Value for Money in Transport Infrastructure Investment: An Enhanced Model for Better Procurement Decisions

Abstract

This paper addresses the nebulous value for money (V*f*M) concept and its widely-criticised use in justifying the adoption of Public-Private Partnerships (PPPs) for transport infrastructure projects. It draws on the theories of value and 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). In this sense, 'public' participation in transport is highlighted in the proposed framework to demonstrate that it is the combination of 'traditional' and 'public' V*f*M that together create a more meaningful V*f*M concept. To underpin the application of the framework, a dynamic V*f*M assessment process is developed that can facilitate the appropriate selection of a procurement method and assess its V*f*M throughout the project lifecycle. Unlike current examples, the framework is designed for both PPPs and their alternatives (e.g., conventional public sector procurement) and aligns *ex-ante* and *ex-post* V*f*M assessment. The enhanced model creates an opportunity for governments to recognise public V*f*M in transport interventions, shift their mindset from singular to multi-dimensional evaluation, and start to actually accumulate and exploit experience from past projects. As such, the contribution of this paper is twofold: (1) drawing upon theories of value, it depicts the ontology of V*f*M and addresses a missing ingredient in V*f*M assessment; and (2) it develops a holistic framework for the public sector to re-calibrate their V*f*M assessment policy when procuring transport projects.

Keywords: Public-Private Partnerships; Public value for money; Transport procurement; Value for money assessment.

"*The chief value for money lies in the fact that one lives in a world in which money is overestimated*."-Henry Louis Mencken

Introduction

Transport infrastructure forms the backbone of an economy's socio-economic development and growth (Maciulis *et al*., 2009). With this in mind, governments around the world are attempting to deliver quality transport services to meet their people's demands. An example is the United Kingdom (UK)'s £88.4 billion investment plan in transport pipeline by 2020-21 to boost the economy and connect communities (Infrastructure and Projects Authority, 2016). According to the Global Infrastructure Hub's estimate (2017, p3), "global infrastructure investment needs to be $94 trillion between 2016 and 2040. This is 19 percent higher than would be delivered under current trends, and is an average of $3.7 trillion per year". However, for large-scale transport projects (>$300 million) and in the face of fiscal constraints, the public sector is increasingly engaging the private sector in the delivery of their transport assets using a Public-Private Partnership (PPP) approach (Carpintero and Petersen, 2015). This is particularly the case when Covid-19 is inflicting critical challenges on budgets and infrastructure delivery (Love *et al*., 2020). An example can be seen in the South African Transport Department's unexpected payment of R24 million (≈US$1.65 million) to the private sector on the Chapman's Peak toll road as a result of the pandemic (National Treasury, 2021). Faced with this situation, it becomes even more important for governments to expend their budget effectively while satisfying taxpayers' needs.

PPPs are purported to be able to alleviate governments' financial pressure by keeping associated spending off the balance sheet, and providing on-time and on-cost products through private-sector expertise and risk transfer (Kwak *et al*., 2009; Verweij, 2015). Put simply, proposals of this nature are justified by the assumption that PPPs can generate better

value for money (V*f*M) than conventional public sector procurement (PSP) (Kweun *et al*., 2019). However, this assumption is sometimes debateable. A case in point is that the construction cost of road PPPs is 24% more expensive than conventional PSPs in the European Union (EU) (Blanc-Brude *et al*., 2009). Another point is that transport PPPs entail underlying transaction costs that, when taken into account, may cause the total costs to outweigh the benefits (Solino and de Santos, 2010). Hence, to determine an appropriate procurement method, governments have prioritised an assessment of V*f*M at the inception stage. Examples can be seen in both mature and emerging economies (e.g., UK, Australia and South Africa) where V*f*M assessment has become an indispensable component in the procurement process (The World Bank, 2013; European PPP Expertise Centre-EPEC, 2015). However, current V*f*M assessment has a tendency to focus on cost savings while overlooks value *per se* (Opara, 2018; Zhao *et al*., 2021). For instance, Decorla-Souze and Farajian (2017) contend that social benefits of transport projects are not captured in the typical assessment. Equally, as Zwalf *et al*. (2017) point out, a 'touch' on the discount rate used in calculating costs can skew the result, rendering its simple use to be ineffective and untenable.

Although the initial focus of this work is on the procurement decision stage, its outcomes have a wider relevance. We foresee V*f*M as a transferrable tool not only for making *ex-ante* decisions but also for monitoring and (*ex-post*) evaluation of projects in their operational phase. Although, in the *ex-post* evaluation, there is a need to consider any new issues that emerge throughout the project lifecycle, it remains important for the evaluation to reflect the criteria that were applied at its outset. Failure to do so, would, as Samset and Christensen (2017) argue, diminish the effectiveness of the evaluation and its role in improving subsequent decision-making.

In traditional value management theory, V*f*M is considered to be an integration of cost and function (Palmer *et al*., 1996). This is supported by 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'. Furthermore, Broadbent and Laughlin (2004) have argued through a longitudinal analysis of the UK's Private Finance Initiative (PFI) that V*f*M in essence is about whether improved public service can be derived. Yet, 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). 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. Despite its significance, there is a paucity of theoretical studies investigating this missing but important link in V*f*M assessment. To fill this void, this paper addresses the following research question: 'How can the V*f*M of transport projects be more realistically assessed, and what are the implications for theories of value?' Accordingly, the contribution of this paper is twofold: (1) drawing upon theories of value, it depicts the ontology of V*f*M and addresses a missing ingredient in V*f*M assessment; and (2) it develops a holistic framework for the public sectors to re-calibrate their V*f*M assessment when procuring transport projects.

The remainder of this paper is structured as follows. It commences by presenting the landscape (*status quo* and challenges) of current transport procurement. Next, a theoretical framework underpinned by theories of value is proposed and explained. Then, a dynamic lifecycle process is developed and relevant implications for procurement are discussed. We conclude this paper by summarising its achievements and future directions in the final section.

PPPs and V*f*M Assessment

Definitions and History

Although existing literature is replete with studies on their pros and cons, there is no consensus on the definition of PPPs (The World Bank, 2018). This is exemplified in some international organisations and economies' guidelines on PPPs as shown in Table 1. Governments' various intentions and arrangements over private participation in infrastructure may go some way in explaining the inconsistency in defining PPPs (Nathan Associates, 2017: p.11). For example, the UK explicitly requires that private sector organisations assume responsibilities (e.g., design, build, finance and operation) that used to be performed by the government; whilst Australia puts more stress on service provision.

Table 1. Different 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)
European Investment Bank (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 (2020)
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 (2018)
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	The Canadian Council for Public-Private Partnerships (2020)

	resources, risks and rewards.	
The United States (U.S)	Contractual agreements between a public agency and a private entity that allow for greater private participation in the delivery of projects.	Department of Transportation (2019)
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; (2) risk-sharing; (3) value realisation; and (4) innovation (Akintola *et al*., 2003; Garvin, 2010; Chen *et al*., 2015; 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, corporatization and decentralization; (2) civil works and service contracts; (3) management and operating agreements; (4) leases/ affermages[1]; (5) concessions, build-operate-transfer (BOT), design-build-operate (DBO); (6) joint ventures and partial divestiture of public assets; (7) full divestiture; and (8) contract plans and performance contracts. In the case of transport projects, they are often procured via concessions in the form of BOT, DBFM (Design-Build-Finance-Maintain), DBFMO (Design-Build-Finance-Maintain-Operate) etc. (Verweij, 2015; Zhang *et al*., 2018; Yescombe and Farquharson, 2018). The latest data have indicated that transport remains the largest PPP sector in both value and numbers in the EU, with the UK accounting for the highest value (EPEC, 2019).

There is an increasing 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

[1] 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.

(Cherkos and Jha, 2021) and sustainability (Hueskes *et al*., 2017) through a bundled 'construction and operation' contract (Chan *et al*., 2009). 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, Media *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. As a consequence, the UK has scrapped its use of Private Finance 2 (PF2) in 2018 (UK Government, 2018). The UK is widely considered to be the cradle of PPPs. PFI was first introduced there in 1992 followed by a revised version - PF2 - in 2012 (Broadbent and Laughlin, 2004; UK Government, 2018). The withdrawal of PF2 due to unsatisfactory performance has again put V*f*M under the spotlight and triggered wider reflection on how to improve the procurement decision-making process for future PPPs (National Audit Office - NAO, 2018).

PPPs and Transport Procurement

Transport projects have been traditionally procured via PSP 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 PSP 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 the private consortia are more capable of managing the complexities (e.g., large-scale investment and uncertainties) embedded in transport infrastructure. Since the 1990s, more than 60 transport projects with a total capital value of £7.8 billion have been procured through PFI in the UK alone (HM Treasury, 2019). This momentum has made PPP forms of procurement become what Reeves (2011) has called 'the only game in town' as the V*f*M assessment that rationalised its implementation is manipulated. In reality, 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 PSP, are subject 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 procurement method.

V*f*M Assessment to Date

V*f*M assessment, similar to project evaluation, can be divided into *ex-ante* and *ex-post* assessment (Harlen and James, 2006). For the latter, copious studies have been undertaken to investigate whether the expected output is delivered at the operation stage (Yuan *et al*., 2009; Henjewele *et al*., 2014; Liu *et al*., 2015). For instance, as revealed by Liu *et al*. (2018),

traditional TCQ (time, cost and quality) criteria continue to be the main factors in the *ex-post* assessment of PPP performance. Against these criteria, Edwards *et al*. (2004) state that V*f*M was not achieved in the first eight UK PFI road projects as a staggering £100 million could have been saved using a different approach. Additionally, systematic reviews conducted by Wang *et al*. (2017) and Cui *et al*. (2018) confirm that these performance management-related studies have formed a major research theme in the field of PPPs. By contrast, taking a simulation perspective, in *ex ante* V*f*M assessment it is common practice to compare the net present value (NPV) of a PPP option with that of a public sector comparator (PSC)[2]. However, such comparisons are subjected to criticism. An example is that cost at the inception stage can be underestimated. Sometimes, according to Flyvbjerg (2007), this appears to be the result of deliberate 'strategic misrepresentation'. Moreover, the PSC method itself is open to criticisms, such as asymmetric comparison, a contentious discount rate, and subjective assumptions (Yescombe and Farquharson, 2018, p. 87-90). A pertinent case that undermines the rigour of PSC was the appraisal of PPP for the capital investment, management and maintenance of the London Underground in which Shaoul (2002) in her study, concluded that the methodology for assessment of V*f*M was unsound.

Faced with the ongoing criticisms of its PSC, the UK suspended this quantitative assessment and emphasised the qualitative benefits that a project can engender (NAO, 2013). However, based on the latest Green Book[3], the PSC continues to play a pivotal role in PPP evaluations in conjunction with qualitative assessment (HM Treasury, 2020). This suggests that the aforementioned problems may persist. More importantly, a problematic issue is that the qualitative assessment is only applied to PPP forms of procurement, while neglecting similar

[2] A PSC is the estimated cost of providing the specified service under PSP. It assumes the same time frame (i.e., start and finish date) and standards as a PPP although these standards may not be achieved by past public provision (See Grimsey and Lewis, 2005 for more details).

[3] In the UK, the Green Book (HM Treasury, 2020) is a guidance on how to appraise policies, programmes and projects. It is for all public servants concerned with proposals for the use of public resources, not just for analysts.

consideration of the PSP (HM Treasury, 2006; HM Treasury, 2020). Nevertheless, efforts have been made by scholars to improve V*f*M assessment. For example, Cui *et al*. (2019) identified 19 V*f*M drivers and explored their interrelationships in contributing to V*f*M. This is similar to previous studies where Cheung *et al*. (2009) and Ng *et al*. (2012) highlight some critical factors that should be accentuated to achieve V*f*M. More recently, Cherkos and Jha (2021) proposed nine factors that can drive the decision to adopt PPPs in the road sector. However, it should be noted that these researchers tend to categorise V*f*M elements without a theoretical underpinning and thus their concept of V*f*M remains nebulous (McKevitt and Davis, 2016). Equally, a roadmap guiding how V*f*M should be consistently and dynamically assessed throughout a transport project lifecycle is still lacking.

Setting the Framework

Theoretical Base

As previously noted, defining V*f*M is challenging, as different stakeholders may perceive project success differently (Wang *et al*., 2017). 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). In this sense, the UK's definition combining whole-of-life cost and quality is widely shared (Morallos and Amekudzi, 2008). Although we acknowledge the merit of this view, it is possible that the commonly-applied term 'fitness for purpose' creates room for uncertainty 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). Hence, in response to the above analysis and the call by McKevitt (2015) for conceptual clarity to the V*f*M concept, we start by dissecting the fundamental theories of value in an attempt to propagate a theory-based V*f*M assessment framework.

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" (cited 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 cited 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 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 NPV of an option, be it the PSP or PPP (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. Akin to this, a balanced view is the philosophical perspective that value judgement is about evaluating what is 'goodness' (and what is not) which in Schroeder (2012) is termed '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 (2015) 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.

With the idea of relativity in mind, Sheth (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, as shown above, is that V*f*M: (1) should represent the interests of the government (supplier) and the end-users (consumer) that pay for the service; and (2) should not only consider the quantitative value but also embody the socially recognised value. Hereby, drawing on these principles, we propose a framework that addresses V*f*M and its assessment in transport procurement.

Framework for V*f*M Assessment of Transport Projects

Traditional VfM

The theoretical base reveals that the supply-side value is not flawless. Empirical evidence provided by Edwards *et al*. (2004) and Blanc-Brude *et al*. (2009) also corroborates this theory by confirming that governments' existing V*f*M assessment does not guarantee PPPs' success. We argue, however, that their measures for V*f*M (i.e., traditional V*f*M: TCQ) are significant

and continue to be an ingredient in our proposed value chain (Figure 1). Support for this view is to 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, we proffer that it is by means of collaboration between the supply side and the demand side that co-creates V*f*M.

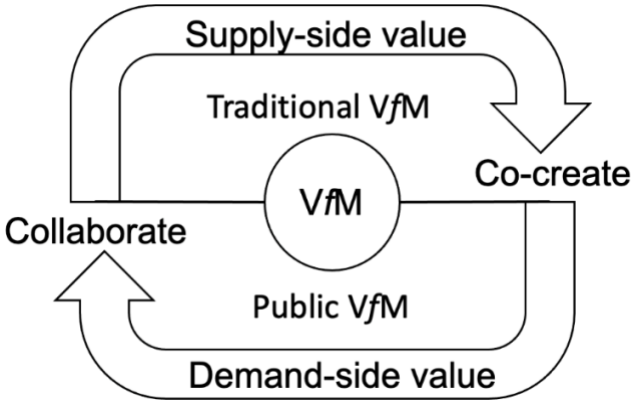

Figure 1. Theoretical V*f*M

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) represent 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, according to

Shenhar *et al*. (1997) and Davis (2017), be (1) dependent on different stakeholders; (2) multi-dimensional; and (3) future-proof. Hence, we adopt the position of the supplier (stakeholder perspective) to examine the traditional V*f*M (dimension perspective) that materialise over a project's future lifecycle (future-proof perspective). It should be noted that the scope of this paper 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 reaffirm PPPs are an effective route. Ramsey and EI Asmar (2015) also suggest that public clients in the U.S. transport sector can use cost and time as the benchmark to decide the adoption of PPPs. In the UK, Pollock *et al*. (2010) refute government claims that PPPs increased time and cost performance. 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 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.

Public VfM

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. 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 (Figure 1), we propose public V*f*M in V*f*M assessment brought by 'public' participation in transport to form a two-wheel system, as outlined in Figure 2. This concurs with Barber (2017), that achieving public V*f*M (i.e., service, environment, distribution, resilience, and social inclusion in our context) 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 2 are in the context of transport infrastructure, and thus may not be universally applicable. For example, Historic England (2014), in the field of heritage, emphasises its value in *knowledge* and *sense of identity* in addition to economic value. However, to the best of our knowledge, these five have emerged as the themes that best reflect public (transport) V*f*M based on the theories of value and the existing body of literature.

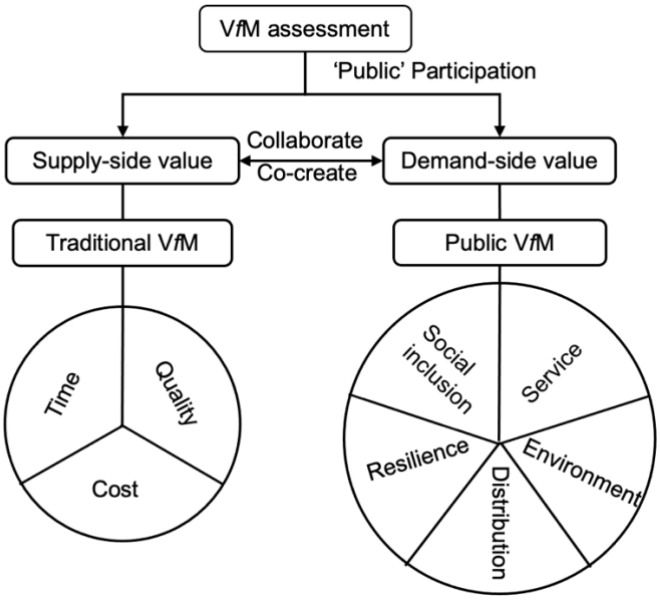

Figure 2. Conceptual framework for V*f*M assessment of transport infrastructure

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 (Boeing 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 in (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 is 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 reported 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.

As stated above, in the UK's HS2 project, communities' concerns over environment issues appear to have been neglected 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, 2020). 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). The 'barrier' arguably lies in the extent of the public's participation in transport decisions to articulate what they value about the environment.

In Figure 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 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 is 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, apply 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, 2021). 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, 2020). What is more, according to Bill and Walker (2017), it is still not fully understood how existing models perform in practice, especially when both temporal and spatial aspects are considered. To address this, here we integrate an aggregate view of the temporal and spatial effect of transport projects into V*f*M assessment.

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, Besinovic (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 an emerging one. According to the resilience curve proposed by Baroud *et al.* (2014), when confronted with stress (such as disruption 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, we address the concern raised by Kunreuther and Michael-Kerjan (2012), that the benefits of disaster risk reduction are largely overlooked in decision makings.

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, 2003) has pioneered studies on the *status quo* and underlying causes and proposed the 'accessibility planning' of its future transport schemes (see, e.g., 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 question of how and when to include it during the procurement process are vague. In response, we include the factor of social inclusion 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 specific areas.

Implications for Procurement Policy

The epistemology of theories of value, as we have explored, implies that value is generated from both the demand side and the supply side. It points out a significant ingredient that has been overlooked in the current V*f*M assessment, namely public V*f*M (Figure 1). Thus, we argue that traditional V*f*M is not comprehensive enough to determine an appropriate procurement approach for transport projects. Consequently, we have introduced a holistic framework to support a dynamic life-cycle V*f*M assessment. This complements 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, our 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), our framework differs from others in several ways. For example, instead of categorising measures based on judgement, we provided a theoretical predication and have elaborated on what V*f*M is. Complementing traditional V*f*M, our novel 'public V*f*M' (shown in Figure 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), while we contend that it is the assessment of both PPPs and the PSP that determines the V*f*M and 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*., 2020).

In order to facilitate the applicability of the proposed framework, we provide, in Figure 3, a dynamic V*f*M assessment process and its relevant implications. Public participation in government policy making is not new in an era of new governance where transparency and accountability prevail (Binham *et al*., 2005). In PPP forms of infrastructure development, scholars (e.g., Kuronen *et al*., 2009; Torvinen and Ulkuniemei, 2016; Yuan *et al*., 2019) are also calling for the consideration of public interests to create a 'tripartite win' between governments, private consortia and people. The benefit, according to Aaltonen and Kujala (2010), is that early engagement with all stakeholders, particularly those who are not bound by the contract (e.g., the public) can ensure project value realisation. As such, we revitalise

‘public (end-users’) participation in transport’ in V*f*M assessment. That is, demand-side value should be assessed from the viewpoint of end-users to realise public V*f*M. 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 PSPs) can deliver the traditional V*f*M and public V*f*M. By applying the same criteria to both options, we can potentially curb the bias towards PSPs (Burger and Hawkesworth, 2011) and PPPs (Bayliss and Van Waeyenberge, 2018). It is then multiplied by the weight of each attribute as we acknowledge there are regional differences. This is consistent with Kweun *et al*., (2018) suggesting that V*f*M assessment should be conducted on a project-by-project or case-by-case basis. In doing so, we avoid excessively complicated techniques and thus provide 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).

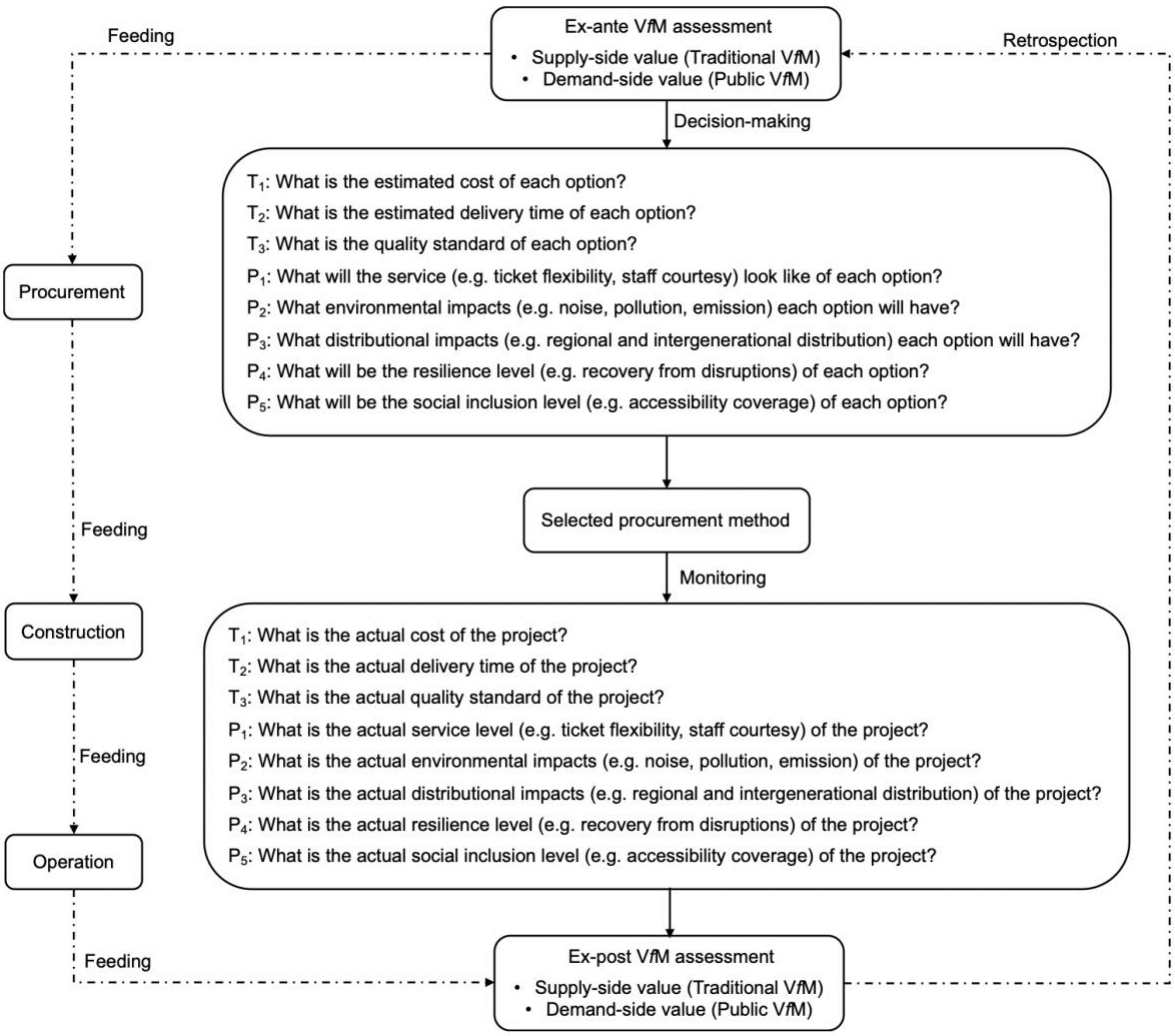

Figure 3. Life-cycle V*f*M assessment process

Figure 3 is based upon the use of the process at the initial procurement stage. At the construction and operation phase, 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 project. 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, we propose the 'feeding and retrospection' mechanism to safeguard the V*f*M assessment process. It requires information to be passed down to the next stage as the reference 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.

Conclusions

Transport infrastructure forms the backbone of an economy's socio-economic development and growth. However, the inherent large-scale capital expenditure and uncertainties can sometimes overwhelm governments' financial capacity constraints. PPP forms of procurement that exploit the private sectors' funds and ingenuity are, therefore, trending around the world. The overall rationale behind this movement is a V*f*M assessment containing the cost comparison of a PPP and an alternative PSP. Nevertheless, there is little evidence to show that PPPs outperform their counterpart, provoking persistent criticism of V*f*M assessment. To date, V*f*M remains a nebulous concept with a paucity of theoretical research to investigate how V*f*M can be comprehensively assessed.

As Covid-19 is posing critical challenges on infrastructure delivery and straining governments' nerve on public spending, it becomes imperative that a holistic and pragmatic V*f*M framework be put in place to assist informed government decisions. Against this contextual backdrop, we have examined the fundamental theories of value and dissected V*f*M

itself. The conclusion is that value is generated in the marketplace (i.e., through supply and demand) and is relative. Acknowledging this epistemology, we have proposed that true V*f*M should consist of traditional V*f*M (government perspective) and public V*f*M (end-users perspective) (Figure 1). 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. Based on which, we revitalise 'public' participation in transport and expound that this type of public V*f*M (i.e., service, environment, distribution, resilience, and social inclusion) should be assessed from the standpoint of end-users. Equally important, we maintain that traditional V*f*M (TCQ) should not pass into oblivion; quite the contrary. A framework consolidating two wheels of V*f*M (Figure 2) and a practical process are then proposed (Figure 3).

The intention of this paper is not to detail how each dimension can be assessed. That is beyond the scope of this paper and has been, in any case, studied in the literature already, albeit in a piecemeal manner. Rather, we uncover the V*f*M concept, develop a holistic framework in which a comprehensive transport V*f*M assessment can coalesce, and provide a practical approach to assess both PPPs and PSPs instead of serving only PPPs. In addition, we highlight the importance of having in place the 'feeding and retrospection' mechanism to facilitate a life-cycle process. By doing so, we apply 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 (or has been) delivered throughout their lifecycle. It creates an opportunity for governments to recognise public V*f*M in transport development, shift their mindset from singular to multi-dimensional evaluation, and start to actually accumulate and exploit experience from past projects. As such, the contribution of this paper is twofold: (1) drawing upon theories of value, it depicts the ontology of V*f*M and addresses public V*f*M in V*f*M

assessment; and (2) it develops an integrated framework for the public sector to re-calibrate their V*f*M assessment practice when procuring transport projects. Although a practical pathway is provided, the framework is conceptual in nature. However, as a requisite model that concentrates on 'form' and 'content' (Phillips, 1984), this study serves the purpose as a guide to action and paves the way for policy makers to think more clearly about V*f*M when assessing it. Future studies can be conducted to empirically test the model and an empirical example demonstrating formations of the weight is needed. As this study is the first step of a research project, lines of inquiry in these respects are ongoing.

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