned from the Sydney Metro experience?. *Transport Policy*, *27*, pp.73-84.

Grasman, S.E., Faulin, J. and Lera-López, F., 2014. Integrating environmental outcomes into transport public–private partnerships. *International Journal of Sustainable Transportation*, *8*(6), pp.399-422.

Grasman, S.E., Faulin, J. and Lera-López, F., 2014. Integrating environmental outcomes into transport public–private partnerships. *International Journal of Sustainable Transportation*, *8*(6), pp.399–422.

Griffin, J., 1986. *Well-Being*. Clarendon Press, Oxford.

Grimsey, D. and Lewis, M.K., 2005. Are Public Private Partnerships value for money?: Evaluating alternative approaches and comparing academic and practitioner views. *Accounting Forum, 29*(4), pp. 345-378.

Grimsey, D. and Lewis, M.K., 2002. Evaluating the risks of public–private partnerships for infrastructure projects. *International Journal of Project Management*, *20*(2), pp.107-118.

Gross, M. and Garvin, M., 2011. Structuring PPP toll-road contracts to achieve public pricing objectives. *Engineering Project Organization Journal*, *1*(2), pp.143-156.

Grout, P.A., 2003. Public and private sector discount rates in public–private partnerships. *The Economic Journal*, *113*(486), pp.C62-C68.

Grout, P.A., 2005. Value-for-money measurements in public-private partnerships, EIB Papers, ISSN 0257-7755, European Investment Bank (EIB), Luxembourg, 10(2), 33-56.

Grubišić Šeba, M., 2015. Transport infrastructure construction in Croatia: an analysis of public–private partnerships. *Southeast European and Black Sea Studies*, *15*(3), pp.327-360.

Guba, E.G. and Lincoln, Y.S., 1994. Competing paradigms in qualitative research. In Denzin, N.K. and Lincoln, Y.S. (ed.) *Handbook of Qualitative Research*. SAGE Publications, California, pp. 105-117.

Guest, G., Bunce, A. and Johnson, L., 2006. How many interviews are enough? An experiment with data saturation and variability. *Field Methods*, *18*(1), pp.59-82.

Guirao, B., García-Pastor, A. and López-Lambas, M.E., 2016. The importance of service quality attributes in public transportation: Narrowing the gap between scientific research and practitioners' needs. *Transport Policy*, *49*, pp.68-77.

Haddad, E.A., Lozano-Gracia, N., Germani, E., Vieira, R.S., Nakamura, S., Skoufias, E. and Alves, B.B., 2019. Mobility in cities: Distributional impact analysis of transportation improvements in São Paulo Metropolitan Region. *Transport Policy*, *73*(C), pp.125-142.

Hammersley, M., 1992. The paradigm wars: Reports from the front. *British Journal of Sociology of Education*, *13*(1), pp.131-143.

Hang, D.T.T., 2016. Evaluating the decision-making on a Public-Private Partnership to finance a road project in Vietnam. *Journal of International studies*, *9*(3), pp.124-137.

Hang, D.T.T., 2019. Approaching Value for Money to assess viability of Public-Private partnership projects. *Journal of International Studies*, *12*(1), pp.229-238.

Harlen, W. and James, M., 1997. Assessment and learning: differences and relationships between formative and summative assessment. *Assessment in education: Principles, policy & practice*, *4*(3), pp.365-379.

Hayes, R., Kyer, B. and Weber, E., 2015. *The case study cookbook*. Worcester Polytechnic Institute: Worcester, MA, USA.

He, Y., Xiong, H. and Wu, L., 2018. Study on fuzzy improved qualitative evaluation of urban rail transit PPP project, *The 6th International Symposium on Project Management,* 21st -23rd July, Chongqing, China

Heald, D., 2003. Value for money tests and accounting treatment in PFI schemes. *Accounting, Auditing & Accountability Journal*, *16*(3), pp.342-371.

Heald, D.A. and McLeod, A., 2002. Public expenditure. *The Law of Scotland: Stair Memorial Encyclopaedia Constitutional Law Volume*, Butterworths, Edinburgh, pp.389-479.

Healy, P. and Devane, D., 2011. Methodological considerations in cohort study designs. *Nurse Researcher*, *18*(3), pp.32-36.

Heathwood, C., 2015. Monism and pluralism about value. In Hirose, I. and Olson, J. (ed.) *The Oxford handbook of value theory*, Oxford University Press, New York.

Henjewele, C., Sun, M. and Fewings, P., 2012. Analysis of factors affecting value for money in UK PFI projects. *Journal of Financial Management of Property and Construction*, *17*(1), pp.9-28.

Henk, G.G., 1998. Privatization and the public/private partnership. *Journal of Management in Engineering*, *14*(4), pp.28-29.

Henry, J., 2000. Adam Smith and the theory of value: Chapter six considered. *History of Economics Review*, *31*(1), pp.1-13.

Hirose, I. and Olson, J. eds., 2015. *The Oxford handbook of value theory*. Oxford University Press, New York.

Historic England, 2014. *Heritage Counts 2014: the value and impact of heritage*. Available at: https://historicengland.org.uk/content/heritage-counts/pub/2014/value-impact-chapter-pdf/ (Accessed: 11-11-2021).

HM Government, 2022. *Levelling up the Untited Kingdom*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1052708/Levelling_up_the_UK_white_paper.pdf (Accessed: 31-5-2022).

HM Treasury, 2004. *Value for Money Assessment Guidance*. Available at: https://delta.bipsolutions.com/docstore/pdf/8038.pdf (Assessed: 10-3-2021).

HM Treasury, 2006. *Value for Money Assessment Guidance*. Available at: https://webarchive.nationalarchives.gov.uk/ukgwa/20130103024255/http://www.hm-treasury.gov.uk/d/vfm_assessmentguidance061006opt.pdf (Assessed: 10-3-2021).

HM Treasury, 2011. *Quantitative assessment: user guide*. Available at: https://webarchive.nationalarchives.gov.uk/ukgwa/20130102211853/http://www.hm-treasury.gov.uk/infrastructure_ppp_vfm.htm (Assessed: 10-3-2021).

HM Treasury, 2012. *A new approach to public private partnerships*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/205112/pf2_infrastructure_new_approach_to_public_private_parnerships_051212.pdf (Accessed: 13-7-2022).

HM Treasury, 2018a. *Budget 2018*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/752202/Budget_2018_red_web.pdf (Accessed: 6-3-2022).

HM Treasury, 2018b. *National infrastructure and construction pipeline 2018*. Available at: https://www.gov.uk/government/publications/national-infrastructure-and-construction-pipeline-2018 (Accessed: 26-11-2018).

HM Treasury, 2019. *Private Finance Initiative and Private Finance 2 projects: 2018 summary data*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/805117/PFI_and_PF2_FINAL_PDF1.pdf (Accessed: 7-3-2022).

HM Treasury, 2020. *Spending Review 2020*. Available at: https://www.gov.uk/government/publications/spending-review-2020-documents/spending-review-2020 (Accessed: 11-12-2021).

HM Treasury, 2020a. *Green Book review 2020: findings and response*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/937700/Green_Book_Review_final_report_241120v2.pdf (Accessed: 4-3-2022).

HM Treasury, 2020b. *The Green Book: Central government guidance on appraisal and evaluation*. The National Archives, London

HM Treasury, 2020c. *National Infrastructure Strategy: fairer, faster, greener*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/938539/NIS_Report_Web_Accessible.pdf (Accessed: 8-11-2022).

HM Treasury, 2021a. *UK Infrastructure Bank: policy design.* Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/994535/UKIB_Policy_Design.pdf (Accessed: 4-3-2022).

HM Treasury, 2021b. *PFI centre of excellence*. UK Government, London.

HM Treasury, 2021c. *Fund extended to help level-up every corner of United Kingdom*. Available at: https://www.gov.uk/government/news/fund-extended-to-help-level-up-every-corner-of-united-kingdom (Accessed: 25-2-2021).

HM Treasury, 2022. *The Green Book: Templates and support material – Template for Outline Business Case*. Available at: https://www.gov.uk/government/publications/the-green-book-templates-and-support-material (Accessed: 13-7-2022).

Hodge, G. A. and Greve, C., 2017. On Public–Private Partnership performance: a contemporary review. *Public Works Management & Policy*, *22*(1), pp.55–78.

Hodge, G. and Greve, C., 2010. Public-private partnerships: governance scheme or language game?. *Australian Journal of Public Administration*, *69*, pp.S8-S22.

Hodge, G., Greve, C. and Biygautane, M., 2018. Do PPP's work? What and how have we been learning so far?. *Public Management Review*, *20*(8), pp.1105-1121.

Hodge, G.A. and Greve, C., 2007. Public–private partnerships: an international performance review. *Public Administration Review*, *67*(3), pp.545-558.

Hodgson, F.C. and Turner, J., 2003. Participation not consumption: the need for new participatory practices to address transport and social exclusion. *Transport Policy*, *10*(4), pp.265-272.

Hodgson, M. and Corrigan, K., 2005. To privatise or not? *Canadian Consulting Engineer, 46*(1)**,** 26-33.

Hong, S., 2016. When does a public-private partnership lead to inefficient cost management? Evidence from South Korea's urban rail system. *Public Money & Management*, *36*, pp.447-54.

Hood, C., 1991. A public management for all seasons?. *Public Administration*, *69*(1), pp.3-19.

House of Commons, 2003. *The Private Finance Initiative (PFI)*. Available at: https://researchbriefings.files.parliament.uk/documents/RP03-79/RP03-79.pdf (Accessed: 13-5-2022).

House of Commons, 2011. *Private Finance Initiative: written evidence*. Available at: https://www.parliament.uk/globalassets/documents/commons-committees/treasury/PFI-Evidence.pdf (Accessed: 27-5-2022).

House of Commons, 2021. *Public spending: a brief introduction*. Available at: https://researchbriefings.files.parliament.uk/documents/CBP-8046/CBP-8046.pdf (Accessed: 12-7-2022).

Howe, K.R., 1988. Against the quantitative-qualitative incompatibility thesis or dogmas die hard. *Educational Researcher*, *17*(8), pp.10-16.

Hox, J.J. and Boeije, H.R., 2005. Data collection, primary vs. secondary. *Encyclopedia of Social Measurement*, *1*(1), pp.593-599.

Hromada, E., 2017. Utilization of dynamic simulation for design and optimization of PPP/PFI projects. *Procedia Engineering*, *196*, pp.399-406.

Hu, X. and Han, J., 2018. Highway project value of money assessment under PPP mode and its application. *Journal of Advanced Transportation*, pp.1802671.

Hueskes, M., Verhoest, K. and Block, T., 2017. Governing public–private partnerships for sustainability: An analysis of procurement and governance practices of PPP infrastructure projects. *International Journal of Project Management*, *35*(6), pp.1184-1195.

Hughes, K., MacKintosh, A.M., Hastings, G., Wheeler, C., Watson, J. and Inglis, J., 1997. Young people, alcohol, and designer drinks: quantitative and qualitative study. *BMJ*, *314*, pp.414-418.

Hyard, A., 2012. Cost-benefit analysis according to Sen: An application in the evaluation of transport infrastructures in France. *Transportation Research Part A: Policy and Practice*, *46*(4), pp.707-719.

Ika, L.A., 2009. Project success as a topic in project management journals. *Project Management Journal*, *40*(4), pp.6-19.

Infrastructure and Projects Authority, 2017. *Guidance: UK Guarantees Scheme*. Available at: https://www.gov.uk/guidance/uk-guarantees-scheme (Accessed: 12-3-2020).

Infrastructure and Projects Authority, 2021a. *Transforming infrastructure performance: Roadmap to 2030.* Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1016726/IPA_TIP_Roadmap_to_2030_v6__1_.pdf (Accessed: 2-3-2022).

Infrastructure and Projects Authority, 2021b. *Analysis of the National Infrastructure and Construction Pipeline 2021.* Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1016759/Analysis_of_the_National_Infrastructure_and_Construction_Pipeline_2021.pdf (Accessed: 4-3-2022).

Infrastructure and Projects Authority, 2022a. *Collection: PFI centre of excellence*. Available at: https://www.gov.uk/government/collections/public-private-partnerships (Accessed: 6-3-2022).

Infrastructure and Projects Authority, 2022b. *Expiry toolkit: PFI structure and parties*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1057591/Expiry_Toolkit_-_PFI_Structure___Parties.pdf (Accessed: 14-5-2022).

Infrastructure Partnerships Australia, 2022. *Public Private Partnerships by jurisdiction*. Available at: https://infrastructure.org.au/chart-group/public-private-partnerships-by-jurisdiction/ (Accessed: 6-3-2022).

Ismail, K., Takim, R. and Nawawi, A.H., 2012. A public sector comparator (PSC) for value for money (VFM) assessment tools. *Asian Social Science*, *8*(7), p.192-201.

Ismail, S., 2013. Drivers of value for money public private partnership projects in Malaysia. *Asian Review of Accounting*, *21*(3), pp.241-256.

Jackson, P., 2012. Value for money and international development: Deconstructing myths to promote a more constructive discussion. eVALation Matters, African Development Bank.

Jasiukevicius, L. and Vasiliauskaite, A., 2018. The assessment of public-private partnership's possibilities to optimise investments in public infrastructure. *Engineering Economics, 29*(1)**,** 32-45.

Jin, X.H. and Zhang, G., 2011. Modelling optimal risk allocation in PPP projects using artificial neural networks. *International Journal of Project Management*, *29*(5), pp.591–603.

Johnson, R.B. and Onwuegbuzie, A.J., 2004. Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, *33*(7), pp.14-26.

Johnston, J. and Gudergan, S.P., 2007. Governance of public—private partnerships: lessons learnt from an Australian case?. *International Review of Administrative Sciences*, *73*(4), pp.569-582.

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

Karmperis, A., Sotirchos, A., Aravossis, K. and Tatsiopoulos, I.P., 2012. Implementing wastewater treatment projects through build–operate–transfer contracts. *International Journal of Sustainable Development and Planning*, *7*(2), pp.237-251.

Kauder, E., 1965. *A history of marginal utility theory*. Princeton University Press: Princeton, New Jersey.

Kavishe, N., Jefferson, I. and Chileshe, N., 2019. Evaluating issues and outcomes associated with public–private partnership housing project delivery: Tanzanian practitioners' preliminary observations. *International Journal of Construction Management*, *19*(4), pp.354-369.

Ke, Y., Hao, W., Ding, H and Wang, Y., 2017. Factors influencing the private involvement in urban rail Public-Private Partnerships projects in China. *Construction Economics and Building*, *17*(1), pp.90-106.

Ke, Y., Wang, S., Chan, A.P. and Cheung, E., 2009. Research trend of public-private partnership in construction journals. *Journal Of Construction Engineering and Management*, *135*(10), pp.1076-1086.

Keçi, J., 2019. Infrastructure public private partnership implementation and risk management – Lessons from Albanian approach. *IABSE Symposium, Guimaraes 2019: Towards a Resilient Built Environment Risk and Asset Management - Report*, pp.900-911.

Kenyon, S., Lyons, G. and Rafferty, J., 2002. Transport and social exclusion: investigating the possibility of promoting inclusion through virtual mobility. *Journal of Transport Geography*, *10*(3), pp.207-219.

Khan, Z., Ali, M., Kirikkaleli, D., Wahab, S. and Jiao, Z., 2020. The impact of technological innovation and public-private partnership investment on sustainable environment in China: Consumption-based carbon emissions analysis. *Sustainable Development*, *28*(5), pp.1317-1330.

Kiger, M.E. and Varpio, L., 2020. Thematic analysis of qualitative data: AMEE Guide No. 131. *Medical Teacher*, *42*(8), pp.846-854.

Koppenjan, J.J.F., 2005. The formation of public-private partnerships: lessons from nine transport infrastructure projects in the Netherlands. *Public Administration*, *83*(1), pp.135-157.

Kuhn, T.S., 1970. *The structure of scientific revolutions* (Vol. 111). University of Chicago Press: Chicago.

Kumar, L., Jindal, A. and Velaga, N.R., 2018. Financial risk assessment and modelling of PPP based Indian highway infrastructure projects. *Transport Policy*, *62*, pp.2-11.

Kunreuther H and Michel-Kerjan E., 2012. *Challenge Paper: Natural Disasters. Policy Options for Reducing Losses from Natural Disasters: Allocating $75 billion*. Revised version for Copenhagen Consensus. Center for Risk Management and Decision Processes, The Wharton School, University of Pennsylvania, Philadelphia, Pennsylvania.

Kuronen, M., Junnila, S., Majamaa, W. and Niiranen, I., 2010. Public-private-people partnership as a way to reduce carbon dioxide emissions from residential development. *International Journal of Strategic Property Management*, *14*(3), pp.200-216.

Kweun, J.Y., Wheeler, P.K. and Gifford, J.L., 2018. Evaluating highway public-private partnerships: Evidence from US value for money studies. *Transport Policy*, *62*, pp.12-20.

LaFrance, J. and Lehmann, M., 2005. Corporate awakening–Why (some) corporations embrace public–private partnerships. *Business Strategy and the Environment*, *14*(4), pp.216-229.

Lam, T. and Gale, K., 2014. Highway maintenance: impact of framework agreements upon project financial performance. *Construction Management and Economics*, *32*(5), pp.460-472.

Lange G.M., Wodon Q., Carey K., 2018. *The changing wealth of nations 2018: Building a sustainable future*. The World Bank, Washington, D.C.

Laplume, A.O., Sonpar, K. and Litz, R.A., 2008. Stakeholder theory: Reviewing a theory that moves us. *Journal of Management*, *34*(6), pp.1152-1189.

Leclercq, E., Pojani, D. and Van Bueren, E., 2020. Is public space privatization always bad for the public? Mixed evidence from the United Kingdom. *Cities*, *100*, pp.102649.

Leigland, J., 2018. Public-Private Partnerships in developing countries: The emerging evidence-based critique. *The World Bank Research Observer*, *33*(1), pp.103–134.

Li, J. and Zou, P.X., 2011. Fuzzy AHP-based risk assessment methodology for PPP projects. *Journal of Construction Engineering and Management*, *137*(12), pp.1205-1209.

Liang, Q. and Hu, H., 2017. Uncertainty analysis of value for money assessment for public-private partnership projects. *Journal of Shanghai Jiaotong University (Science)*, *22*(6), pp.672-681.

Lidskog, R. and Soneryd, L., 2000. Transport infrastructure investment and environmental impact assessment in Sweden: public involvement or exclusion?. *Environment and Planning A*, *32*(8), pp.1465-1479.

Lincoln, Y.S., Lynham, S.A. and Guba, E.G., 2011. Paradigmatic controversies, contradictions, and emerging confluences, revisited. In Denzin, N.K. and Lincoln, Y.S. (4th ed.) *The Sage Handbook of Qualitative Research*, SAGE Publications, California, pp.163-188.

Liu, H.J., Love, P.E., Ma, L. and Sing, M.C., 2021. Predicting production-output performance within a complex business environment: from singular to multi-dimensional observations in evaluation. *International Journal of Production Research*, *59*(24), pp.7390-7399.

Liu, H.J., Love, P.E., Sing, M.C., Niu, B. and Zhao, J., 2019. Conceptual framework of life-cycle performance measurement: Ensuring the resilience of transport infrastructure assets. *Transportation Research Part D: Transport and Environment*, *77*, pp.615-626.

Liu, H.J., Love, P.E., Smith, J., Sing, M.C. and Matthews, J., 2018. Evaluation of public–private partnerships: a life-cycle performance prism for ensuring value for money. *Environment and Planning C: Politics and Space*, *36*(6), pp.1133-1153.

Liu, J. and Wei, Q., 2018. Risk evaluation of electric vehicle charging infrastructure public-private partnership projects in China using fuzzy TOPSIS. *Journal of Cleaner Production*, *189*, pp.211-222.

Liu, J., Love, P.E., Smith, J., Regan, M. and Davis, P.R., 2015. Life cycle critical success factors for public-private partnership infrastructure projects. *Journal of Management in Engineering*, *31*(5), p.04014073.

Liu, T. and Wilkinson, S., 2013. Can the pilot public-private partnerships projects be applied in future urban rail development? *Built Environment Project and Asset Management*, *3*, pp.250-63.

Liu, W. and Song, Z., 2020. Review of studies on the resilience of urban critical infrastructure networks. *Reliability Engineering & System Safety*, *193*, p.106617.

Liyanage, C. and Villalba-Romero, F., 2015. Measuring success of PPP transport projects: a cross-case analysis of toll roads. *Transport Reviews*, *35*(2), pp.140-161.

Local Government Association, 2022. *Public-Private Partnerships: Driving growth, building resilience*. Available at: https://www.local.gov.uk/publications/public-private-partnerships-driving-growth-building-resilience (Accessed: 6-3-2022).

Locatelli, G., 2020. Infrastructure megaprojects that are delivered late and over budget aren't necessarily failures – here's why. *The Conversation*, UK.

Lor, P.J., 2010. International and comparative librarianship. In M.J. Bates and M.N. Maack, (ed.) *Encyclopedia of Library and Information Science*. Taylor & Francis, London.

Love, P. and Davis, P. and Baccarini, D. and Wilson, G. and Lopez, R., 2008. *Procurement selection in public sector: A tale of two states*, in CRC construction innovation (ed), Client Driving Innovation, Mar 12 2008, pp. 1-10. Gold Coast: CRC Construction Innovation.

Love, P.E., Ika, L., Matthews, J. and Fang, W., 2021. Shared leadership, value and risks in large scale transport projects: Re-calibrating procurement policy for post COVID-19. *Research in Transportation Economics*, *90*, pp.100999.

Love, P.E., Ika, L.A., Matthews, J. and Fang, W., 2020. Curbing poor-quality in large-scale transport infrastructure projects. *IEEE Transactions on Engineering Management*. DOI: 10.1109/TEM.2020.3031890.

Love, P.E., Sing, M.C., Ika, L.A. and Newton, S., 2019. The cost performance of transportation projects: The fallacy of the Planning Fallacy account. *Transportation Research Part A: Policy and Practice*, *122*, pp.1-20.

Lovejoy, A.O., 1963. *The thirteen pragmatisms and other essays*. JHU Press, Maryland.

Loxley, J., 2012. Public-private partnerships after the global financial crisis: Ideology trumping economic reality. *Studies in Political Economy*, *89*(1), pp.7-38.

Lucas, K., 2012. Transport and social exclusion: Where are we now?. *Transport Policy*, *20*, pp.105-113.

Lucio-Arias, D. and Leydesdorff, L., 2008. Main-path analysis and path-dependent transitions in HistCite™-based historiograms. *Journal of the American Society for Information Science and Technology*, *59*(12), pp.1948-1962.

Ma, G., Wu, M., Jia, J. and Yang, W., 2021. Two-level quality decision support system for building structural damage prediction and maintenance solution recommendation in the operation and maintenance phase. *Journal of Construction Engineering and Management*, *147*(6), p.04021044.

Macário, R., Ribeiro, J. and Costa, J.D., 2015. Understanding pitfalls in the application of PPPs in transport infrastructure in Portugal. *Transport Policy*, *41*, pp.90-99.

Mackie, P. and Smith, N. (2005). Financing roads in Great Britain. *Research in Transportation Economics*, *15*, pp.215-229.

Madden, A.D., 2021. A review of basic research tools without the confusing philosophy. *Higher Education Research & Development*, pp.1-15.

Makovsek, D. and Moszoro, M., 2017. Risk pricing inefficiency in public–private partnerships. *Transport Reviews*, *38*(3), pp. 298-321.

Makovšek, D. and Moszoro, M., 2018. Risk pricing inefficiency in public–private partnerships. *Transport Reviews*, *38*(3), pp.298-321.

Malterud, K., Siersma, V.D. and Guassora, A.D., 2016. Sample size in qualitative interview studies: guided by information power. *Qualitative Health Research*, *26*(13), pp.1753-1760.

Malvestio, A.C., Fischer, T.B. and Montaño, M., 2018. The consideration of environmental and social issues in transport policy, plan and programme making in Brazil: A systems analysis. *Journal of Cleaner Production*, *179*, pp.674-689.

Markolf, S.A., Hoehne, C., Fraser, A., Chester, M.V. and Underwood, B.S., 2019. Transportation resilience to climate change and extreme weather events–Beyond risk and robustness. *Transport Policy*, *74*, pp.174-186.

Markovich, J. and Lucas, K., 2011. The social and distributional impacts of transport: a literature review. Oxford University, TSU Working Paper.

Marrone, J.A., 2010. Team boundary spanning: A multilevel review of past research and proposals for the future. *Journal of Management*, *36*(4), pp.911-940.

Mason, J., 2002. *Qualitative Researching* (2nd ed.). SAGE Publications, London.

Matinheikki, J., Naderpajouh, N., Aranda-Mena, G., Jayasuriya, S. and Teo, P., 2021. Befriending Aliens: Institutional Complexity and Organizational Responses in Infrastructure Public–Private Partnerships. *Project Management Journal*, *52*(5), pp.453-470.

Mattsson, L.G. and Jenelius, E., 2015. Vulnerability and resilience of transport systems–A discussion of recent research. *Transportation Research Part A: Policy and Practice*, *81*, pp.16-34.

Maxwell, J. (1997). Designing a qualitative study. In Bickman, L. and Rog, D.J. (ed.) *Handbook of applied social research methods*. SAGE Publications, California. pp.69-100.

McErlane, A, Heaney, G, Haran, M and McClements, S., 2016. The application of stakeholder theory to uk ppp stakeholders. In: P W Chan and C J Neilson (ed.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 863-872.

McKevitt, D., 2015. Debate: Value for money—in search of a definition. *Public Money & Management*, *35*(2), pp.99-100.

McLeod, L., Doolin, B. and MacDonell, S.G., 2012. A perspective-based understanding of project success. *Project Management Journal*, *43*(5), pp.68-86.

McQuaid, R.W. and Scherrer, W., 2010. Changing reasons for public–private partnerships (PPPs). *Public Money & Management*, *30*(1), pp.27-34.

Medda, F., 2007. A game theory approach for the allocation of risks in transport public private partnerships. *International Journal of Project Management*, *25*(3), pp.213–218.

Medda, F.R., Carbonaro, G. and Davis, S.L., 2013. Public private partnerships in transportation: Some insights from the European experience. *IATSS Research*, *36*(2), pp.83–87.

Merna, T. and Lamb, D., 2009. *Application of risk analysis in privately financed projects: The value for money assessment through the public sector comparator and private finance alternative* (pp. 379-397). Wiley-Blackwell, Oxford, UK.

Milios, J., 2003. Marx's Value Theory revisited: A 'value-form' approach. *Proceedings of the Seventh International Conference in Economics*. Available at: http://users.ntua.gr/jmilios/F2_3.pdf (Accessed: 3-7-2018).

Ministry of Finance, 2014. *Notice on the problems regarding the promotion of PPPs*. Available at: http://jrs.mof.gov.cn/zhuanti2019/ppp/zcfbppp/201410/t20141031_1155346.htm (Accessed: 21-6-2021).

Ministry of Finance, 2015. *Notice on launching 'PPP Value for Money Assessment Guidance'*. Available at: http://www.ccgp.gov.cn/ppp/zcfg/201601/t20160106_6428967.htm (Accessed: 21-6-2021).

Ministry of Finance, 2016. *Notice on launching 'PPP Value for Money Assessment Guidance (updated version)'*. Available at: http://www.pppcenter.org.cn/zcfg/bwzc/czb/201611/144829KJp.html (Accessed: 21-6-2021).

Mitchell, A., 2015. *A comparison of the offshoring and outsourcing strategies of German and UK multinational companies: a critical engagement with 'varieties of capitalism' perspective*. PhD thesis, University of Hertfordshire, Hertfordshire.

Mitchell, A., 2018. A review of mixed methods, pragmatism and abduction techniques. *The Electronic Journal of Business Research Methods*, *16*(3), pp.103-116.

Miyamoto, K., Sato, Y. and Kitazume, K., 2005. Private-sector participation in infrastructure projects and value for money: Economic and financial impacts. *Transportation Research Record*, *1932*(1), pp.16-22.

Moore, G.E., 1903. *Principia Ethica.* Cambridge University Press, Cambridge.

Moore, M.A., Boardman, A.E. and Vining, A.R., 2017. Risk in public sector project appraisal: it mostly does not matter!. *Public Works Management & Policy*, *22*(4), pp.301-321.

Morallos, D. and Amekudzi, A., 2008. The state of the practice of value for money analysis in comparing public private partnerships to traditional procurements. *Public Works Management & Policy*, *13*(2), pp.114-125.

Morallos, D., Amekudzi, A., Ross, C. and Meyer, M., 2009. Value for money analysis in US transportation public–private partnerships. *Transportation Research Record*, *2115*(1), pp.27-36.

Morgan, G. and Smircich, L., 1980. The case for qualitative research. *Academy of Management Review*, *5*(4), pp.491-500.

Mrvar, A. and Batagelj, V., 2016. Analysis and visualization of large networks with program package Pajek. *Complex Adaptive Systems Modeling*, *4*(1), pp.1-8.

Muleya, F., Zulu, S. and Nanchengwa, P.C., 2020. Investigating the role of the public private partnership act on private sector participation in PPP projects: a case of Zambia. *Journal of Construction Management*, *20*(6), pp.598-612.

Naoum, S.G. and Egbu, C., 2016. Modern selection criteria for procurement methods in construction. *International Journal of Managing Projects in Business*, *9*(2), pp.309–336.

Nathan Associates, 2017. *Public-Private Partnerships: A basic introduction for non-specialists: topic guide*. Available at: https://www.gov.uk/research-for-development-outputs/public-private-partnerships-a-basic-introduction-for-non-specialists-topic-guide (Accessed: 10-5-2022).

National Audit Office, 2009. *Department for Transport: the failure of Metronet*. Available at: https://webarchive.nationalarchives.gov.uk/ukgwa/20170207052351/https://www.nao.org.uk/wp-content/uploads/2009/06/0809512es.pdf (Accessed: 5-3-2022).

National Audit Office, 2011. *Lessons from PFI and other projects*. Available at: https://www.nao.org.uk/wp-content/uploads/2011/04/1012920.pdf (Accessed: 6-7-2022).

National Audit Office, 2011. *Successful commissioning toolkit: Assessing value for money*. Available at: https://nao.org.uk/successful-commissioning/general-principles/value-for-money/assessing-value-for-money/ (Accessed: 3-6-2011).

National Audit Office, 2013. *Review of VFM assessment process for PFI*. Available at: https://www.nao.org.uk/wp-content/uploads/2014/01/Review-of-VFM-assessment-process-for-PFI1.pdf (Accessed: 14-7-2018).

National Audit Office, 2018. *PFI and PFI 2*. Available at: https://www.nao.org.uk/wp-content/uploads/2018/01/PFI-and-PF2.pdf (Accessed: 12-9-2019).

National Audit Office, 2022. *Assessing value for money*. Available at: https://www.nao.org.uk/successful-commissioning/general-principles/value-for-money/assessing-value-for-money/ (Accessed: 7-3-2022).

National Treasury-Republic of South Africa, 2021. *Budget 2021: budget review*. Available at: http://www.treasury.gov.za/documents/national%20budget/2021/review/FullBR.pdf (Accessed: 3-10-2021).

Newman, J., Barnes, M., Sullivan, H. and Knops, A., 2004. Public participation and collaborative governance. *Journal of Social Policy*, *33*(2), pp.203-223.

Ng, A. and Loosemore, M., 2007. Risk allocation in the private provision of public infrastructure. *International Journal of Project Management*, *25*(1), pp.66-76.

Ng, S.T., Wong, Y.M. and Wong, J.M., 2012. Factors influencing the success of PPP at feasibility stage–A tripartite comparison study in Hong Kong. *Habitat International*, *36*(4), pp.423-432.

Northeast Combined Authority and Nexus, 2016. *Metro and Local Rail Strategy*. Available at: https://www.nexus.org.uk/what-nexus/transport-strategies (Accessed: 16-7-2022).

Nowell, L.S., Norris, J.M., White, D.E. and Moules, N.J., 2017. Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods*, *16*(1), pp.1-13.

O'Dowd, A., 2018. Public will have to pay£ 220bn for PFI until 2040, NAO calculates. *The BMJ*, *360*, pp.1-1.

Oakley, A., 1999. Paradigm wars: some thoughts on a personal and public trajectory. *International Journal of Social Research Methodology*, *2*(3), pp.247-254.

Oddie, G., 2015. Value and Desires. In Hirose, I. and Olson, J. (ed.) *The Oxford handbook of value theory*, Oxford University Press, New York.

OECD, 2007. *Public-Private Partnership (PPP)*. Available at: https://stats.oecd.org/glossary/detail.asp?ID=7315 (Accessed: 14-5-2022).

OECD, 2008. Transport infrastructure investment: Options for efficiency. OECD Publishing, Paris.

OECD, 2012. *Recommendation of the Council on Principles for public governance of Public-Private Partnerships*. Available at: https://www.oecd.org/governance/budgeting/PPP-Recommendation.pdf (Accessed: 6-3-2022).

OECD, 2014. *Competition issues in Public Private Partnerships*. Available at: https://www.oecd.org/competition/competitionissuesinpublic-privatepartnerships.htm (Accessed: 3-5-2020).

Office for National Statistics, 2021. *UK government debt and deficit: June 2021*. Available at: https://www.ons.gov.uk/economy/governmentpublicsectorandtaxes/publicspending/bulletins/ukgovernmentdebtanddeficitforeurostatmaast/june2021 (Accessed: 1-12-2021).

Oldak, P.G., 1970. Analysis of the Concept of Value. The Labor Theory of Value As Opposed To the Theory of Marginal Utility. *Problems in Economics*, *13*(6), pp.47-67.

Onishi, H., 2019. A proof of labor theory of value based on marginalist principle. *World Review of Political Economy*, *10*(1), pp.85-94.

Opara, M. and Rouse, P., 2019. The perceived efficacy of public-private partnerships: A study from Canada. *Critical Perspectives on Accounting*, *58*, pp.77-99.

Opara, M., 2018. Value for money and risk relationships in public–private partnerships: Evaluating program-based evidence. *Australian Accounting Review*, *28*(3), pp.391-404.

Opara, M., Elloumi, F., Okafor, O. and Warsame, H., 2017. Effects of the institutional environment on public-private partnership (P3) projects: Evidence from Canada. *Accounting Forum*, *41*(2), pp. 77-95.

Osei-Kyei, R., Chan, A.P. and Ameyaw, E.E., 2017. A fuzzy synthetic evaluation analysis of operational management critical success factors for public-private partnership infrastructure projects. *Benchmarking: An International Journal*, *24*(7), pp.2092-2112.

Palmer, A., Kelly, J. and Male, S., 1996. Holistic appraisal of value engineering in construction in United States. *Journal of Construction Engineering and Management*, *122*(4), pp.324-328.

Parfit, D., 1984. *Reasons and Persons.* Oxford University Press, New York.

Parks, R. and Terhart, R. (2009). *Evaluation of Public-Private Partnerships*. Ottawa: Blair, Mackay, Mynett Valuations; Canadian Union of Public Employees.

Patil, N.A. and Laishram, B.S., 2016. Sustainability of Indian PPP procurement process: development of strategies for enhancement. *Built Environment Project and Asset Management*, *6*(5)**,** pp.491-507.

Patton, M.Q., 2002. *Qualitative research & evaluation methods (3rd ed.)*. SAGE Publications, California.

Pellegrino, R., Carbonara, N. and Costantino, N., 2019. Public guarantees for mitigating interest rate risk in PPP projects. *Built Environment Project and Asset Management*, *9* (2), pp.248-261.

Peña-Miguel, N. and Cuadrado-Ballesteros, B., 2021. Explaining Public-Private Partnership Projects through Political Factors: An Assessment of Developing Countries. *Political Studies*, pp.1-23.

Peng, W. and Liu, H., 2013. Using Online Simulation Technique for Revenue-Based Value for Money Assessment Model in PPP Project. *International Journal of Interactive Mobile Technologies*, *9*(3), pp.88-92.

Peng, W., Cui, Q., Lu, Y. and Huang, Li. (2014). Achieving value for money: an analytic review of studies on public, private partnerships. *Construction Research Congress*, Atlanta, Georgia, 19-21 May.

Penyalver, D., Turró, M. and Williamson, J.B., 2019. Measuring the value for money of transport infrastructure procurement; an intergenerational approach. *Transportation Research Part A: Policy and Practice*, *119*, pp.238-254.

Perera, S., Silva, S.D., Osei-Kyei, R., Yin, Y., Zhou, L., Jin, X., Fernando, N., Sabatunde, S. and Feng, Y., 2019. *BIM execution framework for early-stage estimating in PPP project*, RICS, London.

Phillips, R., 2003. *Stakeholder theory and organizational ethics*. Berrett-Koehler Publishers Inc, San Francisco, CA.

Plimmer, G., 2022. *UK Infrastructure Bank criticised for investing in third party funds*. Financial Times, London.

Pollock, A.M., Price, D. and Player, S., 2007. An examination of the UK Treasury's evidence base for cost and time overrun data in UK value-for-money policy and appraisal. *Public Money and Management*, *27*(2), pp.127-134.

Pollock, A.M., Shaoul, J. and Vickers, N., 2002. Private finance and "value for money" in NHS hospitals: a policy in search of a rationale?. *BMJ*, *324*(7347), pp.1205-1209.

Pollock, A. M. and Price, D., 2004. *Public Risk for Private Gain? The Public Audit Implications of Risk Transfer and Private Finance*. UNISON, London.

Post, J.E., Preston, L.E. and Sachs, S., 2002. *Redefining the corporation—stakeholder management and organizational wealth*. Stanford University Press, Stanford, CA.

PPP Knowledge Lab, 2020. *What are public-private partnerships?* Available at: https://ppp.worldbank.org/public-private-partnership/overview/what-are-public-private-partnerships (Accessed: 12-2020).

PricewaterhouseCoopers - PWC, 2021. *Value for money (VfM) in the public sector*. Available at: https://www.pwc.com/rw/en/publications/value-for-money.html (Accessed: 7-3-2022).

Project Management Institute, 2021. *The standard for project management and a guide to the project management body of knowledge* (7th ed.). Project Management Institute, US.

Pu, W., Xu, F., Chen, R. and Marques, R.C., 2020. PPP project procurement model selection in China: does it matter?. *Construction Management and Economics*, *38*(2), pp.126-139.

Public Private Partnership Legal Resource Centre, 2009. *Toolkit for Public Private Partnerships in roads and highways: overview of PPP experience*. Available at: https://ppiaf.org/sites/ppiaf.org/files/documents/toolkits/highwaystoolkit/6/pdf-version/1-21.pdf (Accessed: 10-5-2022).

Public-Private Partnership Legal Resource Centre, 2022. *Concessions Build-Operate-Transfer (BOT) and Design-Build-Operate (DBO) projects.* Available at: https://ppp.worldbank.org/public-private-partnership/agreements/concessions-bots-dbos (Accessed: 19-7-2022).

Queensland Government, 2015. *Project assessment framework: Queensland PPP supporting guidelines*. Available at: https://s3.treasury.qld.gov.au/files/paf-supporting-guidelines.pdf?v=2 (Accessed: 3-6-2021).

Queiroz, C., 2007. Public-Private Partnerships in Highways in Transition Economies: Recent Experience and Future Prospects. *Transportation Research Record*, *1996*(1), pp.34-40.

Raisbeck, P., Duffield, C. and Xu, M., 2010. Comparative performance of PPPs and traditional procurement in Australia. *Construction Management and Economics*, *28*(4), pp.345-359.

Ramsey, D.W. and El Asmar, M., 2015. Cost and Schedule Performance Benchmarks of US Transportation Public-Private Partnership Projects: Preliminary Results. *Transportation Research Record*, *2504*(1), pp.58-65.

Ravald, A. and Grönroos, C., 1996. The value concept and relationship marketing. *European Journal of Marketing*, *30*(2), 19–30.

Reeves, E., 2011. The only game in town: public private partnerships in the Irish water services sector. *The Economic and Social Review*, *42*(1), pp.95-111.

Reeves, E., 2013. The not so good, the bad and the ugly: Over twelve years of PPP in Ireland. *Local Government Studies*, *39*(3), pp.375-395.

Reeves, E., 2015. A review of the PPP experience in Ireland: Lessons for comparative policy analysis. *Journal of Comparative Policy Analysis: Research and Practice*, *17*(5), pp.467-480.

Ren, G., Li, H., Ding, R., Zhang, J., Boje, C. and Zhang, W., 2019. Developing an information exchange scheme concerning value for money assessment in Public-Private Partnerships. *Journal of Building Engineering*, *25*, p.100828.

Roe, P. and Craig, A., 2004. *Reforming the Private Finance Initiative*. Centre for Policy Studies, Surrey: 4-Print.

Rønnow-Rasmussen, T., 2015. Intrinsic and extrinsic value. In Hirose, I. and Olson, J. (ed.) *The Oxford handbook of value theory*, Oxford University Press, New York.

Rouhani, O.M., Geddes, R.R., Gao, H.O. and Bel, G., 2016. Social welfare analysis of investment public–private partnership approaches for transportation projects. *Transportation Research Part A: Policy and Practice*, *88*, pp.86-103.

Roumboutsos, A. and Pantelias, A., 2014. Allocating Revenue Risk in Transport Infrastructure Public Private Partnership Projects: How it Matters. *Transport Reviews*, *35*(2), pp.183–203.

Rye, T., Hrelja, R., Monios, J. and McTigue, C., 2021. Partnership or franchising to improve bus services in two major English urban regions? An institutional analysis. *Transport Policy*, *114*, pp.59-67.

Saaty, R.W., 1987. The analytic hierarchy process—what it is and how it is used. *Mathematical Modelling*, *9*(3-5), pp.161-176.

Saaty, T.L., 1980. *The analytic hierarchy process: Planning, priority setting, resource allocation*. McGraw-Hill, New York.

Saaty, T.L., 1990. How to make a decision: the analytic hierarchy process. *European Journal of Operational Research*, *48*(1), pp.9-26.

Sabir, S. and Shamshir, M., 2020. Impact of Economic and Social Infrastructure on the long-run Economic Growth of Pakistan. *Sustainable Water Resources Management*, *6*(1), pp.1-16.

SAGE Research Methods, 2017. *Reviewing the literature*. Available at: https://methods.sagepub.com/base/download/Stage/37 (Accessed: 21-4-2022).

Samset, K. and Christensen, T., 2017. Ex ante project evaluation and the complexity of early decision-making. *Public Organization Review*, *17*(1), pp.1-17.

Santandrea, M., Bailey, S. and Giorgino, M., 2016. Value for money in UK healthcare public–private partnerships: A fragility perspective. *Public Policy and Administration*, *31*(3), pp.260-279.

Sarmento, J.M., 2010. Do public-private partnerships create value for money for the public sector? The Portuguese experience. *OECD Journal on Budgeting*, *2010*(1), pp.93-119.

Savas, E.S. and Savas, E.S., 2000. *Privatization and public-private partnerships*, Chatham House, New York.

Schöpfel, J. and Farace, D., 2010. Grey literature. In Bates M.J. and Maack, M.M. (3rd ed.) *Encyclopedia of library and information sciences*. CRC Press, Florida. pp. 2029-2039.

Schroeder, M., 2021. Value theory, in Zalta, E.N. (ed.), *The Stanford Encyclopedia of Philosophy*, available at: http://plato.stanford.edu/archives/sum2012/entries/value-theory/ (Accessed: 11-12-2019).

Seawright, J. and Gerring, J., 2008. Case selection techniques in case study research: a menu of qualitative and quantitative options. *Political Research Quarterly*, *61*(2), pp.294-308.

Shahbaz, M., Raghutla, C., Song, M., Zameer, H. and Jiao, Z., 2020. Public-private partnerships investment in energy as new determinant of CO2 emissions: the role of technological innovations in China. *Energy Economics*, *86*, pp.104664.

Shaoul, J., 2002. New developments: A financial appraisal of the London underground public-private partnership. *Public Money and Management*, *22*(2), pp.53-60.

Shaoul, J., 2005. A critical financial analysis of the Private Finance Initiative: selecting a financing method or allocating economic wealth?. *Critical Perspectives on Accounting*, *16*(4), pp.441-471.

Shaoul, J., 2011. 'Sharing'political authority with finance capital: The case of Britain's Public Private Partnerships. *Policy and Society*, *30*(3), pp.209-220.

Shaoul, J., Stafford, A. and Stapleton, P., 2010. Financial black holes: The disclosure and transparency of privately financed roads in the UK. *Accounting, Auditing & Accountability Journal*, *23*(2), pp.229-255.

Shenhar, A.J., Dvir, D. and Levy, O., 1997. Project success: a multidimensional, strategic concept. In *Innovation in Technology Management. The Key to Global Leadership. PICMET'97* (p. 391). IEEE.

Sheth, J.N., Newman, B.I. and Gross, B.L., 1991. Why we buy what we buy: A theory of consumption values. *Journal of Business Research*, *22*(2), pp.159-170.

Shi, J., Duan, K., Wu, G., Zhang, R. and Feng, X., 2020. Comprehensive metrological and content analysis of the public–private partnerships (PPPs) research field: A new bibliometric journey. *Scientometrics*, *124*(3), pp.2145-2184.

Shu, X., Smyth, S. and Haslam, J., 2021. Post-decision project evaluation of UK public–private partnerships: insights from planning practice. *Public Money & Management*, *41*(6), pp.477-486.

Siemiatycki, M. and Farooqi, N., 2012. Value for money and risk in public–private partnerships: Evaluating the evidence. *Journal of the American Planning Association*, *78*(3), pp.286-299.

Siemiatycki, M. and Friedman, J., 2012. The trade-offs of transferring demand risk on urban transit public–private partnerships. *Public Works Management & Policy*, *17*(3), pp.283-302.

Sing, M.C., Love, P.E. and Liu, H.J., 2019. Rehabilitation of existing building stock: A system dynamics model to support policy development. *Cities*, *87*, pp.142-152.

Singh, L.B. and Kalidindi, S.N., 2006. Traffic revenue risk management through Annuity Model of PPP road projects in India. *International Journal of Project Management*, *24*(7), pp.605-613.

Sitton J.F., 2010. *Marx Today: selected work and recent debates*. Palgrave Macmillan, New York.

Snyder, H., 2019. Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, *104*, pp.333-339.

Social Exclusion Unit, 2003. *Making the connections: final report on transport and social exclusion.* Available at: https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_policy/---invest/documents/publication/wcms_asist_8210.pdf (Accessed: 1-2-2021).

Song, J., Yu, Y., Jin, L. and Feng, Z., 2018. Early termination compensation under demand uncertainty in public-private partnership projects. *International Journal of Strategic Property Management*, 22(6), pp.532-543.

Song, J., Zhang, H. and Dong, W., 2016. A review of emerging trends in global PPP research: analysis and visualization. *Scientometrics*, *107*(3), pp.1111-1147.

Song, W., Zhu, Y., Zhou, J., Chen, Z. and Zhou, J., 2022. A new rough cloud AHP method for risk evaluation of public–private partnership projects. *Soft Computing*, *26*, pp.2045-2062.

Soomro, M.A. and Zhang, X., 2016. Evaluation of the functions of public sector partners in transportation public-private partnerships failures. *Journal of Management in Engineering*, *32*(1), pp.04015027.

Spackman, M., 2002. Public–private partnerships: lessons from the British approach. *Economic Systems*, *26*(3), pp.283-301.

Spencer, L., Ritchie, J., Lewis, J. and Dillon, L., 2003. *Quality in qualitative evaluation: a framework for assessing research evidence*. Cabinet Office, London.

Stafford, A., 2011. Discount Rates for the Evaluation of Public-Private Partnerships, by David F. Burgess and Glenn P. Jenkins (Eds.), *International Journal of Public Administration*, 34(6), 410-411.

Stanley, J. and Lucas, K., 2008. Social exclusion: What can public transport offer?. *Research in Transportation Economics*, *22*(1), pp.36-40.

State-owned Assets Supervision and Administration Commission, 2021. *Guidance on enhancing local SOE's debt risk management*. Available at: http://www.gov.cn/zhengce/zhengceku/2021-03/26/content_5595867.htm (Accessed: 2-6-2021).

Sun, C., Li, N. and Zhang, Y., 2019. Study on qualitative evaluation index system of VfM in PPP project, *3rd International Workshop on Renewable Energy and Development (IWRED 2019), Guangzhou, 8-10 March.*

Sun, Q., Zhang, S., Ke, Y., Ma, X. and Galvin, S., 2020. Comparative analysis on the PPP research in Chinese and international journals: a bibliometric perspective. *International Journal of Construction Management*, pp.1-21.

Tang, L., Shen, Q. and Cheng, E.W., 2010. A review of studies on public–private partnership projects in the construction industry. *International Journal of Project Management*, *28*(7), pp.683-694.

Tappolet, C., 2015. Value and Emotions. In Hirose, I. and Olson, J. (ed.) *The Oxford handbook of value theory*, Oxford University Press, New York.

Taylor, D., 2021. HS2 tunnel protest will be first of many, says activist. *The Guardian*, 13th February.

Taylor, K.S., 1996. *Human Society and the Global Economy*. Economics Department, State University of New York-Oswego, New York.

Teddlie, C. and Tashakkori, A., 2009. *Foundations of mixed methods research: Integrating quantitative and qualitative approaches in the social and behavioral sciences*. SAGE Publications, California.

Teddlie, C. and Yu, F., 2007. Mixed methods sampling: A typology with examples. *Journal of Mixed Methods Research*, *1*(1), pp.77-100.

The Canadian Council for Public-Private Partnership, 2020. *What are P3s?.* Available at: https://www.pppcouncil.ca/web/Knowledge_Centre/What_are_P3s_/Definitions_Models/web/P3_Knowledge_Centre/About_P3s/Definitions_Models.aspx?hkey=79b9874d-4498-46b1-929f-37ce461ab4bc (Accessed: 10-12-2020).

The European Commission, 2003. *Guidelines for successful Public-Private Partnerships*. Available at: https://ec.europa.eu/regional_policy/sources/docgener/guides/ppp_en.pdf (Accessed: 14-5-2022).

The European Commission, 2014. *Guide to Cost-Benefit Analysis of investment projects: Economic appraisal tool for cohesion policy 2014-2020*. Available at: https://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/cba_guide.pdf (Accessed: 3-12-2014).

The NSW Treasury, 2017. *NSW Public Private Partnership guidelines: preparation, procurement and contract management*. Available at: https://www.treasury.nsw.gov.au/sites/default/files/2021-06/TPP17-07%20NSW%20Public%20Private%20Partnerships%20Guidelines%202017-1.pdf (Accessed: 3-6-2021).

The United Nations, 2015. *The Addis Ababa Action Agenda of the Third International Conference on Financing for Development*. Available at: https://www.un.org/esa/ffd/wp-content/uploads/2015/08/AAAA_Outcome.pdf (Accessed: 2-3-2022).

The World Bank, 2009. *Toolkit for Public-Private Partnerships in roads and highways: value for money and the PSC*. Available at: https://ppiaf.org/sites/ppiaf.org/files/documents/toolkits/highwaystoolkit/6/pdf-version/5-22.pdf (Accessed: 12-3-2022).

The World Bank, 2017. *Public Private Partnership reference guide: version 3*. The World Bank, Washington DC.

The World Bank, 2019. *Climate-smart PPP legal and regulatory framework*. Available at: https://ppp.worldbank.org/public-private-partnership/climate-smart-clean-technology-ppps/climate-smart-ppp-legal-and-regulatory-framework (Accessed: 11-12-2020).

The World Bank, 2020. *PPP arrangements/ types of PPP agreements*. Available at: https://ppp.worldbank.org/public-private-partnership/agreements (Accessed: 12-2020).

The World Bank, 2022. *Public-Private Partnerships reference guide- version 3*. Available at: https://library.pppknowledgelab.org/documents/4699/download (Accessed: 4-3-2022).

Tiberius, V., 2015. Prudential value. In Hirose, I. and Olson, J. (ed.) *The Oxford handbook of value theory*, Oxford University Press, New York.

Torres, L. and Pina, V., 2002. Delivering public services—mechanisms and consequences: changes in public service delivery in the EU countries. *Public Money and Management*, *22*(4), pp.41-48.

Torvinen, H. and Ulkuniemi, P., 2016. End-user engagement within innovative public procurement practices: A case study on public–private partnership procurement. *Industrial Marketing Management*, *58*, pp.58-68.

Transport North East, 2022. *North East Rail and Metro Strategy*. Available at: https://www.transportnortheast.gov.uk/strategy-and-policy/railandmetro/ (Accessed: 19-7-2022).

Treasury Committee, 2011. *Private Finance Initiative: Seventeenth report*. Available at: https://publications.parliament.uk/pa/cm201012/cmselect/cmtreasy/1146/114602.htm (Accessed: 13-5-2022).

Tsamboulas, D., Verma, A. and Moraiti, P., 2013. Transport infrastructure provision and operations: Why should governments choose private–public partnership?. *Research in Transportation Economics*, *38*(1), pp.122-127.

UK Government, 2018. *Policy paper: Private Finance 2 (PF2)*. Available at: https://www.gov.uk/government/publications/private-finance-2-pf2 (Accessed: 3-5-2019).

UK Government, 2019. *Guidance: Devolution of powers to Scotland, Wales and Northern Ireland*. Available at: https://www.gov.uk/guidance/devolution-of-powers-to-scotland-wales-and-northern-ireland (Accessed: 12-7-2022).

UK Government, 2020. *Collection: Public private partnerships*. Available at: https://www.gov.uk/government/collections/public-private-partnerships (Accessed: 10-12-2020).

UK Parliament, 1998. *Supplementary memorandum by National Air Traffic Services Ltd (ATC 03C)*. Available at: https://publications.parliament.uk/pa/cm199798/cmselect/cmenvtra/360-e/36055.htm#n8 (Accessed: 11-7-2022).

UK Parliament, 2008. *Private Finance Initiative – its rationale and accounting treatment*. Available at: https://www.parliament.uk/globalassets/documents/upload/0807PFI.pdf (Accessed: 13-5-2022).

UK Parliament, 2018. *Private Finance Initiatives contents: conclusions and recommendations*. Available at: https://publications.parliament.uk/pa/cm201719/cmselect/cmpubacc/894/89405.htm (Accessed: 27-5-2022).

US Department of Transportation, 2021. *Public-Private Partnerships (P3)*. Available at: https://www.transportation.gov/buildamerica/p3 (Accessed: 10-12-2021).

Vale, L.J., 2014. The politics of resilient cities: whose resilience and whose city?. *Building Research & Information*, *42*(2), pp.191-201.

van den Hurk, M., 2018. Public–private partnerships: where do we go from here? A Belgian perspective. *Public Works Management & Policy*, *23*(3), pp.274-294.

Vasileiou, K., Barnett, J., Thorpe, S. and Young, T., 2018. Characterising and justifying sample size sufficiency in interview-based studies: systematic analysis of qualitative health research over a 15-year period. *BMC Medical Research Methodology*, *18*(1), pp.1-18.

Velasquez, M. and Hester, P.T., 2013. An analysis of multi-criteria decision making methods. *International Journal of Operations Research*, *10*(2), pp.56-66.

Verweij, S. and van Meerkerk, I., 2021. Do public–private partnerships achieve better time and cost performance than regular contracts?. *Public Money & Management*, *41*(4), pp.286-295.

Verweij, S., 2015. Achieving satisfaction when implementing PPP transportation infrastructure projects: a qualitative comparative analysis of the A15 highway DBFM project. *International Journal of Project Management*, *33*(1), pp.189–200.

Vickerman, R., 2021. Will Covid-19 put the public back in public transport? A UK perspective. *Transport Policy*, *103*, pp.95-102.

Vining, A. and Boardman, A., 2014. Self-interest springs eternal: Political economy reasons why public-private partnerships do not work as well as expected. *CESifo DICE Report*, *12*(3), pp.17-23.

Viswanathan, S.K., Tripathi, K.K. and Jha, K.N., 2020. Influence of risk mitigation measures on international construction project success criteria–a survey of Indian experiences. *Construction Management and Economics*, *38*(3), pp.207-222.

Vives, A., Benavides, J. and Paris, A.M., 2010. Selecting infrastructure delivery modalities: No time for ideology or semantics. *Journal of Construction Engineering and Management*, *136*(4), pp.412-418.

Volden, G.H. and Welde, M., 2022. Public project success? Measuring the nuances of success through ex post evaluation. International *Journal of Project Management*, in press.

Wall, A. and Connolly, C., 2009. The private finance initiative: An evolving research agenda?. *Public Management Review*, *11*(5), pp.707-724.

Wallis, I., 2020. Value for money in procurement of urban bus services–Competitive tendering versus negotiated contracts: Recent New Zealand experience. *Research in Transportation Economics*, *83*, pp.100960.

Wang, E. and Li, P., 2019. Research on portfolio evaluation of PPP water construction project considering project relevance. *IOP Conference Series: Earth and Environmental Science, 242*(5), pp.052047.

Wang, H., Xiong, W., Wu, G. and Zhu, D., 2018. Public–private partnership in Public Administration discipline: a literature review. *Public Management Review*, *20*(2), pp.293-316.

Wang, Y., 2018. Research on the selection of discount rate in value for money evaluation: based on the data analysis of the third batch of demonstration projects, *2018 International Conference on Computer, Civil Engineering and Management Science* (ICCEMS 2018), 9-11 March, Lanzhou, China.

Warsen, R., Greve, C., Klijn, E.H., Koppenjan, J.F. and Siemiatycki, M., 2020. How do professionals perceive the governance of public–private partnerships? Evidence from Canada, the Netherlands and Denmark. *Public Administration*, *98*(1), pp.124-139.

Weick, K.E., Sutcliffe, K.M. and Obstfeld, D., 2005. Organizing and the process of sensemaking. *Organization Science*, *16*(4), pp.409-421.

Wettenhall, R., 2005. The Public-Private Interface: Surveying the History. In G. Hodge and C. Greve (ed.). *The Challenge of Public-Private Partnerships: Learning from International Experience*. Edward Elgar, Cheltenham.

Whiteside, H., 2020. Public-private partnerships: market development through management reform. *Review of International Political Economy*, *27*(4), pp.880-902.

Whitfield, D., 2007. *Cost overruns, delays and terminations in 105 outsourced public sector ICT contracts*. ESSU Research Report No. 3, European Services Strategy Unit.

Whiting, L.S., 2008. Semi-structured interviews: guidance for novice researchers. *Nursing Standard, 22*(23), pp.35-40.

Whyte, J., 2019. How digital information transforms project delivery models. *Project Management Journal*, *50*(2), pp.177-194.

Wu, J., Liu, J., Jin, X. and Sing, M.C., 2016. Government accountability within infrastructure public–private partnerships. *International Journal of Project Management*, *34*(8), pp.1471-1478.

Xie, J. and Ng, T.S., 2013. Multiobjective Bayesian network model for public-private partnership decision support. *Journal of Construction Engineering and Management*, *139*(9), pp.1069-1081.

Xiong, M., Whetsell, T.A., Zhao, J.Z. and Cheng, S., 2021b. Centrally administered state-owned enterprises' engagement in China's public-private partnerships: a social network analysis. *Area Development and Policy*, *6*(3), pp.296-318.

Xiong, W, Zhong, N, Wang, F, Zhang, M and Chen, B., 2021a. Political opportunism and transaction costs in contractual choice of public-private partnerships. *Public Administration*, DOI: https://doi.org/10.1111/padm.12760.

Xiong, W., Zhang, X. and Chen, H., 2016. Early-termination compensation in public–private partnership projects. *Journal of Construction Engineering and Management*, 142(4), pp.1-10.

Xuan, M. and Marinov, M., 2016. Tyne and Wear Metro delays: improvements and evaluation of performance using event based simulations. *RailNewcastle Talks 2016*, Newcastle upon Tyne, United Kingdom, 13-17th June.

Yang, T., Long, R., Cui, X., Zhu, D. and Chen, H., 2017. Application of the public–private partnership model to urban sewage treatment. *Journal of Cleaner Production*, *142*, pp.1065-1074.

Yescombe, E.R. and Farquharson, E., 2018. *Public-private partnerships for infrastructure: Principles of policy and finance*. Butterworth-Heinemann.

Yin, R.K., 2018. *Case study research and applications: design and methods* (6th ed.). SAGE Publications, California.

Young, L., 2015. *Social Value Act review: A report to Cabinet Office*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/403748/Social_Value_Act_review_report_150212.pdf (Accessed: 1-2-2021).

Yuan, J., Chan, A.P., Xiong, W., Skibniewski, M.J. and Li, Q., 2015. Perception of residual value risk in public private partnership projects: Critical review. *Journal of Management in Engineering*, 31(3), 04014041.

Yuan, J., Ji, W., Guo, J. and Skibniewski, M.J., 2019. Simulation-based dynamic adjustments of prices and subsidies for transportation PPP projects based on stakeholders' satisfaction, *Transportation*, *46*, pp.2309-2345.

Yuan, J., Li, X., Ke, Y., Xu, W., Xu, Z. and Skibnewski, M., 2020. Developing a building information modelling–based performance management system for public-private partnerships. *Engineering, Construction and Architectural Management*, *27*(8), pp.1727-1762.

Yuan, J., Zeng, A.Y., Skibniewski, M.J. and Li, Q., 2009. Selection of performance objectives and key performance indicators in public–private partnership projects to achieve value for money. *Construction Management and Economics*, *27*(3), pp.253-270.

Yuan, J., Zhang, L., Tan, Y. and Skibniewski, M.J., 2020. Evaluating the regional social sustainability contribution of public-private partnerships in China: The development of an indicator system. *Sustainable Development*, *28*(1), pp.259-278.

Yuan, J.F., Skibniewski, M.J., Li, Q. and Shan, J., 2010. The driving factors of china's public-private partnership projects in Metropolitian transportation systems: Public sector's viewpoint. *Journal of Civil Engineering and Management*, *16*(1), pp.5-18.

Yuan, X.X. and Li, Y., 2018. Residual value risks of highway pavements in Public–Private Partnerships. *Journal of Infrastructure Systems*, 24(3), 04018020.

Zeithaml, V.A., Berry, L.L. and Parasuraman, A., 1988. Communication and control processes in the delivery of service quality. *Journal of Marketing*, *52*(2), pp.35-48.

Zerjav, V., McArthur, J. and Edkins, A., 2021. The multiplicity of value in the front-end of projects: The case of London transportation infrastructure. *International Journal of Project Management*, *39*(5), pp.507-519.

Zhang, L., Sun, X. and Xue, H., 2019. Identifying critical risks in Sponge City PPP projects using DEMATEL method: A case study of China. *Journal of Cleaner Production*, *226*, pp.949-958.

Zhang, X. and Soomro, M.A., 2016. Failure path analysis with respect to private sector partners in transportation public-private partnerships. *Journal of Management in Engineering*, *32*(1), pp.04015031.

Zhang, Y. and Wildemuth, B.M., 2009. Unstructured interviews. In Wildemuth, B.M. (2nd ed.). *Applications of social research methods to questions in information and library science*. Exeter: Libraries Unlimited, pp. 222-231.

Zhang, Y., Feng, Z., Zhang, S. and Song, J., 2018. The effects of service level on BOT transport project contract. *Transportation Research Part E: Logistics and Transportation Review*, *118*, pp.184–206.

Zhao, J., Liu, H.J., Love, P.E., Greenwood, D.J. and Sing, M.C., 2022. Public-private partnerships: A dynamic discrete choice model for road projects. *Socio-Economic Planning Sciences*, *82*(Part A), 101227.

Zhao, J., Liu, H.J., Sing, M.C., Jin, X. and Ginige, K., 2021. Delivery of Transport Infrastructure Assets: Decision-Making Model to Ensure Value for Money. *Journal of Infrastructure Systems*, *27*(1), pp.05020008.

Zhu, J. and Mostafavi, A., 2017. Discovering complexity and emergent properties in project systems: A new approach to understanding project performance. *International Journal of Project Management*, *35*(1), pp.1-12.

Zhuge, H., 2006. Knowledge flow network planning and simulation. *Decision Support Systems*, *42*(2), pp.571-592.

Zimmerman, M.J., 2015. Value and normativity. In Hirose, I. and Olson, J. (ed.) *The Oxford handbook of value theory*, Oxford University Press, New York.

Zwalf, S., 2017. Competitive neutrality in public-private partnership evaluations: a non-neutral interpretation in comparative perspective. *Asia Pacific Journal of Public Administration*, *39*(4), pp.225-237.

Zwalf, S., Hodge, G. and Alam, Q., 2017. Choose your own adventure: Finding a suitable discount rate for evaluating value for money in public–private partnership proposals. *Australian Journal of Public Administration*, *76*(3), pp.301-315.

# APPENDICES

## Appendix I: Interview Guide

### Aim and scope of the interview

Value for Money (V*f*M) assessment is widely used to determine a procurement method (e.g., Public-Private Partnerships or the conventional public sector procurement) for transport projects. Currently, V*f*M assessment is conducted through the life-cycle cost comparison between the two options. However, the general public's side of V*f*M (e.g., wider impacts) should also be considered given transport infrastructure's huge socio-economic implications. Therefore, this interview aims to solicit your views on a holistic V*f*M assessment framework that consolidates V*f*M from both government and general public perspectives. Feedback will be provided after the interview for your reference.

### Data security

This interview forms part of a PhD project. You are assured that data collected from this interview will be kept in confidence and handled in strict compliance with the University's ethics policy (i.e., kept securely and deleted at the end of the project). If you have any questions about the interview, please contact the researcher at jianfeng.zhao@northumbria.ac.uk

### Interview questions

PART A: General questions

1. How long have you being involved with infrastructure procurement?

2. What is your main role in the process?

2-2. If there is a V*f*M assessment, what is the main method?

3. What does 'value for money' mean to you?

PART B: The traditional V*f*M mainly refers to the 'iron triangle' (i.e., cost, time and quality) that has long been used in the construction sector for project evaluation.

1. Currently, governments prefer a procurement method that entails the lowest whole-of-life cost to ease budget constraints. Do you think the importance of 'cost' is exaggerated in V*f*M assessment? If so, why?

2. Shorter completion times can reduce transport projects' construction uncertainties and produce an earlier start to providing services. How advantageous is a procurement method that can deliver transport projects on time or even before the expected time?

3. Quality-related metrics can help clients see how the transport project looks like in advance. Does V*f*M assessment give enough weight to delivering projects in conformance with specifications and standards?

PART C: Public V*f*M refers to those impacts a transport intervention can bring to the people/ society.

1. One direct aim of transport infrastructure is to provide a quality service that can transport people to their destination. Does V*f*M assessment give enough weight to the service or functionality provided?

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2. Transport is said to be the largest source of air and noise pollution and accounts for around 25% of $CO_2$ emission in the UK. If a procurement method can propose an environmentally friendly way of constructing and operating the transport project, will it increase your preference over that approach?

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3. A single transport project usually requires millions of pounds investment or more, which means the bill could extend to the next generation. At the same time, more transport projects in a specific area can stimulate its economy while other areas lag behind. In V*f*M assessment, would you consider both types of distribution effects? Why?

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4. The UK suffers from natural disruptions such as flooding and strong winds. These can lead to transport problems (e.g. train delays and cancellations and road closures). Does V*f*M assessment give enough weight to the ability to provide a resilient service under these circumstances?

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5. Besides the direct aim of functionality, transport ultimately works as a means to access other key services such as employment, education and health. In this context, what do you think of the importance of 'social inclusion' in V*f*M assessment?

6. Are there any other variables that you think should be considered when conducting V*f*M assessment for transport projects?

**Appendix II: Participant Information Sheet**

You are being invited to take part in this research study. Before you decide it is important for you to read this leaflet so you understand why the study is being carried out and what it will involve.

Reading this leaflet, discussing it with others or asking any questions you might have will help you decide whether or not you would like to take part.

**What is the Purpose of the Study?**

The aim of this study is to empirically develop a life-cycle Value for Money-oriented model for deciding whether or not to use Public Private Partnerships to procure transport infrastructure.

**Why have I been invited?**

Because you are indicated as having relevant experience in the area.

**Do I have to take part?**

No. It is up to you whether you would like to take part in the study. This information sheet

**What will happen if I take part?**

After signing a consenting to be interviewed form, you will be asked a series of questions by the investigator. You can find these questions in the attachment. After you have completed the study the investigator will give you a debrief sheet explaining the nature of the research, how you can find out about the results, and how you can withdraw your data if you wish. It is estimated that the total interview time will be 30 to 45 minutes.

**Will my taking part in this study be kept confidential and anonymous?**

Yes. Your name will not be written on any of the data we collect; the written information you provide will have an ID number, not your name. Your name will not be written on the recorded interviews, or on the typed up versions of your discussions from the interview, and your name will not appear in any reports or documents resulting from this study. The consent form you have signed will be stored separately from your other data.

**How will my data be stored, and how long will it be stored for?**

All electronic data, including the recordings from your interview, the typed up transcripts from your interview and your consent forms will be kept in locked storage, will be stored on a password protected computer drive. All data will be stored in accordance with University guidelines and the Data Protection Act (2018).

**What categories of personal data will be collected and processed in this study?**

Contact details, position in the organization, role responsibilities in transport infrastructure procurement and relevant duration of working experiences will be collected and processed.

**What is the legal basis for processing personal data?**

The legal basis for processing personal data in this study is GDPR Article 6(1) (e).... "processing is necessary for the performance of a task carried out in the public interest".

**Who are the recipients or categories of recipients of personal data, if any?**

Only this research team at Northumbria University will be using, analyzing or otherwise processing the personal data. Your personal data will not be transferred to third parties for further processing.

**What will happen to the results of the study and could personal data collected be used in future research?**

The general findings will be reported in a PhD thesis, scientific journal or presented at a research conference, however the data will be anonymized and you or the data you have provided will not be personally identifiable, unless we have asked for your specific consent for this beforehand.

**Who is Organizing and Funding the Study?**

This study is fully organized and funded by Northumbria University.

**Who has reviewed this study?**

The research project, submission reference 17897 has been approved in Northumbria University's Ethics Online system.

**What are my rights as a participant in this study?**

Your rights include but not limited to the following:

- a right of access to a copy of the information comprised in their personal data (to do so individuals should submit a *Subject Access Request*);
- a right in certain circumstances to have inaccurate personal data rectified;
- a right to object to decisions being taken by automated means.

if they are dissatisfied with the University's processing of personal data, they have the right to complain to the Information Commissioner's Office.

**Contact for further information:**

**Researcher name: Jianfeng Zhao**

**Researcher email: jianfeng.zhao@northumbria.ac.uk**

**Name and contact details of the Records and Information Officer at Northumbria University: Duncan James (dp.officer@northumbria.ac.uk).**

***You can find out more about how we use your information at:***
***www.northumbria.ac.uk/about-us/leadership-governance/vice-chancellors-office/legal-services-team/gdpr/gdpr---privacy-notices/***

***or by contacting a member of the research team***

**Appendix III: Consent Form where Personal Data is Collected**

**Project title: Rethinking Value for Money in Public Private Partnerships: A critique, analysis, and model for transport infrastructure projects**

**Principal Investigator: Jianfeng Zhao**

**Please tick or initial where applicable**

I have carefully read and understood the Participant Information Sheet. ☐

I have had an opportunity to ask questions and discuss this study and I have received satisfactory answers. ☐

I understand I am free to withdraw from the study at any time, without having to give a reason for withdrawing, and without prejudice. ☐

I agree to take part in this study. ☐

I also consent to the retention of this data under the condition that any subsequent use also be restricted to research projects that have gained ethical approval from Northumbria University. ☐

Signature of participant:

Date:

Signature of researcher:

Date:

**Appendix IV: Extract of the Questionnaire Survey**

**Page 1: Introduction**

Value for Money (V*f*M) assessment is widely used to determine a procurement method (i.e., Public-Private Partnerships - PPPs) or the conventional public sector procurement) for transport projects. This survey aims to solicit your views on the significance of variables that should be considered in transport VfM assessment.

It should take around 10 to 15 minutes to complete both Section A (background information) and Section B (pairwise comparison of variables). Your views on the impact of the following variables on the VfM assessment are greatly appreciated.

You are assured that data collected from this survey will be handled in strict compliance with Northumbria University's ethics policy (i.e., kept securely and deleted at the end of the project) and your response will be anonymous.

**Page 2: Background information**

This section aims to provide a general summary of the respondents. Please be assured that this kind of information will not be shared with anyone other than the researcher.

1. What is your organisation type?

□ Public sector □ Private sector □ University/ Research institutions □ Consultancy

2. How long have you been involved with PPPs?

□ 3 years or less □ 3~5 years □ 5~7 years □7 years or more

3. How many transport PPPs have you worked on?

□ 1~2 □ 3~4 □ 5~6 □ 7 or more

4. What type of work are you involved with?

□ Feasibility analysis □ Value for money assessment □ Performance evaluation

□ others (please specify_____)

5. Are you aware of the existence of VfM assessment in PPP types of project even if you have not directly participated in this work?

□ Yes □ No

**Page 3: Pairwise comparison of the variables**

Based on your personal experience and understanding, please select a variable that you think is more important than the other and by how much using a scale of 1 to 9 (e.g., 1=equally important, 2=between equally important and moderately more important, 3=moderately more important, 9=extremely more important).

Descriptions

| Variables | Descriptions |
|---|---|
| Cost | Whole-of-life cost |
| Time | Time taken to construct the project |
| Quality | Projects completed in conformance with specifications and standards |
| Service/ Functionality | Transport projects that can move people to their destinations |
| Environment | Transport projects that consider their impact on noise and air pollution, and CO2 emissions |
| Distribution | Transport projects that consider bills extended to the next generation and consider balance between regions |
| Resilience | Transport projects that can function under disruptions (e.g., flooding, snow, winds) |
| Social inclusion | Transport projects that allow the disadvantaged people to have access to transport services and enjoy other key services (e.g., education and health) in that area |

Between cost and time, which one do you think is more important?

□ Cost □ Time □ Equally important (i.e., 1)

If any one of the first two options is selected, then the following question will be prompted:

How much more important is the one you selected than the other?

□ 2 □ 3 □ 4 □5 □6 □7 □8 □9

## Appendix V: Publications

### Refereed journal articles

Zhao, J., Greenwood, D., Thurairajah, N., Liu, H.J. and Haigh, R. (2022). Value for money in transport infrastructure investment: an enhanced model for better procurement decisions. *Transport Policy*, 118, 68-78.

Zhao, J., Liu, H.J., Love, P.E.D., Greenwood, D. and Sing, M.C.P. (2022). Public-Private Partnerships: a dynamic discrete choice model for road project. *Socio-Economic Planning Sciences*, 82(Part A), 101227.

Zhao, J., Thurairajah, N., Greenwood, D., Liu, H. and Yuan, J. (2022). Unpacking the context of value for money assessment in global markets: a procurement option framework for Public Private Partnerships. *Engineering Construction and Architectural Management*, in press.

Zhao, J., Liu, H.J., Sing, M.C.P., Jin, X. and Ginige, K. (2021). Delivery of transport infrastructure assets: decision-making model to ensure value for money. *Journal of Infrastructure Systems*, 27(1), 05020008.

### Refereed conference proceedings

Zhao, J., Thurairajah, N., Greenwood, D. and Liu, H.J. (2021). Value for money assessment for procuring infrastructure projects: state of the practices in global markets. *37th Annual Association of Researchers in Construction Management Conference (ARCOM)*, 6-7 September.

Zhao, J., Liu, H.J., Sing, M.C.P., Jin, X. and Humphrey, R. (2019). V*f*M assessment of transport PPPs: implications for future improvement. *43rd Australasian University Building Education Association Conference (AUBEA)*, 6-8 November, Noosa, Queensland, Australia.

## Appendix VI Additional Sources for the Case Study

| Item | Title | Sources |
|---|---|---|
| 1 | How Metro was built | https://www.nexus.org.uk/history/how-metro-was-built |
| 2 | Tyne and Wear Metro: 40 years and counting | http://www.tautonline.com/tyne-wear-metro-40-years-counting/ |
| 3 | All about Metro Modernisation | https://www.nexus.org.uk/metro/modernisation/all-about-metro-modernisation |
| 4 | Tyne and Wear Metro system to be publicly-run as DB Regio contract set to be scrapped next year | https://www.chroniclelive.co.uk/news/north-east-news/tyne-wear-metro-system-publicly-11037005 |
| 5 | Tyne & Wear Metro 'renationalised' | https://www.railnews.co.uk/news/2017/04/03-tyne--wear-metro-renationalised.html |
| 6 | Tyne and Wear Metro reveals its new trains | https://www.youtube.com/watch?v=TrAsqIbtBXc&t=6s |
| 7 | Metro train fleet refurbishment is completed | https://www.nexus.org.uk/news/item/metro-train-fleet-refurbishment-completed |
| 8 | DB Regio named 'Operator of the year' | https://www.nexus.org.uk/news/item/db-regio-named-operator-year |
| 9 | Heatwave chaos in North East with Metro and rail disruption and multiple fires amid 30°c C temperatures | https://www.chroniclelive.co.uk/news/north-east-news/north-east-heatwave-fires-trains-24524892 |
| 10 | Why the new £363m Tyne and Wear Metro fleet will be much better at surviving intense heatwaves | https://www.chroniclelive.co.uk/news/north-east-news/metros-new-trains-heatwave-nexus-24533971 |
| 11 | Making rail accessible: helping older and disabled passengers | https://www.nexus.org.uk/sites/default/files/dpppmakingrailaccessible-helpingolderpeopleanddisabledpeoplejune2021_2.pdf |
| 12 | Tyne and Wear Metro's new trains: your questions answered | https://www.nexus.org.uk/sites/default/files/metros_new_train_fleet_faq_1.pdf |
| 13 | V*f*M: Economic value for Metro and Local Rail to the North East | https://www.nexus.org.uk/sites/default/files/vfm_2019.pdf |
| 14 | Chancellor confirms £350 million Metro investment in Budget speech | https://www.nexus.org.uk/news/item/chancellor-confirms-%C2%A3350-million-metro-investment-budget-speech |