A multi-dimensional financing appraisal framework for public infrastructure

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A Multi-Dimensional Financing Appraisal Framework for Public Infrastructure

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Thesis Declaration

I certify that the work presented in this thesis is, to the best of my knowledge and belief, original, except as acknowledged in the text, and that the material has not been submitted, either in whole or in part, for a degree at this or any other university. I acknowledge that I have read and understood the University's rules, requirements, procedures and policy relating to my higher degree research award and to my thesis. I certify that I have complied with the rules, requirements, procedures and policy of the University (as they may be from time to time).

Liesel Henn
8 September 2015
List of Publications


Abstract

This thesis aims to add to the toolkit of public infrastructure decision makers when they consider the range of approaches available for financing large-scale public infrastructure. To this end, the study develops a new appraisal framework for selecting a capital raising approach that is in the best interest of taxpayers. This framework is termed the Multi-Criteria Financing Appraisal (MCFA) framework.

In contrast with well-established project appraisal methodologies, such as Multi-Criteria Analyses (MCA) and Benefit-Cost Analyses (BCA), the literature offers little guidance on how to select a public infrastructure financing approach. In fact, one of the cornerstones of financial theory, the Miller-Modigliani theorem (1958), states that the way in which projects are financed does not matter. The foundational principle adopted in this thesis, however, is that the way in which public infrastructure projects are financed is critical. Such a perspective effectively accords with the view that financial markets are imperfect, and therefore the net cost of financing differs by instrument.

There is a multitude of innovative financing instruments and various economic and social factors, as well as a range of stakeholders with different and sometimes conflicting objectives that require consideration in selecting an optimum financing approach. Public infrastructure decision makers need to navigate through these intricacies and establish which combination of financing instruments, and in what proportions, will be optimal from a societal point of view. At present, however, there is no readily available and comprehensive financing appraisal framework that considers all the aspects involved.

This thesis adopts an interpretive paradigm that relies on qualitative evidence, through exploratory and descriptive research, to address the research problem. The development of the framework relied on insights provided by a review of the status quo of financing appraisal approaches. The framework also incorporates elements of mainstream project appraisal methods, although these have been tailored specifically for the financing decision. It allows for the calculation of an effective cost of capital by instrument akin to the quantitative BCA method, while the intangible impact measures are appraised using a qualitative MCA approach, which, when combined, reveals an optimal financing approach.

In sum, the framework developed consists of the concepts, classifications, criteria and impact assessment method required to perform an assessment of a range of financing approaches. Such a tool can help public infrastructure decision makers to appraise capital raising methods
in a responsible, transparent and accountable fashion so as to consider the interests of both current and future generations.
Acknowledgements

I would like to express my sincerest appreciation for the guidance, commitment and patience of my three supervisors, Keith Sloan, Michael Charles and Neil Douglas. This research would also not have been possible without the moral support of my husband, Johann and kids, Alma and Adrian. My dad, At Jonker, has been a major inspiration and has always impressed on us the importance of obtaining a good education. I am very grateful to the Cooperative Research Centre for Rail Innovation (an Australian Government Initiative) for their sponsorship. Lastly, all glory goes to God.
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<tr>
<td>AGE</td>
<td>Applied General Equilibrium</td>
</tr>
<tr>
<td>AHP</td>
<td>Analytic Hierarchy Process</td>
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<tr>
<td>AUD</td>
<td>Australian dollar</td>
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<tr>
<td>BCA</td>
<td>Benefit-Cost Analysis</td>
</tr>
<tr>
<td>BCR</td>
<td>Benefit-Cost Ratio</td>
</tr>
<tr>
<td>CAPM</td>
<td>Capital Asset Pricing Model</td>
</tr>
<tr>
<td>CBA</td>
<td>Central Borrowing Authority</td>
</tr>
<tr>
<td>ECF</td>
<td>Effective Cost of Financing</td>
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<tr>
<td>EIB</td>
<td>European Investment Bank</td>
</tr>
<tr>
<td>EIRR</td>
<td>Economic Internal Rate of Return</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>EUR</td>
<td>Euro</td>
</tr>
<tr>
<td>FIRR</td>
<td>Financial Internal Rate of Return</td>
</tr>
<tr>
<td>GBP</td>
<td>British Pound</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GFC</td>
<td>Global Financial Crisis</td>
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<tr>
<td>GTE</td>
<td>Government Trading Enterprise</td>
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<tr>
<td>HSR</td>
<td>High-Speed Rail</td>
</tr>
<tr>
<td>IRR</td>
<td>Internal Rate of Return</td>
</tr>
<tr>
<td>ISO</td>
<td>Initial Superannuation Offering</td>
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<tr>
<td>JNR</td>
<td>Japanese National Railways</td>
</tr>
<tr>
<td>JPY</td>
<td>Japanese Yen</td>
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<tr>
<td>JRCC</td>
<td>Japan Railway Construction Public Corporation</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<td>---------</td>
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<tr>
<td>JRTT</td>
<td>Japan Railway Construction, Transport and Technology Agency</td>
</tr>
<tr>
<td>LGV</td>
<td><em>Ligne à Grande Vitesse</em></td>
</tr>
<tr>
<td>MCA</td>
<td>Multi-Criteria Analysis</td>
</tr>
<tr>
<td>MECE</td>
<td>Mutually Exclusive and Collectively Exhaustive</td>
</tr>
<tr>
<td>MCFA</td>
<td>Multi-Criteria Financing Appraisal</td>
</tr>
<tr>
<td>MMRF</td>
<td>Monash Multi-Regional Forecasting Model</td>
</tr>
<tr>
<td>NMCCF</td>
<td>Net Multi-Criteria Cost of Financing</td>
</tr>
<tr>
<td>NPV</td>
<td>Net Present Value</td>
</tr>
<tr>
<td>NSW</td>
<td>New South Wales</td>
</tr>
<tr>
<td>PAYGO</td>
<td>Pay-As-You-Go</td>
</tr>
<tr>
<td>PPP</td>
<td>Public-Private Partnership</td>
</tr>
<tr>
<td>PSC</td>
<td>Public Sector Comparator</td>
</tr>
<tr>
<td>PTE</td>
<td>Public Trading Enterprises</td>
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<tr>
<td>SPV</td>
<td>Special Purpose Vehicle</td>
</tr>
<tr>
<td>TIF</td>
<td>Tax Incremental Financing</td>
</tr>
<tr>
<td>USD</td>
<td>American Dollar</td>
</tr>
<tr>
<td>VFM</td>
<td>Value-for-Money</td>
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<tr>
<td>WACC</td>
<td>Weighted Average Cost of Capital</td>
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</table>
# Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Basis point</td>
<td>Equivalent to 0.01 per cent</td>
</tr>
<tr>
<td>Brownfield project</td>
<td>An existing project or infrastructure.</td>
</tr>
<tr>
<td>Capital recycling</td>
<td>Privatizing mature public infrastructure and explicitly hypothecating the proceeds to the financing of new public infrastructure projects.</td>
</tr>
<tr>
<td>Credit risk</td>
<td>The risk that the borrower will default on their debt.</td>
</tr>
<tr>
<td>Delivery vehicle</td>
<td>The entity responsible for providing and financing the infrastructure.</td>
</tr>
<tr>
<td>Economic infrastructure</td>
<td>Infrastructure is regarded as forming part of economic production by businesses and households.</td>
</tr>
<tr>
<td><em>ex ante</em></td>
<td>When an analysis is performed based on estimations rather than historical or actual results.</td>
</tr>
<tr>
<td><em>ex post</em></td>
<td>When an analysis is performed based on actual results or historical data rather than estimations or forecasts.</td>
</tr>
<tr>
<td>Externality</td>
<td>A benefits (a positive externality) and/or cost (a negative externality) of an activity which does not accrue to the entity or person carrying out the activity.</td>
</tr>
<tr>
<td>Financing</td>
<td>The approach used to raise upfront capital for a project.</td>
</tr>
<tr>
<td>Funding</td>
<td>The mechanism used to accumulate or repay the upfront capital for a project.</td>
</tr>
<tr>
<td>Information asymmetry</td>
<td>When one party in a contract or transaction has access to more or better information than the other party or parties.</td>
</tr>
<tr>
<td>Investment decision</td>
<td>Deciding which project (or project option) should be selected for construction.</td>
</tr>
<tr>
<td>Operationalization</td>
<td>The process of translating a concept to a measure that allows for empirical observation.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>-------------------------------</td>
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<tr>
<td>Optimism bias</td>
<td>The inclination to systematically overestimate project revenues and underestimate project costs and timeframes.</td>
</tr>
<tr>
<td>Privatize</td>
<td>Asset is transferred from government control or ownership to control or ownership by the private sector.</td>
</tr>
<tr>
<td>Public good</td>
<td>A good or service that is non-rivalrous (additional users of the infrastructure do not hinder the benefits that flow to existing users) and non-excludable (difficult, expensive, or impractical to exclude those who refuse to pay).</td>
</tr>
<tr>
<td>Public-Private Partnership</td>
<td>Contract between the public sector and the private sector where the private sector assumes significant risk.</td>
</tr>
<tr>
<td>Seniority of claim</td>
<td>Priority of debt payment in the case of financial distress.</td>
</tr>
<tr>
<td>Social infrastructure</td>
<td>Public infrastructure accommodating social services such as health care and education.</td>
</tr>
<tr>
<td>Spill-over</td>
<td>When different parts of the economy are connected, for instance, when one industry imposes an externality on another.</td>
</tr>
<tr>
<td>Systematic risk</td>
<td>Market-wide risks affecting all asset classes that cannot be reduced by diversification.</td>
</tr>
<tr>
<td>Triangulation</td>
<td>The process of assessing research results from multiple points of view to improve accuracy.</td>
</tr>
</tbody>
</table>
1 Introduction

1.1 Overview
This thesis sets out to develop an appraisal framework to assess a range of financing approaches for large-scale public infrastructure in order to select the alternative that is in the best interest of a nation’s broader society. The foundational principle adopted is that the way in which public infrastructure projects are financed is important. This effectively accords with the view that capital markets are imperfect, because of a range of market deficiencies including different knowledge, expectations, and ability to bear risk. As a result, the effective cost of capital differs by financing approach. Each financing approach therefore has dissimilar distributional impacts, economic and social costs and benefits. It follows that a financing appraisal should systematically and transparently weigh up the trade-offs between monetary aspects such as the cost of capital, and social impacts such as intergenerational equity.

1.2 Background
Some public infrastructure projects involve raising billions of dollars and span multiple countries, including Europe’s Channel Tunnel (between France and Britain), the Oresund bridge (between Denmark and Sweden), and the large High-Speed Rail (HSR) network connecting most of Europe. The successes and failures of these so-called ‘megaprojects’ have been the subject of much debate and analysis (including, for example, Altshuler & Luberoff, 2003; Flyvbjerg et al., 2003; Flyvbjerg, 2005). The provision of public infrastructure has also emerged as an increasingly topical issue in Australia. Australia’s population is expected to double by 2075, thereby prompting the need for increased public infrastructure to meet the growing demands of the nation. Public sector revenue sources are limited resulting from a trend to smaller government, yet public value expectations are increasing. The growing pressure on public finances has led to a particular emphasis being placed on how to finance these projects. One of the largest public infrastructure projects being considered in the history of Australia is an AUD 114 billion HSR project stretching from Brisbane to Melbourne. Financing has been raised as a critical challenge for this project (HSR Advisory Group, 2013). However, nobody has performed a systematic appraisal of all the alternative financing approaches available for the HSR project. The financing dilemma for this potential Australian HSR project was therefore the catalyst for undertaking this
study, the results of which will also be applicable to considering the financing of any large infrastructure project.

The choice of financing instrument has become an important issue, not only for the HSR project, but also for public infrastructure in general. It is recognized that financing, as Hann and Mack (2005, p.302) point out, can no longer be ‘left in a ‘black box’ to be opened only when the planning decisions have already been made’. Indeed, commentators have come to the realization that the way in which a project is financed influences not only the future stream of finance servicing costs and contingent liabilities that taxpayers are burdened with, but also impacts on the very success of projects. For instance, the lack of recognition that public infrastructure requires a tailored financing approach was a pivotal reason for the financial failure of the Sydney Airport Rail Link (Hann & Mack, 2005). A recent report by Australia’s Productivity Commission (2014) also acknowledged public infrastructure financing as a major problem for Australia to solve. Other studies that attempted to find public infrastructure financing solutions include the Infrastructure Finance Working Group (2012), Funding Australia Forum papers such as Mulino (2013), and a Productivity Commission staff working paper (Chan et al., 2009). These studies suggested a wide range of innovative and complicated financing instruments, including various hybrids. They also applied several different assessment approaches.

Within this complicated and confusing context, public sector decision makers need to find a financing solution that is in the best interest of society, and which balances the various costs and benefits. Economists have called for a formalized and systematic ‘trade-off’ appraisal of the alternative financing approaches available (Infrastructure Finance Working Group [IFWG], 2012; Freebairn & Corden, 2013, Productivity Commission [PC], 2014). This is what the proposed appraisal framework seeks to achieve. Section 1.3 expands on the concept of trade-offs between financing instrument costs and benefits, including an example.

1.3 Justification
The main justification for the research stems from the conclusion that the ways in which public sector decision makers currently select financing instruments for public infrastructure projects are fundamentally flawed. Instead of relying on a systematic approach that considers all possible financing avenues objectively with a view to compiling an approach that is in the best interest of society, even a cursory review of financing processes reveals that these decisions are often reactive and ideologically driven. To return to HSR, an initial review of
International case studies revealed financing choices that were reflective of political motivations, national pride, or a reactive attempt to fix historic fiscal policy errors (Henn et al., 2013). The outcome of such informal and highly subjective decision-making processes has often been suboptimal financing choices. The current situation in Australia is another example of how the ideology of the government of the time can dictate and constrain financing choices.

The Australia Government’s existing public policy dictates that government maintains balanced or surplus cash budgets. This places a ceiling on the use of public debt to finance infrastructure and is often justified by government as a requirement for protecting its credit rating. For instance, one of the goals of the New South Wales government’s ten-year policy guidance (Government of New South Wales [NSW], 2011) is the retention of its AAA credit rating, supported by increased use of private sector infrastructure financing. This goal is also reflective of a noticeable shift towards reliance on private sector financing for public infrastructure. Such a shift is predicated on the notion that, particularly for economic infrastructure, government’s capital contribution should be limited to that which cannot be filled by the private sector, otherwise known as the commercial financing gap. This libertarian financing ideology is evident in most of the Australian Government’s financing policies and related literature, including an enquiry into financing public infrastructure by the Productivity Commission (2014), Infrastructure Australia’s National Public-Private Partnership Guidelines (2008), Infrastructure Finance Working Group (2012) and Infrastructure Australia (2014). Studies for the Australian HSR project have similarly assumed the requirement for maximizing private sector financing as a given, including the HSR Advisory Group (2013), AECOM (2011, 2013) and ARUP TMG (2001).

Australia’s current public financing philosophy is questioned by independent economists and commentators. They contend that the Australian Government still has ample capacity for additional public sector borrowings within its AAA credit rating, since the country has low public debt levels compared to other developed nations (IFWG, 2012). The debt limit

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1 A focus on maintaining its credit rating or constraints on borrowing to finance capital spending is also observed in some of the states, for example Western Australia (COAG, 2007); Victoria (DTF [Department of Treasury and Finance], 2007a, 2007b); New South Wales (NSW, 2012); South Australia (Government of South Australia, 2007).

2 Defined as “a person who believes in very limited state intervention in people’s lives” (Oxford English Dictionary, 2012).

3 Australia’s government debt-to-GDP ratio has been consistently low, and estimated at 34 per cent in 2014 (CIA, 2015). Another contributing factor to the infrastructure deficit is the mismatch between the responsibility
is criticized for being overly conservative when it comes to public infrastructure financing. Robinson (2002) points out that a policy that requires a fiscal balance contradicts the widely-accepted Golden Rule of Public Finance. The rule opposes the use of debt for current expenditure, but supports borrowing to finance infrastructure to improve intergenerational equity and achieve what is generally termed ‘fiscal smoothing’. The ‘surplus fetish’ is also blamed for exacerbating the country’s infrastructure deficit (Stiglitz, 2010), since even public infrastructure projects with demonstrable net economic benefit have been put on hold or have been abandoned as a result (Freebairn & Corden, 2013; Sheehan & Gregory, 2013). Failure to build infrastructure prevents current and future generations from attaining the benefits of productive and welfare-enhancing infrastructure.

Together with its self-imposed debt limitations, the Australian Government’s default approach of relying on private financing means that a number of financing approaches are not being thoroughly considered. A comprehensive trade-off appraisal of the full range of financing instruments might, however, indicate that a different solution is in the best interest of society (Henn et al., forthcoming). Government’s public finance ideology changes frequently and has serious ramifications for the financing of public infrastructure. Yet the way in which public infrastructure is financed may affect society for several generations (Hyman, 1999; Robinson, 2002; Kitchen, 2004; Gruber, 2007; Snyder & Luby, 2012). For public financing to be fair, transparent and accountable, it is important that that the full long-term costs and benefits of all alternatives be compared objectively to arrive at an answer. For example, a high-level trade-off analysis between some of the costs and benefits of a public infrastructure financing policy motivated by the debt ceiling produces interesting results.

The drive to attract private financing might preserve a government’s credit rating and promote faster project delivery, but may come at a staggering cost of capital differential. Indeed, the gap between private and public financing can be as much as eight per cent (Han, and ability to finance infrastructure in Australia’s federal system. The federal government arguably has substantial capacity for additional borrowings on its balance sheet, without harming its AAA credit rating (IFWG, 2012); however, it does not have the prime responsibility for financing infrastructure. Instead, this responsibility lies with state and territory level governments, which have limited capacity for additional borrowing without putting pressure on their current credit ratings (Sheehan & Gregory, 2013).

4 Also referred to simply as the ‘golden rule’. The rule is followed in developed countries such as the United Kingdom and Germany (Kellerman, 2007).

5 This term refers to the process of addressing cyclical changes in national capital requirements over time.

6 Other critics of the so-called ‘surplus fetish’ include Wettenhall (2011), the Australia Institute (2011) and Richardson (2011).
2013; Organisation for Economic Co-operation and Development [OECD], 2015). Private investors require commercial returns. This means that government foregoes some or all of a project’s potential long run profits, as evidenced by the Sydney Airlink Public-Private Partnership (PPP), where government’s returns were estimated at 2 percent, compared to the private sector’s 23 per cent (Hann & Mack, 2005). If governments were to use public debt instead, this could arguably lead to a credit rating downgrade, but only if it is seen as excessive debt. The cost of every one-level credit rating downgrade, however, is estimated to be no more than 50 basis points7 (IFWG, 2012). This may be far outweighed by the high costs of using private sector financing. The use of private financing in response to the debt ceiling can also have societal ramifications such as rent-seeking behaviour and moral hazard (Keefer & Knack, 2007; Baily & Asenova, 2009; Gannon & Smith, 2009; Adler et al., 2010; Williams, 2010; Liu & Webb, 2011; Pottinger, 2013).8 Even if explicit government guarantees are not offered, failing private entities are often assisted by government in view of the strategic role that public infrastructure projects often play in an economy (Lucas, 2014). These intangible issues need to be incorporated into a well-considered and clear appraisal of the different financing instruments.

Europe’s ongoing public debt crisis similarly demonstrates how financing policy can impact on society, as evidenced by the economic tumult and political backlash that Greece is currently experiencing (Economist, 2015).9 In contrast with Australia, Europe experienced alarmingly high public debt levels, some in excess of a nation’s annual GDP. Such excessive public debt has a multitude of potential detrimental impacts. Taxes may need to be significantly increased, particularly if the assessment base and personal incomes are not growing enough to accommodate the steadily increasing debt levels (Chan et al., 2009). If this situation continues, unwarranted debt can squeeze out future capital priorities, produce inflationary impacts, and contribute to political instability (Vander Ploeg, 2006; Chan et al., 2009). When these issues first began to loom in Europe, governments reacted by imposing strict debt ceilings, such as the Maastricht Criteria and Growth and Stability Pact. These debt ceilings were criticized for having other unintended consequences, such as slowing down

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7 One basis point is equivalent to 0.01 per cent.
8 Moral hazard occurs when an entity takes undue risks when they do not have to bear the full consequences. Rent-seeking refers to an entity using its resources to attain an economic gain from others without returning benefits to society. Rent-seeking and moral hazard risks in PPP financing stems from the fact that government retains a large portion of risks in many cases (Keefer & Knack, 2007).
9 Greece has experienced political unrest, austerity measures, economic decline, and risks expulsion from the Eurozone as a result of its debt crisis (Economist, 2015).
infrastructure investment and economic growth (Checherita-Westphal & Rother, 2012). This demonstrates the importance of making a robust appraisal of the financing situation for public infrastructure, as it has major implications for society.

This study adopts, as a foundational principle, the view that different financing approaches may result in different costs of financing, which is consistent with the growing body of knowledge on financial market imperfections. Miller and Modigliani (1958) theorized that a project’s capital structure is essentially irrelevant in the presence of perfect financial markets, since a project’s cost of capital is exclusively determined by the project’s risk profile. In practice, however, financial markets do not consistently price finance, as a consequence of market imperfections such as barriers to entry, asymmetric information being fed into the decision-making framework and varying abilities to absorb, diversify and control investment risks (Wilkes, 1983; Kay, 1993; Ariccia et al., 1999; Spackman, 2001; Tuladhar, 2003; Guriev & Kvasov, 2009; Shoji et al., 2012; Snyder & Luby, 2012; Chaudhuri & Gupta, 2014). These aspects are explored further in Chapter 2.

When public sector decision makers select a particular financing approach, such as opting for an approach with a large portion of reserves instead of bonds, this results in a different cost of capital. There are also many variations within each financing category. For example, bonds may be secured or unsecured, general purpose or specific purpose, issued by the public sector or private sector, or a Special Purpose Vehicle (SPV).\(^\text{10}\) The cost of capital for each of these variations is also different. Such variances are reflective of more than just a project’s inherent risks – they also account for capital market failures. Different financing vehicles expose financiers to different levels of credit risk. For example, debt has greater seniority of claim in the case of financial distress than equity, while there are different classes of equity, such as privately or publicly traded, and ordinary or preference shares. Failure to recognize these aspects of the financial markets can have misleading policy implications (Shoji et al., 2012). The choice of financing approach also affects how costs and risks are shared (General Accounting Office [GAO], 2002) and other distributional impacts (Institute of Energy Economics and the Rational Use of Energy [IER], 2005). Financing instruments should be fair and improve horizontal, vertical and intergenerational equity. For instance, the use of municipal tax-exempt bonds is regarded as unfair from a horizontal equity point of view. This is because the burden associated with lost tax revenues falls on all taxpayers, while only

\(^{10}\) Legal entity created for delivery of a PPP project.
certain communities stand to benefit directly from the infrastructure being financed (Chan et al., 2009). To compare, debt is often credited with improving intergenerational equity, because it synchronizes the costs and benefits of financing long-lived infrastructure assets. This is in contrast with financing from accumulated reserve funds, which involves mainly past generations (Robinson, 2002).

There are also other impacts to consider in an appraisal of financing approaches, such as the flexibility, stakeholder support, accountability, and transparency of an instrument. Flexibility refers to the ability to adjust to changing project requirements. For example, loans are usually more flexible than bonds, since it is possible to renegotiate terms and conditions.\textsuperscript{11} In particular, short-term loans allow for the refinancing of an asset once the project is established and risks are clearer. Transparency and accountability is essential for protecting the public interest and to address problems such as rent seeking. For instance, while the terms of government-issued bonds are transparent to taxpayers, transparency may be jeopardised when private equity is employed and there is non-disclosure of contracts for commercial-in-confidence reasons. ‘Off-balance sheet’ financing\textsuperscript{12} raised through Government Trading Enterprises (GTEs) or Public-Private Partnerships (PPPs) may also bypass expenditure controls and reduce parliamentary and public scrutiny. Stakeholder support also differs by financing instruments. For example, reserve financing is often regarded by the public as more fiscally prudent than debt. Given that financing also has ownership implications, it could be a significant consideration for strategic public assets where government may wish to retain public ownership. While instruments such as government reserves or debt financing allow for retention of ownership and control, external equity may compromise this. In other instances, local participation and financing is important, and often affects the decision to encourage or disallow foreign financing and investment (Henn et al., 2015).

In contrast with inconsistent and \textit{ad-hoc} appraisal of the financing decision, the appraisal of projects rely on mature and comprehensive methodologies. The decision to build large public infrastructure projects customarily requires complex project appraisals, which involves detailed analysis of a project’s full economic and social costs and benefits. Benefit-Cost

\textsuperscript{11} Some bonds have a call provision, which obviates this problem. Such bonds attract an interest rate premium because of the call value.

\textsuperscript{12} When the debt associated with financing infrastructure is not reflected on governments’ balance sheets, but instead is found on the balance sheet of the corporation or SPV. This is also referred to as ‘off-budget’.
Analysis (BCA) and Multi-Criteria Analysis (MCA) are the most well-accepted project appraisal methods. An optimal financing decision not only involves consideration of a complex set of alternatives, and a range of economic and social impacts, but also involves other factors such as cyclical changes in the availability of financial instruments. For instance, for a period after the Global Financial Crisis (GFC), debt became more expensive, while credit risk insurance and some traditional forms of finance were no longer readily available (Regan, 2009). Just as powerful appraisal tools are required to aid public sector decision makers in appraising projects, the same holds for the financing decision.

Yet nowhere in an initial exploratory review of public infrastructure financing practices could any evidence be found of a consistent and proactive financing appraisal approach which considers the wide spectrum of considerations, even though such appraisals are routinely performed to assess projects. Instead, various studies have addressed different aspects of financing of infrastructure, such as possible new financing instruments (such as IFWG, 2012; Mulino, 2013 and PC, 2014), or have discussed the challenges associated with selecting an appropriate financing approach for public infrastructure (including, for example, Hann and Mack, 2005 and the HSR Advisory Group, 2013). It follows that a formal and comprehensive appraisal approach is required to help public infrastructure decision makers with selecting a financing approach that is in the best interest of society. The framework being proposed herein aims to achieve this objective and addresses long-standing gaps in financing appraisal approaches.

1.4 Summary
The choice of financing instruments has different costs and benefits. This is because capital markets are imperfect. The financing of large public infrastructure projects usually involves large amounts of money. A suboptimal financing decision can impose significant impacts on the broader society within a country, such as excessive financing costs, moral hazard, intergenerational inequity, and political backlash (such as union action and social unrest). The stance adopted in this study is that the financing decision should be considered from a societal and full economic impact perspective, akin to the rigour applied to project appraisals. However, such a financing appraisal methodology does not appear to exist for large-scale public infrastructure projects, such as the possible Australian HSR project. In the absence of a complete and consistent framework, there is the potential for suboptimal choice to be made. These complications have led to a call by economists and commentators for a
balanced trade-off appraisal process for financing approaches. Hence, there is clearly a need for developing a framework that takes all of these complexities into consideration.

In view of the above, this study aims to develop a multi-criteria appraisal framework that considers a broad range of impacts in order to aid the selection of a public infrastructure financing approach which is in the best interest of society. The proposed appraisal method requires the weighting and rating of a set of monetary and intangible criteria by an expert panel, supported by detailed analysis. The set of economic appraisal criteria consists of the cost of capital, society’s claim on project revenues, contingent liabilities, impact on credit rating, cost of project delay, administration and transaction costs, and taxes foregone. The main social criteria are: fairness, flexibility, stakeholder support, accountability and transparency, and degree of ownership and control. The framework modifies and builds on the standard approaches used for public infrastructure project appraisals. It also involves converting most of the criteria into a monetary unit (Effective Cost of Financing) akin to a BCA method, while the remaining intangible criteria are rated and combined into an overall assessment through the application of weights, thereby providing public sector decision makers with a MCA-type summary appraisal by financing approach. The framework was designed to assist public policy formulators and decision makers at any level of government in making a balanced and transparent decision that can be justified in terms of the economic and societal factors involved. In addition, the framework developed from this study is intended to help public policy decision makers with comparing the full array of financing instruments, ranging from the different forms of debt on the one end of the spectrum, to accumulated reserves on the other end, together with all forms of derivative instruments in between.

The research applies a theory-building methodology that relies on various iterations of exploratory and descriptive literature reviews, augmented by case studies and consultation with industry, academic and policy experts in the field of public infrastructure. The chapters are structured as follows: Chapter 2 presents an overview of contemporary public infrastructure financing theory and practices; Chapter 3 explains and justifies the research methodology adopted; Chapter 4 selects HSR as an example of large public infrastructure projects and explores how financing decisions were made for a range of international case studies; and Chapter 5 examines how public infrastructure projects are appraised to identify trends, lessons and potential elements that can inform the development of the appraisal framework. The last three chapters present various elements of the framework. Chapter 6
discusses a classification of financing instruments, while Chapter 7 introduces the full set of framework criteria. Chapter 8 combines these components, outlines the way in which they are operationalized and considers the societal impacts of a high-level application of the framework for a hypothetical HSR project linking the East Coast of Australia. Chapter 9 concludes the thesis with summary findings and future research aspects.
2 Examination of Financing Theory and Appraisal Practices

2.1 Introduction

An initial review of the literature demonstrated the need for a comprehensive and systematic financing appraisal framework for large public infrastructure projects. Preliminary research also indicated that appraisal of the financing decision is often flawed and inconsistent with the robust approach used by governments and other actors for selecting in which public infrastructure projects to invest. This chapter explores these aspects in more depth so as to build a stronger foundation for the development of a framework. The chapter considers the links between public infrastructure financing and economic theory, as well as capital market theory. It also examines what contemporary financing appraisal approaches are available for public infrastructure decision makers. The concepts involved in appraising financing alternatives are also reviewed.

This chapter is structured as follows: Section 2.2 commences with a review of economic theory and how it pertains to the financing of public infrastructure; Section 2.3 briefly outlines the evolution of capital market theories and clarifies the view adopted; Section 2.4 discusses the treatment of key financing concepts in public infrastructure literature; Section 2.5 follows with a review of public infrastructure financing appraisal methods; Section 2.6 presents an overview of how public infrastructure projects are appraised in terms of the investment decision and choice of delivery vehicle; and Section 2.7 concludes the chapter with a summary of findings and questions that emerged for further research.

2.2 Background and Theory

In 1776, when Adam Smith published his famous book, An Inquiry into the Nature and Causes of the Wealth of Nations, the role of government became a central part of the study of economics. Public Economics is essentially both a positive and normative study of the part that government plays in economic efficiency and distribution, including aspects such as public expenditure, finance and economic policies. Public Economics is positive and normative in that it not only looks at what government’s effect on the economy actually is, but also how it ought to shape the welfare of society (A Dictionary of Economics, 2013). It touches on elements of political science and moral philosophy (Abelson, 2008). Welfare
Economics offers well-developed normative theory on when governments should intervene in markets and what the effects of such intervention will be (A Dictionary of Economics, 2013). The general theoretical guidance is that government involvement is required in the presence of market failures. The following market failures may be present in the provision of public infrastructure:

- **Externalities**: These are situations where market signals do not adequately mirror the benefits (a positive externality) and/or costs (a negative externality) of a good or service. Left to themselves, therefore, competitive markets are likely to overproduce goods involving negative externalities, and under produce those with positive externalities (Perkins, 2005).
- **Inelastic demand**: The demand for public infrastructure services that are essential in nature is relatively inelastic. Since there are generally few practical substitutes for such services, demand tends to be relatively insensitive to changes in price or cost (Vander Ploeg, 2006).
- **Economies of scale**: The costs of duplicating large systems with high initial capital costs and long payback periods prevents competition, thus resulting in a natural monopoly situation (Vander Ploeg, 2006).
- **Nature of public goods**: The non-rivalrous (additional users of the infrastructure do not hinder the benefits that flow to existing users) and non-excludable (difficult, expensive, or impractical to exclude those who refuse to pay) characteristics of goods of a public nature (Perkins, 2005; Ubbels et al., 2001; Gannon & Smith, 2009).

The clear existence of market failures implies that the allocation of goods and services by a free market is not efficient. Efficient free market provision of public infrastructure may be hampered, for example, by the natural monopolies that frequently exist, the predominance of sunk costs that often hamper competitive supply and the network nature, which may attract mechanisms of central coordination (Kay, 1993). Likewise, the strategic importance of public infrastructure has usually resulted in public involvement to avoid provision by a single dominant private supplier, poor coordination, and insufficient capital investment in a timely manner (Kay, 1993). Government involvement in infrastructure provision is often essential for three reasons: (a) to overcome the potential for supply bottlenecks where the public interest is at risk; (b) to oversee the delivery of necessary infrastructure; and (c) to address those market failures which may result in sub-optimal private investment in infrastructure (Allen Consulting Group [ACG], 2005).
While public infrastructure falls into the broad category of a public good, there are very few examples of pure public goods (such as national defence, or an open-access park) or pure private goods (such as groceries). Rather, most infrastructures tend to be quasi-public or merit goods. Merit goods, such as education, museums and theatres, provide significant benefits to individuals and society as a whole (Nelson, 2005, Vander Ploeg, 2006). Quasi-public goods (such as public transport, water treatment, and highways) have elements of non-excludability and non-rivalry, while also providing substantial benefits to individuals (Nelson, 2005, Vander Ploeg, 2006). Significant transport infrastructure projects such as HSR fall into this category. Government often involves itself in the provision of quasi-public and merit goods, mainly because consumption would be too low if individuals were to pay the full cost themselves. Services such as health care, education, correctional facilities, public housing and courts are usually regarded as social infrastructure (Infrastructure Australia [IA], 2008). Economic infrastructure is regarded as forming part of economic production by businesses and households, and may include water and waste utilities, telecommunications, roads, power, rail, ports, and communications (Merna & Njiru, 2002).

Ideological views differ on the appropriate degree of government involvement in the provision of public infrastructure and the economy. The political spectrum ranges from Libertarians (who believe in a very limited role for government) and socialists (who support a very high degree of involvement by government), with conservatives and social democrats falling somewhere between these two extremes (Abelson, 2008). Given the link between politics and economics, a range of economic views exist, with the prevailing economic view shifting over time. The views of mainstream economists in developed nations have almost turned full circle, from subscription to a minimal role for government for much of the nineteenth century. This was followed by support for increased government involvement for about a century from about 1870, after which the dominant theory was generally reversed to a reduced role for government from the last quarter of the twentieth century. More recently, the impact of the 2008/09 GFC resulted in an increased role for governments that sought to implement various economic stimulus programmes, many of which were in some way reminiscent of Keynesian principles (Stiglitz, 2010).

\[13\] Note that this involves both the infrastructure and operational expenditures.
Table 1 provides a concise overview of the recent history of fiscal policy in developed countries.

Table 1: High-level shifts in mainstream fiscal policy

<table>
<thead>
<tr>
<th>Period</th>
<th>Fiscal policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-World War I</td>
<td>Explicit or implicit fixed budget rules.</td>
</tr>
<tr>
<td>Inter-war years</td>
<td>Expansive fiscal measures to stimulate economy.</td>
</tr>
<tr>
<td>Post-World War II</td>
<td>Flexible Keynesian fiscal policy</td>
</tr>
<tr>
<td>1970s to late 1990s</td>
<td>Fiscal responsibility policies, conservative financing approaches, whereby government finances out of current revenues, as well as public debt limitation rules.</td>
</tr>
<tr>
<td>Since late 1990s</td>
<td>Although not consistently applied in all countries, there is generally a further relaxation of fiscal rules. Increased involvement of private sector in public infrastructure provision.</td>
</tr>
</tbody>
</table>


Table 1 shows that the Pre-World War One years were characterized by fiscal restrictions, such as the balanced budget principle (Chan et al., 2009). This was followed by fiscal measures, and public works projects to help economies recover following the impacts of the Great Depression of the 1930s. After the Second World War, there were once again calls for fiscal policy that is more responsive to changes in economic conditions (Schick, 1998). For example, government borrowing was used for financing most of the major infrastructure projects between the 1950s and the early 1980s (Schick, 1998). However, in the 1970s, there was a return to fiscal tightening in response to concerns over the consequences of the ‘crowding-out’\(^{14}\) effect of spending options (OECD, 1995). Particularly in the 1990s, policies implied that all forms of government expenditure, including capital, should be financed from accumulated revenues, resulting in zero net borrowing. In Europe, concerns about excessive public debt prompted the imposition of strict debt ceilings, such as the

\(^{14}\) Occurs when increased government involvement in a market economy substantially affects the remainder of the market, for example, when excessive public debt leads to increased interest rates and a decline in private investment, as well as overall investment spending in a country. This is discussed in more detail in Section 7.4.4.
Treaty of Maastricht,\textsuperscript{15} which imposed a requirement for National Public Debt to be maintained below sixty per cent of GDP, as well as debt prescriptions in the Growth and Stability Pact.\textsuperscript{16} This had the effect of limiting the amount of financing available for infrastructure investment, which in turn adversely affected economic efficiency (Clark \textit{et al.}, 2002). This resulted in calls for the relaxation of fiscal policies amid concerns about economic performance given the bias against public capital investment (Robinson, 2002). The United Kingdom introduced a new budget framework that made a distinction between current and capital spending in 1998 (Kellerman, 2007). The fiscal ‘golden rule’ requires that, instead of maintaining a cash balance or no public sector debt, government retains an operating budget balance over the economic cycle (Robinson, 2002). However, the ‘golden rule’ is not consistently applied. For example, Australian fiscal policy still requires balanced or surplus cash budgets (PC, 2014). In 2005, reforms to the EU’s Stability and Growth Pact also eased fiscal requirements, whereby austerity measures were relaxed for Member States that were experiencing economic downturns (De Grauwe, 2003). After the GFC of 2008/09, there were further fiscal stimulus programmes and government intervention in order to rescue collapsing banking systems and other industries, such as failing car manufacturers in the United States (Lucas, 2014).

Table 1 demonstrates that the pendulum has swung over time between tight fiscal discipline and more responsive fiscal policy. This has resulted in the development of a range of delivery models for public infrastructure. Finding the optimal role for government in the provision of public infrastructure is not easy, especially for quasi-public goods such as passenger rail, which can be simultaneously a private market product\textsuperscript{17}, while also creating positive or negative externalities. This ‘boundary’ status between the public and private realms explains the many various delivery and financing models emerging over time; ranging from purely public provision (such as the origins of rail in Britain, Canada and Australia in the early nineteenth century) to private delivery models (the rail barons of the late 19th and early 20th centuries in the United States), to the recent wave of PPP models (Nelson, 2005). Involvement of the private sector in financing of public infrastructure has grown in

\textsuperscript{15} The Treaty of Maastricht (officially the Treaty on European Union) was signed in 1992 resulted in the creation of the European Union (EU) and set criteria for countries that wished to adopt the Euro, including targets for inflation and budget deficits (Reuters, 2015).

\textsuperscript{16} The EU’s Stability and Growth Pact was agreed in 1997 and set budgetary rules for member states and built on the Maastricht Criteria. Rules included that total public debt not exceed sixty per cent of GDP or that steps are being undertaken to reduce achieve the maximum level (Reuters, 2015).

\textsuperscript{17} Thus, with the characteristics of excludability and rivalry in consumption.
popularity since the 1990s. One of the important reasons for the growing adoption of PPPs was the desire to move financing costs off governments’ balance sheets in view of fiscal restrictions and limits on government budget deficits (Engel et al., 2010).

Several options exist for government to participate in PPP projects, including the provision of state loans, indemnities and debt guarantees, each with its own advantages and disadvantages (Regan, 2009). Private financing partners also require sufficient financial gains, and need to consider the potentially undesirable characteristics of public infrastructure, such as regulation, safety aspects, and dealing with multiple levels of government (Hann & Mack, 2005). Large-scale public infrastructure developments are associated with a number of risks, in particular: (a) they are capital intensive and need to be well maintained, which may lead to the creation of independent agencies who are often subjected to financial constraints; (b) they have long lead times, with the result that capacity decisions need to be based on expected demand for the service, but levels of demand is often highly uncertain; and (c) they are often provided by multiple levels of government and agencies from different jurisdictions, which can create complexities and inefficiencies in terms of coordination of all parties involved (Van der Loo, 2010).

The role of government in the economy of a country is guided by Public and Welfare Economics. While this provides the basis for determining the extent of government involvement in markets, it offers much less guidance on exactly how governments should intervene in such situations (Vining & Weimer, 2005). Debate continues regarding the optimal mix of public and private involvement in providing public infrastructure. For example, there is presently significant stakeholder resistance to privatization of public infrastructure in various Australian states (Gleeson, 2015; McIlroy, 2015). This is because there are successes and failures evident in all models. For instance, in reviewing the experiences of large-scale public investments in a wide variety of jurisdictions, Vining and Boardman (2008) found that large government infrastructure projects delivered by state-owned enterprises often far exceed their budgets, and that private involvement can lower production costs given the impact of competitive pressures. Focusing on PPPs, Hale (2008) discovered that time, cost and capability advantages form the main case in favour of PPPs. Regan (2009) similarly concluded that the advantages of maintaining PPPs in their present

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18 Also known as ‘off-balance sheet’ financing.
form (such as its potential for greater innovation and risk transfer) significantly outweighs the disadvantages of PPPs.

However, there are also significant pitfalls and failures associated with public-private arrangements, a notable example being that of the London Underground PPP, which allowed for private sector consortiums to take over infrastructure maintenance and rehabilitation of the infrastructure (Gannon & Smith, 2009). Financing consisted of equity contributions by the private consortiums involved (Metronet and Tube Lines), as well as annual government grants. The thirty-year contract was implemented from 2004, yet, by early 2010 both consortiums had collapsed and control of the infrastructure had returned to government (Williams, 2010). In addition to its inability to repay high financing costs, the London Underground PPP failure has generally been ascribed to unnecessarily complex contracts, asymmetric information and a range of factors which introduced questionable risk sharing, performance incentives and moral hazard (Gannon & Smith, 2009; Williams, 2010). Hale (2008) mentions similar potential dangers of delivering infrastructure by way of PPPs, including ‘foggy governance’, issues of accountability, and financial arrangements. Partnering with private entities therefore adds a range of new complications to the selection of a financing approach.

The theory of Public Finance and Public Policy provides the basic building blocks to understand how governments’ financial decisions impact the wider economy and markets. It is important to recall that, in addition to monetary aspects, Public Finance and Public Policy theory introduces intangible and social appraisal criteria for taxation systems (funding mechanisms), which could inform the formulation of appraisal criteria for financing approaches. Common appraisal criteria for taxation systems include efficiency, equity (or fairness), transparency, accountability and certainty (McNutt, 2002; Abelson, 2008; McTaggart et al., 2010). Textbooks on Public Finance and Public Policy usually discuss the high-level principles of government’s overall financial position, which is important contextual information, but which is peripheral to the topic of appraising financing instruments. For example, textbooks such as those of Hyman (1999), Gruber (2007), Rosen and Gayer (2007) and Abelson (2008) discuss the various principles and practices involved in public expenditure and taxation, social welfare and the public interest. These textbooks explain market failure, the economic rationale for government, market regulation, economic growth and the effects of taxes. The impacts of budget deficits on the economy and what constitutes excessive debt is also discussed, as well as various theories regarding the burden
of public debt such as the Neoclassical model and the Ricardian model. Rosen and Gayer (2007) pointed out that much of the theoretical discourse focuses entirely on governments’ financial liabilities, without relating the liabilities to tangible public infrastructure and other assets. This omission may result in highly misleading assessments of a government’s financial position. In sum, Public Finance and Public Policy theory touches on public sector financing aspects, but stops short of providing sufficient detail that could guide the selection of financing instruments for public infrastructure.

2.3 Capital Markets

Some literature on financing public infrastructure and finance theory accepts as a cornerstone the Modigliani-Miller theory (1958). Examples include Klein (1999), Kee and Forrer (2002), Infrastructure Partnership Australia (IPA, 2007) and Lucas (2014). The Modigliani-Miller theory states that, in the presence of perfect financial markets, a project’s capital structure is essentially irrelevant, since the project’s cost of capital is dictated solely by the project’s risk profile and not by whether it uses public or private capital, nor by the choice of financing instrument or any other characteristic of its capital structure. The notion of a perfect financial market is also assumed in other seminal work on financial market theory, such as Irving Fisher’s The Theory of Interest (1930) and J. R. Hicks’ Value and Capital (1939). A perfect financial market exists when a range of requirements are met, including that:

- Firms can borrow and lend as much money as they wish at the rates of interest for various periods prevailing in the loan market (Foldes, 1961).
- Lending and borrowing rates are the same (Cheng Hu, 1980).

Another growing body of knowledge argues that, in reality, financial markets are far from perfect and that financing decisions do matter, because an optimal capital structure can minimize investors’ costs (Guriev & Kvasov, 2009). Theoretical and empirical literature is growing on the imperfections of the capital market, including: the existence of barriers to entry (Ariccia et al., 1999); incomplete markets, asymmetric information and the existence of a risk premium (Tuladhar, 2003); and the fact that there are distinct borrowing and lending interest rates (Wilkes, 1983). Snyder and Luby (2012) demonstrated that market participants also have varying abilities to absorb, diversify and control investment risks, while Chaudhuri and Gupta (2014) held that credit transactions are often interlinked with other transactions such as output and labour transactions, as well as lenders’ monopoly power and imperfect
information regarding their borrowers. Similarly, Guriev and Kvasov (2009) expanded on imperfections on both the firm’s side (asymmetric information, conflicts of interest between management and shareholders) and the side of financial markets (including market power, the need for reputational capital; and economies of scale associated with information accumulation and processing, and thus, the existence of barriers to entry).

Failure to recognize market imperfections and heterogeneity in accessing credit markets can have misleading policy implications (Shoji et al., 2012). Spackman’s (2001) work supports this argument and contends that, while perfect financial markets may exist in theory, institutional structure and relationships are seen as distinctive features of a project in practice. Market imperfections are frequently evident in the financing of public infrastructure, including the under or over pricing of project risk. A case in point is the gap between the private sector’s equity premium and a public infrastructure project’s estimated risk rating (or, the so-called equity premium puzzle) (Spackman, 2001). A number of factors could lead to such a distortion, including contractual complexity related to using private sector equity to finance a public project, the amount of competition in financial markets, as well as other factors such as cyclical changes in investors’ risk appetite and the prevalence of financial engineering and asset leveraging (Spackman, 2001; Jenkinson, 2003; Chan et al., 2009). In sum, financial markets are imperfect and, therefore, the total effective cost of each financing instrument differs. These effective cost differentials can have significantly varying impacts on society, especially where large sums of capital are required to finance public infrastructure.

2.4 Assessment of Public Infrastructure Financing Instruments

The next stage of the literature review involved an evaluation of publicly available studies that set out to analyse the different financing approaches for public infrastructure projects. The following three assessment approaches were identified in the literature:

- Overviews: These studies provide discussions based on a number of attributes including advantages and disadvantages, applications, and case studies. Studies in this category assist in understanding instruments better, yet they do not aim to select a specific financing instrument.

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19 The private sector generally has strong risk aversion and the premium may be a reflection of institutional structure (such as the way that managers are incentivized) and not of economic theory.
• Conceptual frameworks: Includes those studies that provide a high-level conceptual framework or structure. While these studies proposed the different contextual concepts or dimensions to be considered in an assessment, the studies did not necessarily perform any assessment.

• Appraisals: These studies perform an appraisal of financing instruments with the aim of selecting the best alternative based on a set of criteria. Appraisals were further subcategorized into qualitative and quantitative appraisals.

The review found that the literature utilizes a multitude of categorization methods, such as grouping a wide set of alternatives into methods internal versus those external to the public agency (Kitchen, 2004), and traditional versus innovative approaches (ACG, 2003). Other studies focus on a subset of instruments only; for instance, IPA (2007) compared PPPs to local government alternatives, and Brittain (2002) reviewed municipal approaches exclusively. Given the inconsistent use of definitions mentioned earlier, inconsistent classifications commonly occur in these studies. For instance, Brittain (2002) categorized mechanisms that this thesis defines as ‘funding’, such as user fees, under non-debt financing alternatives. The study performed by Kitchen (2004) for the Chinese Ministry of Finance, Canadian Agency of International Development and the World Bank also included delivery vehicles (such as PPPs) and funding mechanisms (such as taxes) within his set of financing alternatives. There are a range of assessment methods with each proposing a different set of appraisal criteria. While the majority of assessments neatly fall into one of the assessment categories, some literature deals with more than one of these aspects. The three main types of assessments identified, these being overviews, conceptual frameworks and appraisals, are discussed below.

2.5 Financing Concepts

This study focuses on the appraisal of financing approaches. Figure 1 illustrates how financing relates to four closely related public infrastructure decisions. Appraisal of a project’s investment decision is different from its financing decision. The investment decision requires filtering of different projects or project options in order to select which one is most beneficial and should therefore be invested in, while the financing decision refers to selection of the immediate source (or sources) of upfront capital to develop the asset.
The need for differentiation between the investment and financing decision has been underscored by early academic literature, including the Fisher Separation Theorem. This holds that a productive investment opportunity that maximizes present value may be determined independently of the best way of financing it (Fisher, 1930). The financing decision is a separate decision from whether an investment will produce net economic benefits and usually follows the investment decision. Financing costs should not be included in a project appraisal, since it constitutes a transfer payment, which does not change a project’s overall economic value. However, since the choice of financing approach has financial and distributional impacts on the society of a country, a separate appraisal of the financing approach is required (IER, 2005).

The other two closely related concepts are funding and delivery. Funding of infrastructure is defined as the revenue stream that repays the upfront capital (in the case of debt or equity) or is accumulated to build up capital (in the case of reserves). For instance, a toll road financed through a mix of private sector debt and equity might be funded by toll charges from users of that asset. Delivery is defined as making a decision about who should be responsible for providing (and financing) the infrastructure. The end-to-end delivery process includes the development of specifications, procurement, obtaining finance and construction, operating and overseeing provision of a service. Delivery may involve a range of different entities in each of these steps.
A review of financing policy and public sector advisory literature and reports reveals significant inconsistency in the use of these financing concepts. The majority of studies use terms such as financing and funding interchangeably, and make no distinction between the different concepts, as indicated in Table 2. Examples include the General Accounting Office in the USA (GAO, 2002), the Allen Consulting Group (ACG, 2003) and Gannon and Smith (2009). For example, the Allen Consulting Group analysed a range of what they term ‘funding’ approaches, which includes financing instruments. Literature, such as the Ontario Ministry of Public Infrastructure Renewal (Ministry of Public Infrastructure Renewal [MPIR], 2004) and IPA (2007) use the term ‘procurement’, even though it is clear that the authors are referring to the delivery concept.

Table 2 summarizes the definition and use of these terms in fifteen studies that present assessments of a range of instruments in the public infrastructure field. These studies cover the period of 2002 to 2014 and consist mainly of industry and professional documents, such as policy, project-related, and commissioned reports.
<table>
<thead>
<tr>
<th>Source</th>
<th>Study scope</th>
<th>Terminology</th>
<th>Examples of inconsistency</th>
<th>Useful aspects for thesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brittain (2002)</td>
<td>Full range of financing instruments at municipal level for Canadian, USA and European jurisdictions.</td>
<td>Inconsistent</td>
<td>Includes ‘user fees’ (a funding type) under non-debt ‘financing’ alternatives (p.568).</td>
<td>Overview of select financing approaches.</td>
</tr>
<tr>
<td>GAO (2002)</td>
<td>Current and newly proposed financing techniques in USA, including federal, state and local levels of government.</td>
<td>Inconsistent</td>
<td>Uses the term ‘innovative finance’ to refer to any ‘funding’ measure (p.3).</td>
<td>Applied an assessment of financing instruments.</td>
</tr>
<tr>
<td>ACG (2003)</td>
<td>Full range of financing instruments at municipal, state (NSW) and federal level (Australia, overseas developments).</td>
<td>Inconsistent</td>
<td>Uses term ‘financing options’ on table listing five funding approaches (p.52).</td>
<td>Overview of select financing approaches. Suggests a range of criteria for evaluating financing/funding instruments.</td>
</tr>
<tr>
<td>Kitchen (2004)</td>
<td>Full range of financing instruments, at local government level.</td>
<td>Inconsistent</td>
<td>“Governments fund capital expenditures from their own revenues and from external revenue” under section heading ‘financing instruments’ (p.9).</td>
<td>Overview of select financing approaches. Suggests a range of criteria for evaluating ‘financial instruments’ for local government (includes funding and financing concepts).</td>
</tr>
<tr>
<td>MPIR (2004)</td>
<td>Full range of financing instruments, at provincial level (Ontario, Canada). Includes research and best practices from other jurisdictions.</td>
<td>Inconsistent</td>
<td>Uses terms ‘funding’ and ‘finance’ interchangeably to describe special levies (p.34).</td>
<td>Overview of select financing approaches.</td>
</tr>
<tr>
<td>Source</td>
<td>Study scope</td>
<td>Terminology</td>
<td>Examples of inconsistency</td>
<td>Useful aspects for thesis</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>------------------</td>
<td>------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Hanak &amp; Rueben (2006)</td>
<td>Compares a range of traditional instruments with innovative instruments, at local government and state level for transport and water (California).</td>
<td>Inconsistent</td>
<td>Uses terms ‘funding’ and ‘finance’ interchangeably to describe bonds (pp.4–5).</td>
<td>Overview of select financing approaches.</td>
</tr>
<tr>
<td>Vander Ploeg (2006)</td>
<td>Reviews full range of financing instruments at state levels (Canada).</td>
<td>Consistent</td>
<td></td>
<td>Comprehensive definitions which distinguishes terms. Definitions incorporated into thesis definitions. Includes a detailed taxonomy of urban infrastructure financing, funding and delivery approaches.</td>
</tr>
<tr>
<td>IPA (2007)</td>
<td>Focuses on comparing PPPs to public funded/financed across all levels of state.</td>
<td>Inconsistent</td>
<td>Uses the term ‘government funded projects’ (p.3) and later in section, described the same concept as ‘government-financed project’ (p.3).</td>
<td>Overview of delivery vehicles, private versus public finance, funding and delivery.</td>
</tr>
<tr>
<td>Chan et al. (2009)</td>
<td>State level, wider range of financing, funding, delivery concepts. International review.</td>
<td>Partially consistent</td>
<td>While study makes a clear distinction between the definitions of terms ‘financing’, ‘funding’, ‘delivery’; these</td>
<td>Comprehensive definitions that distinguish terms financing, funding, delivery. Incorporated into thesis definitions.</td>
</tr>
</tbody>
</table>

---

20 Government finances a project out of current revenues.
<table>
<thead>
<tr>
<th>Source</th>
<th>Study scope</th>
<th>Terminology</th>
<th>Examples of inconsistency</th>
<th>Useful aspects for thesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gannon &amp; Smith (2009)</td>
<td>Focuses on PPPs in UK, local government.</td>
<td>Inconsistent</td>
<td>Uses terms ‘funding’ and ‘finance’ and ‘delivery’ interchangeably. For instance, grant ‘funding’ is listed as a category on a spectrum of ‘financing’ options (p.5).</td>
<td>Overview of financing aspects of PPP delivery.</td>
</tr>
<tr>
<td>Ernst &amp; Young (E&amp;Y) (2011)</td>
<td>Focuses on funding role of superannuation industry in public infrastructure for Australia, compared to international examples.</td>
<td>Consistent</td>
<td></td>
<td>Comprehensive definitions and making the point that concepts are often confused, with useful examples from media.</td>
</tr>
<tr>
<td>PC (2014)</td>
<td>Presents an inquiry into methods for attracting private financing for Australian infrastructure.</td>
<td>Consistent</td>
<td></td>
<td>Clear set of definitions of financing aspects, including instruments.</td>
</tr>
</tbody>
</table>

2.5.1 Overviews

A substantial body of knowledge is available that provides an overview of financing instruments, including trends, policy issues, and strengths and weaknesses of the different financing instruments, often drawing from a range of international public infrastructure experiences. Some overviews are relatively short, such as the brief overviews in Merna and Njiru (2002) and Brittain (2002). Other overviews are more detailed, for instance that of Chan et al. (2009) and Vander Ploeg (2006), which consists of over 150 and 120 pages each respectively, and includes detailed taxonomies of public infrastructure financing, funding and delivery approaches. A number of overviews incorporate qualitative attributes in their reviews, although these overviews do not appraise or select instruments. A summary of sources that provide overviews of a range of financing instruments are shown in Table 3.
Table 3: Overviews

<table>
<thead>
<tr>
<th>Source</th>
<th>Financing categories</th>
<th>Useful aspects for this study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brittain (2002)</td>
<td>• Non-debt financing&lt;br&gt;• Traditional debt financing&lt;br&gt;• ‘New’ debt financing (including revenue bonds and zero coupon bonds)&lt;sup&gt;21&lt;/sup&gt;&lt;br&gt;• Innovative financing&lt;br&gt;• Other</td>
<td>Description of financing alternatives, advantages and disadvantages.</td>
</tr>
<tr>
<td>Merna &amp; Njiru (2002)</td>
<td>• Public finance from general taxation &amp; borrowing&lt;br&gt;• Private finance&lt;br&gt;• PPP in financing</td>
<td>Advantages, disadvantages and practical considerations for financing approaches.</td>
</tr>
<tr>
<td>MPIR (2004)</td>
<td>• Traditional Capital Procurement (by government) from general revenues or debt&lt;br&gt;• Various PPP models</td>
<td>Framework components for identification and selection of financing alternatives in terms of guiding principles. Overview of infrastructure planning, financing and procurement models.</td>
</tr>
<tr>
<td>de Alth &amp; Rueben (2005)</td>
<td>• Pay-As-You-Go (PAYGO)&lt;br&gt;• Leasing and private provision&lt;br&gt;• Borrowing.</td>
<td>Description of circumstances under which financing approaches are usually applied.</td>
</tr>
<tr>
<td>Hanak &amp; Rueben (2006)</td>
<td>• PAYGO&lt;br&gt;• Design build&lt;br&gt;• Debt</td>
<td>Considerations to aid selection of best financing alternative.</td>
</tr>
<tr>
<td>Vander Ploeg (2006)</td>
<td>• PAYGO</td>
<td>Taxonomy and detailed overview of financing instruments including their considerations.</td>
</tr>
</tbody>
</table>

<sup>21</sup> Revenue bonds and zero coupon bonds are explained in Section 6.6. A zero coupon bond does not require any interest payment, sold at a discount and redeemed at par upon maturity (Brittain, 2002).
<table>
<thead>
<tr>
<th>Source</th>
<th>Financing categories</th>
<th>Useful aspects for this study</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Borrowing</td>
<td>respective advantages, disadvantages, key success factors and applications of each approach.</td>
</tr>
<tr>
<td>Chan et al. (2009)</td>
<td>• Budget appropriations</td>
<td>Overview of applications and trends, policy issues, strengths and weaknesses of various financing approaches.</td>
</tr>
<tr>
<td></td>
<td>• Specific purpose bonds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Off-budget financing by government businesses</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Development contributions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• PPPs</td>
<td></td>
</tr>
<tr>
<td>Gannon &amp; Smith (2009)</td>
<td>• PPPs</td>
<td>Overview of PPPs, including its various advantages and disadvantages.</td>
</tr>
<tr>
<td>Abelson (2011)</td>
<td>• Taxation</td>
<td>Overview of advantages and disadvantages of a range of financing instruments, as well as how funding and financing instruments are related.</td>
</tr>
<tr>
<td></td>
<td>• Consolidated revenue</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Infrastructure levies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Public sector borrowing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• General bonds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Infrastructure funds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Infrastructure revenue bonds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Public enterprise borrowing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Private sector financing (debt; equity, and mixed).</td>
<td></td>
</tr>
<tr>
<td>E&amp;Y (2011)</td>
<td>• Superannuation financing instruments</td>
<td>Description and discussion of the role of the superannuation industry in public infrastructure financing (for Australia and other international examples).</td>
</tr>
<tr>
<td>PC (2014)</td>
<td>• Public finance</td>
<td>Description of a wide range of financing instruments, contrasts a subset of potential private financing proposals with summary findings.</td>
</tr>
<tr>
<td></td>
<td>• Budget appropriations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• General purpose government borrowing</td>
<td></td>
</tr>
<tr>
<td>Source</td>
<td>Financing categories</td>
<td>Useful aspects for this study</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------</td>
<td>-------------------------------</td>
</tr>
</tbody>
</table>
|        | • Project-specific infrastructure bonds  
|        | • Private finance    
|        | • Equity             
|        | • Debt               |                               |

2.5.2 Conceptual Frameworks

Of the fifteen most relevant studies reviewed, three provide helpful conceptual frameworks that contribute a systematic breakdown of the different dimensions involved in analysing financing approaches. Each of the studies provides guidance on different levels of an appraisal, as follows:

- Where finance fits into the overall investment decision.
- Where to start, and the order of key decisions around financing, funding and delivery.
- What information is required in a systematic and principled finance selection process?

It is useful to understand where financing decisions fit into the broader infrastructure investment decision-making process. The first report that sets out a simple conceptual framework depicting the interaction between efficiency in investment, financing, funding and delivery, is that of Chan et al. (2009). The framework conveys the different aspects of public infrastructure investment, and is helpful in clarifying and visually communicating how these different aspects are linked, as indicated in Figure 2. However, as was discussed earlier in Section 2.3, this report’s definition of efficiency appears to imply that capital markets are efficient. While elements of the framework could be incorporated into development of an appraisal framework for financing approaches, an adjustment would be required in order to reflect capital market failures.
Figure 2: Efficiency considerations of good investment decisions

Efficient investment:
Allocative efficient if the investment has the highest net benefit relative to other investments

Efficient funding:
Allocative efficient if funds in the investment have the highest return relative to other use of funds including lower taxes
AND
Subsidy is set at level which equates the cost of public funds to the additional benefit of lower user charges

Efficient financing:
Protectively efficient if project risks are allocated to those best able to manage risks
AND
Transaction costs at a level where additional costs are justified in terms of lower net risk and/or efficiency pay-offs from better information

Characteristics to consider for efficient financing:
• Risk management – allocation of project risks
• Transaction costs, including delay costs
• Information asymmetries
• Flexibility to respond to changes


The second report that provides a helpful decision-making framework that conceptually distinguishes and links the three key decisions involved in public infrastructure development is that of Vander Ploeg (2006). This report also refers to the three related components of funding, financing and delivery and goes further by classifying the two boundary classes for each of these aspects, called the ‘rule of two’. The ‘rule of two’ holds that that there are only two boundary ways to finance, two ways to fund, and two ways to deliver infrastructure. The report also presents a decision matrix (Refer Figure 3), which includes a checklist for decision makers to ensure that they have the information needed to make a logical match between financing, funding and delivery and the key characteristics of the public infrastructure asset in question, such as its size and marketability.
Figure 3: Conceptual framework of major public infrastructure decisions

Although the works of Chan et al. (2009) and Vander Ploeg (2006) were helpful in facilitating a greater understanding of how the high-level concepts of funding, financing and delivery fit together, a report by Ontario’s Ministry of Public Infrastructure Renewal (MPIR, 2004) provides the next level of detail. The MPIR (2004) document establishes a more practical framework, namely the Infrastructure Planning, Financing and Procurement (or IPFP) framework. The IPFP prescribes the information required by government to evaluate investment planning, financing and procurement. The foundation of the framework is a set of five guiding principles, which have to be explicitly referenced in any public infrastructure proposals being submitted for approval to the Ontario government. These principles are listed and described as follows (MPIR, 2004):

Source: Based on Vander Ploeg 2006, p.21.
• Protection of the public interest: this concept speaks of efficient delivery, promotion of quality public services that are accessible to all, and the protection and promotion of public health and safety.
• Value for money: this refers to cost effectiveness, optimal risk allocation, on time and within budget completion.
• Appropriate public control or ownership: these aspects are regarded as especially important for hospitals, water/sewer delivery, and public schools.
• Accountability: entails clear lines of accountability and responsibility, transparent reporting, and measurable performance metrics.
• Fair, transparent and efficient processes: in particular, bidding processes, contractual agreements, guidelines and public disclosure need to meet these requirements.

Furthermore, a set of criteria is proposed for government in their assessment and selection of a preferred financing and procurement approach, as follows (MPIR, 2004):

• Financial, or cost effectiveness.
• Technical, or practical solutions that meet public service delivery requirements.
• Operational considerations.
• Public policy, including legislative or regulatory constraints.
• Implementation issues or constraints.

Table 4 summarizes the results of the three studies that contained conceptual frameworks.

Table 4: Conceptual frameworks

<table>
<thead>
<tr>
<th>Source</th>
<th>Financing categories</th>
<th>Useful suggestions for this study</th>
</tr>
</thead>
</table>
| MPlIR (2004)      | • Traditional capital procurement (by government) from general revenues or debt  
|                   | • Various PPP models                                     | Considerations for identification and selection of financing alternatives in terms of guiding principles. Overview of infrastructure planning, financing and procurement models. |
| Vander Ploeg (2006) | • Pay-As-You-Go (PAYGO)  
|                   | • Borrowing                                              | Decision-making framework that links financing, funding and delivery to characteristics of infrastructure, including size; up-front costs; and complexity. Taxonomy and detailed overview of approaches, including advantages, disadvantages, key success factors and applications of each approach. |
| Chan et al. (2009) | • Budget appropriations  
|                   | • Specific purpose bonds (securitised borrowing)         | Explanation of interaction between efficiency in investment, finance and funding. Overview                                                        |
2.5.3 Quantitative Appraisals

Three studies were identified that employ quantitative criteria to compare financing options. First, a testimony prepared by the United States General Accounting Office before the Committee on Finance in the US Senate (GAO, 2002) compared the costs that governments or GTEs would incur when they apply four alternative financing instruments, namely grants, tax credit bonds, tax-exempt bonds, and direct federal loans. The costs are expressed in Net Present Value (NPV) and consist of an accounting cost analysis, as opposed to a full economic cost analysis, of direct financing costs such as repayments and tax credits. The study concluded that grants had the lowest financial cost implications, given they do not require any interest payments.

Second, ACG (2003) employed the Monash Multi-Regional Forecasting model (MMRF) to assess instruments that include a mix of financing and funding instruments. The MMRF22 model, developed by Monash University in Australia, is a dynamic multi-regional, multi-sectoral Applied General Equilibrium (AGE) model of the Australian economy. The model examines the impact of additional infrastructure being financed, as well as the burden imposed upon the economy to pay for it. The report examined two scenarios: an investment equivalent to AUD 200 million every five years, and an investment equivalent to AUD 5 billion every five years. The results were measured as the gains to government from each approach in terms of the Net Present Value (NPV) of changes in the Gross Domestic Product (GDP) and in job creation over the investment period. It was found that government debt is the preferred financing instrument for both scenarios. However, the use of general equilibrium models is controversial on account of criticisms relating to the determination of the point of equilibrium, risk of double counting, inconsistency in calculations, lack of

<table>
<thead>
<tr>
<th>Source</th>
<th>Financing categories</th>
<th>Useful suggestions for this study</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Off-budget financing by government businesses</td>
<td>of applications and trends, policy issues, strengths and weaknesses.</td>
</tr>
<tr>
<td></td>
<td>Development contributions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PPPs</td>
<td></td>
</tr>
</tbody>
</table>


22 The MMRF model is frequently used by both public and private sector entities in the appraisal of major developments. For example, the MMRF is currently operated by the NSW Treasury and is often used to appraise the economy-wide impacts of policy issues, including an assessment of the Sydney Olympic Games (ACG, 2003).
transparency and the relative immaturity of models (Dixon, 2009; Tavasszy, et al., 2011; Hof, 2012). In addition, MMRF uses GDP as a measure. However, GDP is not an appropriate criterion for many public projects, since it does not account for a number of factors which apply to public infrastructure such as externalities, non-marketed goods, and national versus foreign interests (Abelson, 2008).

The third study that used quantitative information to compare different financing approaches was a collaborative study by Infrastructure Partnerships Australia, the Allen Consulting Group, and the University of Melbourne (IPA, 2007). The study compared the performance of PPPs with traditional public sector financed projects in terms of optimism bias. Optimism bias was measured on the basis of how well an approach achieved its budgeted construction costs and delivery timeframes. The study concluded that PPPs are preferred, given their better performance in terms of both costs and delivery timeframes.

Table 5 summarizes the quantitative appraisal findings, as well as useful aspects for this study.

Table 5: Quantitative appraisals

<table>
<thead>
<tr>
<th>Source</th>
<th>Appraisal criteria</th>
<th>Appraisal findings</th>
<th>Useful aspects for this study</th>
</tr>
</thead>
</table>
| GAO (2002) | • Principal and interest payments  
• Tax credits and taxes forgone | Selected grant funding based on lower accounting costs. | A range of monetary appraisal criteria (total financial costs). |
| ACG (2003) | • General equilibrium modelling | Debt was found to be optimal. | A range of quantitative and qualitative appraisal criteria. |
| IPA (2007) | • Efficacy/effectiveness: Optimism bias in terms of cost, and time overruns | PPP projects were not subject to optimism bias to the extent witnessed in traditional projects | Quantitative appraisal criterion. |


There are other forms of quantitative appraisals of financing approaches that are commonly performed, but which were not included in the literature review for a variety of reasons. This includes appraisals of financing requirements from the viewpoint of individual entities as opposed to society. Examples include public sector treasury corporations that provide financing to states for delivery of infrastructure. Public sector treasury corporations typically
model the financial costs of various forms of financing alternatives as monetary policy and other cost of capital factors change over time. Merchant bankers also apply sophisticated financial appraisals of different sources of financing for financing of public infrastructure that involves private parties, or PPPs. However, both types of appraisals are performed purely from the perspective of the particular financier and not from a societal perspective, and consider only the financial impacts and not full economic cost. These models are also usually not available in the public domain. In addition, the capital needs for public infrastructure during the assets lifetime (including planning, construction and operation) are also commonly determined by the parties involved in its delivery and financing. Figure 4 shows an example of such an assessment for the city of Toronto (Brittain, 2002).

Figure 4: Illustrative capital requirements for City of Toronto

![Illustrative capital requirements for City of Toronto](image)


Governments also have to track the anticipated requirements for possible new public debt financing, based on the relationship between capital needs and sustainable base funding. Figure 5 shows the example of such an analysis for the city of Toronto, with base funding defined to include baseline debt, reserves, and direct operating contributions.
While these analyses are important in understanding and planning for changing capital requirements over time, they do not offer guidance on how to select the best financing approach for meeting these requirements from a societal point of view. For all of the above reasons, such appraisals were not explored in the formulation of an appraisal framework.

2.5.4 Qualitative Appraisals

Four of the studies reviewed offer comparisons of financing instruments based on a number of qualitative criteria, with the aim of selecting a financing approach. This included studies by the Allen Consulting Group (ACG, 2003), Kitchen (2004), IPA (2007) and PC (2014). The qualitative criteria applied in these comparative studies overlap significantly. For example, the concepts effectiveness, efficiency, fairness (or equity), transparency, accountability and cost containment appear in some form in all the above studies. The appraisals were often performed by the authors or other experts given their subjective judgments and political-economic ideology. For instance, Kitchen’s appraisal was premised on the ‘benefits received model’. This model asserts that, whenever a direct link is made between the users of public infrastructure and its funding, this improves efficiency, accountability, transparency, and fairness (Duff, 2003; Kitchen, 2004). The majority of the literature in this group furthermore only provides general comments regarding the performance of each instrument in terms of each study’s sets of qualitative criteria. One
study by the Allen Consulting Group on behalf of the Property Council of Australia (ACG, 2003) performed an explicit and transparent qualitative appraisal of the various instruments, resulting in a rating for each approach, as depicted in Table 6. Apart from Infrastructure Partnerships Australia (IPA, 2007), which found that private financing through a PPP is preferred, the other three comparative studies fail to select a clear winner, and conclude that the answer depends on the circumstances. However, the appraisal performed by IPA (2007) has limited application for this thesis, given that it only considers two high-level financing categories (private versus public financing), based on one main criterion (efficiency\(^{23}\)).

Table 6: Allen Consulting Group appraisal summary

<table>
<thead>
<tr>
<th>Criteria</th>
<th>State Taxes</th>
<th>Municipal Taxes</th>
<th>Debt</th>
<th>User Charges</th>
<th>Producer Levies</th>
<th>SPV(^{24})s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective?</td>
<td>√</td>
<td>X</td>
<td>√</td>
<td>X</td>
<td>√ – ?</td>
<td>?</td>
</tr>
<tr>
<td>Efficient?</td>
<td>X</td>
<td>√</td>
<td>X</td>
<td>√</td>
<td>X</td>
<td>√</td>
</tr>
<tr>
<td>Fair/Equitable?</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>X</td>
<td>√</td>
</tr>
<tr>
<td>Reliable?</td>
<td>√</td>
<td>X</td>
<td>√</td>
<td>√</td>
<td>X</td>
<td>√</td>
</tr>
<tr>
<td>Low Administration Cost?</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>X</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Low compliance costs, certain, transparent?</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Stakeholder support?</td>
<td>X</td>
<td>√</td>
<td>X</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>2-3</td>
<td>4-5</td>
</tr>
</tbody>
</table>

Source: ACG 2003, p.73.

Table 7: summarizes a review of these appraisals, as well as useful insights for this thesis. The qualitative criteria are fairly consistent across studies and overlap significantly. These criteria appear to be borrowed from the criteria commonly used in Public Economics textbooks to evaluate taxation systems (funding concepts), such as efficiency, fairness,

\(^{23}\) The term ‘efficacy’ was used in the IPA (2007) report.
\(^{24}\) Special Purpose Vehicle, usually associated with PPP delivery.
administratively simple and politically responsible (Abelson, 2008; Baily, 2002; Rosen & Gayer, 2008). The qualitative comparisons were all based on subjective appraisals made by experts. These appraisals usually did not involve rating, ranking or operationalization\textsuperscript{25} of the effects of instruments in terms of the criteria.

\textsuperscript{25} Operationalization is defined as the process of translating a concept to a measure which would allow empirical observation (Neuman, 2011). For example, the definition of performance indicators operationalizes a conceptual criterion, such as ‘cost of capital’.
Table 7: Qualitative appraisals

<table>
<thead>
<tr>
<th>Source</th>
<th>Criteria</th>
<th>Appraisal findings</th>
<th>Useful aspects for this study</th>
</tr>
</thead>
</table>
| ACG (2003) | • Effectiveness  
• Efficiency  
• Equity  
• Stability/reliability of the revenue base  
• Certainty and transparency  
• Stakeholder support  
• Administration costs  
• Cost of compliance  
• Cost of compliance | Qualitative assessment: No clear best approach. Four approaches scored 5 out of maximum score of 7. | The following qualitative criteria were reflected in the qualitative criteria:  
• Effectiveness  
• Equity  
• Stability/reliability of the revenue base  
• Certainty and transparency  
• Stakeholder support  
The following criteria were reflected in the monetary criteria:  
• Efficiency  
• Administration costs  
• Cost of compliance |
| Kitchen (2004) | • Efficiency  
• Accountability  
• Transparency  
• Fairness  
• Ease of administration | Strong arguments for borrowing (bonds), mainly because future generations pay for the infrastructure over time, rather than upfront. | The following qualitative criteria were reflected in the qualitative criteria:  
• Accountability  
• Transparency  
• Fairness  
The following criteria were reflected in the monetary criteria:  
• Efficiency  
• Ease of administration |
<p>| IPA (2007) | • Efficacy (effectiveness) in terms of optimism bias in cost overruns and time overruns. | PPP projects were not subject to optimism bias to the extent witnessed in traditional projects. | The effectiveness aspects considered were reflected in the monetary criteria as contingent liabilities and project delays. |</p>
<table>
<thead>
<tr>
<th>Source</th>
<th>Criteria</th>
<th>Appraisal findings</th>
<th>Useful aspects for this study</th>
</tr>
</thead>
</table>
| PC (2014) | • Risk management  
• Transaction costs  
• Exposure to market or other disciplines (including transparency and accountability concepts) | Each approach had strengths and weaknesses in terms of criteria. | The following qualitative criteria were reflected in the qualitative criteria:  
• Accountability  
• Transparency  
• The following criteria were reflected in the monetary criteria:  
• Risk management  
• Transaction costs |

Source: Based on Henn *et al.* 2012, pp.19–22.
2.6 Public Infrastructure Project Appraisals in the Literature

Section 2.4 summarized the way in which financing has been appraised in the literature reviewed. This section turns to the way in which projects’ investment and delivery decisions are made. The investment decision involves an appraisal of public infrastructure projects in order to make the decision about which project (or project scenario) to invest in. An investment decision is regarded as economically productive if the investment choice maximizes present value, or delivers the highest risk adjusted Net Present Value (NPV) in comparison to alternatives (Fisher, 1930; Diakoulaki & Karangelis, 2007; Hunsucker, 2012). A public infrastructure project requires the appraisal of more than just the financial considerations, because it is expected to add to community welfare (Martin, 1997; Barfod et al., 2011; Suksri et al., 2012). This concept is explored in more detail in Chapter 5. Figure 6 shows how the investment decision relates to the other decisions involved in public infrastructure projects.

Figure 6: Project appraisal in context of other public infrastructure decisions

![Diagram of project appraisal decision-making process]

Source: Based on Henn et al. 2012, p.2.

Public infrastructure policy makers and planners employ project appraisals in order to inform the investment decision. Two main project appraisal categories are evident in the public
infrastructure domain, these being Benefit-Cost Analysis (BCA) and Multi-Criteria Analysis (MCA) (also known as Multi-Criteria Decision Analysis, or MCDA) (Tudela et al., 2006; Barfod et al., 2011). BCA is the most commonly used appraisal method for large public infrastructure projects. However, MCA is becoming increasingly popular on account of its ability to formalise the inclusion of multiple criteria (including intangible aspects) of a range of stakeholders (Tudela et al., 2006). A number of aspects regarding appraisal of the investment decision are transferable to the appraisal of the financing decision. Therefore, the investment decision is discussed in more detail in Chapter 5.

A review of the literature on how the delivery vehicles for public infrastructure projects are selected showed that a Value-for-Money (VFM) appraisal is the most prominent mechanism (IPA, 2007). A VFM assessment essentially appraises the full economic impact of varying degrees of private versus public involvement in the delivery of public infrastructure. Figure 7 shows the way in which the delivery decision relates to the three other closely-related major decisions involved in the financing of public infrastructure.

Figure 7: Appraisal of the delivery aspect of a project.

Source: Based on Henn et al. 2012, p.2.

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26 The terms ‘Cost-Benefit Analysis’ (CBA) and ‘Benefit-Cost Analysis’ (BCA) were generally used interchangeably in the literature. The convention used in this study is to use BCA except where quoting directly.
The delivery decision involves benchmarking of the NPV of delivery through a PPP vehicle against the NPV of the same project should government deliver it. A VFM appraisal requires the calculation of a public sector benchmark against which to compare private or PPP delivery. This benchmark is called the Public Sector Comparator (PSC), which is a discounted cash-flow analysis of the estimated full cost of a project’s construction and ongoing operations, including the value of any risk transferred to the private sector (IPA, 2007). Samples of risk transfer associated with PPP delivery include shifting the full risks involved in the design, construction risk and performance of the infrastructure to a private supplier; in other words, the private entity carries the risk for designing and constructing the infrastructure, followed by performance and reliability of the service throughout its usage period (Kee & Forrer, 2002). However, the use of the PSC has a range of limitations, including the availability of relevant data and the influence of the discount rate and risk valuation methods adopted on results (PC, 2014). The appraisal of the delivery decision which is based on a PSC benchmark is less comparable to the way that financing is appraised. Therefore, this aspect was not reviewed in further detail.

In sum, this brief review indicates that there are generally accepted and mature methodologies for evaluating and selecting the optimal infrastructure projects and project delivery vehicles. This includes appraisals to inform the investment decision, which apply methodologies such as the well-known BCA method, and more recently, MCA techniques. Similarly, the appraisal of various delivery vehicles is contained in a large body of knowledge, in particular, to inform the choice between public delivery or PPP delivery.

2.7 Main findings
A review of the theory, concepts and appraisal approaches applied for evaluating financing alternatives revealed gaps, inconsistencies and weaknesses in current financing appraisal theory and methods. Public and Welfare Economics provide principles for assessing an appropriate role for government in the economy and markets. Public Finance and Public Policy textbooks also introduce appraisal criteria for taxation systems (a funding concept) which are in the best interest of society, including non-tangible aspects such as fairness, transparency and accountability, and efficiency. However, there is no clear theoretical guidance for public sector decision makers regarding the selection of a financing approach for public infrastructure which is in the best interest of society. This leaves public sector decision makers without a strong theoretical basis for considering the role of government in
financing public infrastructure and how to select financing approaches which are in the best interest of society. The study aims to address this gap. This finding leads to questions about how public sector decision makers go about selecting financing approaches for public infrastructure projects, in the absence of a theoretical basis.

The review found that the majority of the literature was not rigorous or careful in the use of the terms ‘financing’, ‘funding’ and ‘delivery’. Instead, there were widespread inconsistencies in the use of concepts and classifications, all of which creates problems when the literature evaluates and compares alternatives deemed to be financing, but, in fact, include funding and delivery aspects. These aspects need to be addressed in the development of an appraisal framework so as to avoid an approach that is marred by inconsistencies, duplication and gaps. A systematic appraisal framework, as a consequence, would require a well-defined set of definitions of the concepts involved in evaluating financing instruments. The question then becomes: how to classify the full range of financing instruments in a systematic way, to assist an appraisal of the full range of alternatives available to public sector decision makers?

The key finding that emerged from the literature review is that there is no readily available comprehensive appraisal framework for large public infrastructure financing instruments or approaches. Instead, the literature review found that the majority of studies that performed some kind of assessment of financing approaches:

- Used a multitude of categorization methods, including grouping alternatives into internal versus external to the public agency; or traditional versus innovative approaches, while others focussed on a subset of instruments only, such as PPPs.
- Applied inconsistent classifications of instruments being assessed, with ‘financing’ classes often including funding mechanisms and delivery vehicles.
- Employed a range of assessment methods, with the scope of studies ranging from assessing select aspects of one particular financing instrument (such as private financing), to approaches which are popular at the time (for instance, ‘innovative financing’), to reviews of a full spectrum of possible options. The depth of assessment was also varied and included overviews of the different considerations for financing approaches, to more in-depth qualitative and/or quantitative appraisals which resulted in the selection of an option, to high-level assessment outlines or frameworks.
- Provided overviews of instruments at a general level. The outcome of these comparisons, however, was inconclusive. Only a small subset performed appraisals with a view to aid the selection of a financing instrument, or optimal set of instruments.

A closer look at the few studies which did perform appraisals of a range of instruments by applying a set of criteria revealed that:

- The qualitative criteria were fairly consistent across studies and overlapped significantly. These criteria appeared to be borrowed from the criteria commonly used in Public Economics textbooks to evaluate taxation systems. Inclusion of these intangible and social aspects is important in appraising a financing approach that is in the best interest of society.

- Qualitative comparisons were based on subjective appraisals made by experts, and did not involve rating, ranking or operationalization of the effects of instruments in terms of the criteria.

- While the literature appears to concur on the qualitative criteria, there is a major discrepancy in quantitative approaches. Two broad quantitative approaches were applied, namely comparison of select cost elements, such as finance servicing costs and project costs, and modelling the impact of financing alternatives on the economy by way of general equilibrium models.

- Only three studies were identified that used quantitative means to evaluate alternative instruments, and thus performed operationalization.

These appraisal approaches were not designed to be adopted in their current form as universal frameworks that would be appropriate for appraising a broad range of financing instruments for any given public infrastructure project in any developed country. First, appraisals were developed for studies that included inconsistent classifications, which included funding mechanisms and delivery vehicles, together with financing instruments. For example, the MMRF model included funding costs. Second, all three appraisal approaches applied a narrow set of criteria. Third, general equilibrium models such as the MMRF may not be suitable for the appraisal of financing instruments. The use of general equilibrium models is controversial as discussed in Section 2.5.3. As a result, general equilibrium models were not researched in further detail.
The inconsistencies observed in financing appraisals prompted questions about how these appraisal methods of financing compare to project appraisal practices, in particular, to how the investment and delivery decisions are made. This was addressed in Section 1.1. This section showed that, in contrast with the status quo of financing appraisals, there are mature and generally accepted economic appraisal methods for the investment and delivery aspects of public infrastructure project appraisals. The appraisal of both of a public infrastructure projects’ investment and delivery decisions make use of systematic decision tools and formal appraisal frameworks. These appraisal methods require the collection of detailed information to support responsible decisions that can be defended with robust and transparent processes. Benefit-Cost Analysis (BCA) and Multi-Criteria Analysis (MCA) are the most popular methods for appraisal of the investment decision. The appraisal of delivery vehicles for public infrastructure employ well-articulated Value-for-Money (VFM) appraisals based on the Public Sector Comparator (PSC) to evaluate the full economic impact of varying degrees of private versus public delivery. Project appraisals also should not include financing costs and benefits, because it is effectively a transfer payment and does not change a projects economic overall economic value (or NPV). At the same time, because different financing approaches impose different financial and distributional costs and benefits on society, a separate appraisal of financing approaches is required. Hence, a key finding of the literature review is that financing appraisals are required, but are less mature and advanced than project and delivery appraisals. There are similarities between the appraisal of the investment decision in order to filter projects and the filtering which is required of financing approaches. This prompts the question: What can we learn from project appraisal methods that could be transferred to assist in the formulation of a financing appraisal framework? This is addressed in Chapter 5.

2.8 Summary

This chapter presented a review of the theory and concepts involved in evaluating financing alternatives and the appraisal approaches available for financing. The main findings were discussed in Section 2.7 and can be summarized as follows:

- There is a gap in theory regarding the selection of a financing approach for public infrastructure that is in the best interest of society.
- The need for rigour in defining and classifying concepts.
- The need for more comprehensive appraisal of alternative financing approaches.
• Project appraisal methods are mature and analogous, and could guide the development of a financing appraisal.
• Current literature contains components that can assist in the development of a financing appraisal framework.

The financing decision is clearly an important one, and hence warrants a formal and balanced appraisal of financing approaches, similar to the rigour that has been applied to the investment and delivery decisions. This requires a well-defined appraisal framework of concepts, definitions and appraisal criteria. Given the inconsistencies and gaps, aspects which require further research include an investigation into the full range of financing instruments that are available for public infrastructure, what criteria should be applied in appraising financing instruments, as well as how to combine these elements into an appraisal approach which would help in the selection of a financing approach. Chapter 3 deals with the research methodology adopted to explore these aspects further.
3 Research Methods

3.1 Introduction
This chapter presents an overview of and justification for the research methodology followed. The research sets out to develop an appraisal framework in view of the gaps in financing appraisal practice and theory. A theory-building research methodology, which was shaped by an interpretive research paradigm, was adopted. The research method involved four-stages and started off as mainly exploratory research, which progressed to mostly assimilative or synthesizing research, in order to develop the required framework. Exploratory research was initially required to understand the research problem better and build the foundation and requirements for development of the framework. Integrative and assimilative research was needed to formulate a conceptual framework, including instrument categories, criteria, an appraisal method and performance indicators. The research method applied entailed the investigation of data that already existed to develop a new appraisal framework. Existing data was gathered in order to examine the relationships between financing aspects, where after the data was manipulated to create a theoretical and conceptual framework. This involved inductive reasoning, whereby a range of particular observations were used to formulate broad generalisations that made up the conceptual appraisal framework. Standard data collection methods had to be tailored for the specific research problem statement. The research relied on a combination of academic and scholarly secondary data, combined with documented evidence for a number of HSR case studies, which were sourced from a range of experts in the relevant field.

The chapter is structured as follows: Section 3.2 introduces the research question; Section 3.3 discusses the justification for the research, followed by Section 3.4, which explains the research methods and procedures adopted and why they were adopted; while Section 3.5 summarizes and concludes the chapter.

3.2 Research Question
Justification for the choice of research paradigm and methodology adopted is found in exploring the nature of the research question and objectives, and the kinds of outcomes that the study is seeking. Therefore, it was important to formulate a clear research question. Chapter 1 discussed the motivation for the research, which in sum was that the financing decision for public infrastructure projects is important, because it involves large amounts of
capital and has substantial implications for society, potentially including excessive financing costs, moral hazard, intergenerational inequity and political backlash. The financing decision is also a complex one, since it requires consideration of a range of complicated alternatives, challenges, risks and stakeholder expectations. The first stage of exploration into financing methods indicated that there are no obvious financing appraisal approaches that are as comprehensive as the project appraisal methods customarily applied to large infrastructure projects. The research question that emerges is: How do we select a financing approach for public infrastructure projects that is in the best interest of society? In other words: from the various alternatives available, what combination of financing instruments, and in what proportions is both economically and socially optimal? Figure 8 shows a summary of the research question and objectives.

Figure 8: Research question and objective

<table>
<thead>
<tr>
<th>Situation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public infrastructure megaprojects require significant capital to be raised amidst a range of challenges, risks and expectations. Selecting the optimal financing alternative is imperative, as the implications of getting the financing mechanism wrong can be substantial.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Complication:</th>
</tr>
</thead>
<tbody>
<tr>
<td>While there is a large body of knowledge with well-defined, consistent and mature project appraisal methods, the literature is less consistent and mature when it comes to offering guidance on the selection of an optimal financing approach for public infrastructure projects.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question:</th>
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</thead>
<tbody>
<tr>
<td>How do we select a financing approach for public infrastructure projects that is in the best interest of society?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Research Objective:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apply a coherent multi-dimensional appraisal framework for choosing a financing approach for public infrastructure projects which is in the best interest of society.</td>
</tr>
</tbody>
</table>

### 3.3 Research Paradigm and Methodology

The research paradigm adopted for a particular study includes the general organizing framework, theory, main issues and models for answering the research question (Neuman,
The research methodology adopted refers to a broad concept which encompasses the methods employed, as well as the rationale for data collection and analysis. A research method refers to the data collection instrument employed, such as surveys, interviews and focus groups (Bryman, 2008). The research paradigm adopted is usually best matched by a specific research methodology and method. In essence, a researcher can adopt either a positivist or interpretive methodology paradigm. Interpretive paradigms seek to answer the questions ‘how’ and ‘why’ through exploration. Interpretive paradigms rely on induction through discovery, theory-building, hypothesis generation and qualitative data analysis (Johnson & Onwuegbuzie, 2004). In contrast, positivist paradigms are explanatory in nature (Gall et al., 2007). Positivist research focuses on deductive processes, in particular the testing, confirmation or prediction of a theory or hypothesis through standardised data collection and statistical analysis (Johnson & Onwuegbuzie, 2004). Interpretive paradigms rely mostly on exploratory and descriptive research, such as literature reviews and case studies to build theory, as opposed to quantitative research techniques (such as regression analysis, surveys and experiments) used in positivist research (Gall et al., 2007). The benefits of exploratory and descriptive research include better identification of themes and potential explanations, and richer in-depth information (Zigmund et al., 2010).

An interpretive research paradigm supported by an integrative, assimilative theory-building research methodology that relied on exploratory and descriptive research methods was selected for this study because such an approach is favoured when the subject is new and no-one has explored it in depth yet (Neuman, 2011). Chapters 1 and 2 demonstrated the lack of a theoretical framework and mature appraisal methodology for selecting financing approaches for public infrastructure, as well as widespread inconsistencies in the use of financing concepts and classifications. Within this context of significant gaps in knowledge, a positivist empiricist approach is not appropriate or viable (Zigmund et al., 2010). Interpretive research paradigms seek to identify which variables are involved in a research problem (Sandberg, 2005). An interpretive research paradigm was appropriate for this study, given that the focus was on identifying the factors, variables and appraisal methods involved in selecting a financing approach that is in the best interest of society. A positivist or explanatory paradigm, which relies on a quantitative research methodology was not applicable. This is because it is only favoured when it is possible to express the precise relationship between variables, and tests theory and propositions (Zigmund et al., 2010; Neuman, 2011).
Theory-building requires exploratory research when there is insufficient information about the research subject, and the process or problem requires illumination in order to suggest the way forward in an uncertain, ambiguous situation (Zigmund et al., 2010; Neuman, 2011). Exploratory research is an essential first step to a more conclusive, confirmatory study and to avoid the formulation of an incorrect, inadequate or misleading hypotheses and research objectives (Zigmund et al., 2010). It often reveals further research questions to be addressed, as was the case for this study. The initial research identified the need for developing an appraisal framework, which amounts to theory-building. Descriptive research entails an investigation of data which already exists to understand relationships between factors better. The data is then interpreted and through inductive reasoning manipulated to formulate a new theory (Denzin & Lincoln, 2003; Johnson & Onwuegbuzie, 2004). In uncertain situations where further insight and better crystallisation of the research problem is necessary (such as the situation that exists for this study), exploratory or descriptive research is more fitting than positivist research. Only once the research problem is properly clarified and synthesized by way of exploratory research can exact measurable relationships and aspects be established by way of positivist research (Zigmund et al., 2010).

3.4 Research Methods and Procedures
A four-staged study design was formulated, as indicated in Figure 9. The first stages entailed predominantly exploratory research to identify and affirm the research question, investigate current financing appraisal theory and methods, and identify the foundational requirements for a framework. The research method in later stages was primarily integrative and synthesizing in nature to formulate and operationalize the framework. Progression through these steps entailed an iterative process of evolution and refinement, where study steps were dependent on the outcome of prior stages, in view of the exploratory nature of the research. The study design was flexible and allowed for changes as the research progressed through its various stages.
Does further investigation affirm the perceived gaps in financing appraisal theory and practices? If “Yes”, then investigate…

Stage 1: Initial Exploration
- First Principles: Imperfect Capital markets, Golden Rule. Need an independent; formal, transparent, systematic, comprehensive and objective appraisal.
- Situation & Complication: Complexity; serious implications; gaps.

Stage 2: Affirm & Build Foundation
- Financing appraisal theory & methods (Chapter 2)
- HSR financing appraisals (Chapter 4)
- Project appraisal practices (Chapter 5)

Stage 3: Develop
- Framework Building Blocks:
  - Stage 2 inputs - foundational requirements
  - Review financing instruments (Chapter 6)
  - Criteria & Performance Indicators (Chapter 7)

Stage 4: Demo
- Illustrative East Coast HSR framework demonstration (Chapter 8)
Reflexivity was embedded in the research design, and is described as the process of reflecting on the learning process that occurs during data analysis, from preconceived theoretical assumptions to the observations actually collected (Scott & Garner, 2012). Reflexivity means that the researcher needs to continuously question and re-question the choices made (Cumming-Potvin, 2013). Since exploratory research seeks to understand an elusive topic better (Neuman, 2011), the study design needs to allow for changes as the topic becomes clearer. Reflexivity requires the researcher to reflect on the learning process that occurred during the data analysis, from preconceived theoretical assumptions to the observations actually collected (Neuman, 2011; Zikmund et al., 2010). As a result, reflexivity may indicate that a shift in the data collection process and analysis strategies is required.

The study design and choice of data gathered were also impacted by the scope of the research. The research scope also dictated the focus of study methods employed. In essence, as alluded to in Chapters 1 and 2, the focus of this research was on developing an appraisal framework to assist public sector decision makers in selecting a financing approach for public infrastructure that is in the best interest of society. Furthermore, the research was also mainly limited to the financing of new infrastructure, within the context of developed nations. The five main scope delimitations are listed and discussed in more detail below:

- The research focused on infrastructure of a public nature. Public infrastructure is broadly defined as long-lived physical assets, or structures, equipment and facilities with high upfront construction costs, where government involvement is required to ensure adequate provision. For the purposes of this study, quasi-public infrastructure and merit goods are included in the definition of public infrastructure. Since the focus is on public infrastructure, the theoretical aspects of appraising private investments were not considered in the research.
- The research scope is also confined to the financing decision. Therefore, the appraisal of alternative delivery vehicles and funding mechanisms were not appropriate for review in formulating the framework.
- The scope is furthermore constrained to the financing of new projects. As a result, the data gathering process was filtered so as to focus on raising capital for the construction of new projects and not the privatization or refinancing of existing projects.
• The framework was developed from the perspective of society as a whole, and how benefits and costs are distributed amongst the nation, as opposed to the interest of individual stakeholders. Therefore, data that dealt with the way in which individual private investors or financiers appraise the financing of public infrastructure was not included in the research.

• The research focused mainly on developed or industrialized countries committed to democracy and a mixed or market economy, all so as to allow for more comparable financial market and economic ideology considerations. The reasons for this decision mainly rested on other country classes having different risk profiles, and thus different benchmark figures. For example, commercial banks in Africa typically demand around four per cent higher lending rates than standard rates in OECD countries (Bhattacharya et al., 2012). Developing countries may also not have access to the same range of financing instruments which are available in advanced economies with mature capital and financial markets. In addition, the financing decision in developing countries is also angled more towards different factors, in particular generating economic progress, progressing political stabilization and providing aid financing, which are not front of mind for developed countries. The focus on developed countries impacted on a range of research aspects, including the choice of case studies and benchmarks used.

In addition, the study design and steps were based on the following assumptions or inferences, which had implications for the entire research design:

• A review of HSR projects is an appropriate lens for assessing the research problem.
• Project appraisal methods provide an appropriate basis for the development of an approach to the appraisal of financing instruments.

First, the study design incorporated HSR in Stages Two and Four. The rationale for this decision was that policy makers typically need to consider a wider array of issues for such projects, and in a way this allows for ‘stress testing’ the framework. Therefore, it was argued that, if it is sufficient to address megaprojects such as HSR, it should also be applicable and perhaps simpler, for smaller projects. HSR projects are generally regarded as ‘megaprojects’. This is because they require billions of dollars in financing and involve many complexities that could feed into the formulation of an appraisal framework, such as multiple stakeholders and levels of government, and cross-country considerations. HSR, being a form of passenger
rail, is also a quasi-public good, a consideration which adds to the richness of observation, since it has led to a variety of financing models that include a wide range of financing instruments. HSR also allowed for observations to be made from a financing history spanning more than five decades. The Australian East Coast HSR financing dilemma was also the main catalyst for performing the research, as explained in the introductory chapter. Further review and application of HSR as a hypothetical case was deemed a natural and appropriate progression and conclusion to the research imperative for a variety of reasons. In sum, it was concluded that a review of international HSR case studies was appropriate and that it was reasonable to assume that, if any frameworks or methodology exist for appraising the financing of these large nation-building projects, they would be applicable to public infrastructure in a more general sense.

Second, it was decided to base the formulation of the financing framework on project appraisal methods. Basing the financing appraisal framework on lessons learnt from project appraisal methods was held to be a reasonable approach, since project appraisal methods and principles are well established. Project appraisal methods for public infrastructure projects have evolved to the point where they consider full societal costs and benefits, as well as other intangible impacts, such as general welfare-enhancing and environmental aspects. Furthermore, project appraisal and selection methods are used to filter different public infrastructure projects or project options to establish which alternative is most beneficial. The a) problem to be solved and b) the type of solution being sought by project appraisal methods are similar to the problem and solution being sought in the financing appraisal. The appraisal of public infrastructure projects is also performed by policy formulators and public sector decision makers, which is the same group of decision makers that this study sets out to assist.

The research process adopted was developed to answer the research question and to meet the research objectives which were discussed in Section 3.2. The nature of the research problem dictated the exploratory and synthesizing or formulate research methods implemented. Together with the research scope delimitations and key assumptions, this resulted in a four-staged research process. The four steps of the research procedure are discussed below.
3.4.1 Stage One

A research process commences with the researcher selecting a topic of interest or importance to him or her. This study was initially prompted by the challenges which were observed in assessing financing approaches for the Australian HSR project. In view of the current focus on how to raise sufficient capital to develop the HSR project in which, the project served as the main research catalyst, and motivated an initial exploration of the current state of financing appraisal practices for public infrastructure. Early exploration of the literature demonstrated that the situation was complex and has potential serious implications for society, further compounded by a lack of existing financing appraisal methods.

Research is also shaped by the perspective adopted on the topic and is based on a researcher’s ideology or fundamental point of view (Kuhn, 1970; Neuman, 2011). The set of basic beliefs or first principles for this study were discussed in Chapter 1 and can be summarized as follows:

- Capital markets are *imperfect* and therefore the effective cost of capital varies between different types of financing instruments.
- The selection of a financing approach which is in the best interest of *society* should consider both economic and social, monetary and intangible aspects.
- An appraisal framework should be *independently* and *objectively* appraised, *robust* over time, and not prejudiced by the political ideology at a particular point in time, since infrastructure financing has long-term implications for society.
- Consideration of social or intangible aspects should be *formally* and *transparently* assessed and included in the appraisal process.

An example of how first principles dictated the study approach is the view that the full costs and benefits to society differs by financing instruments. An alternative perspective that the cost on society does not differ by financing approach, would nullify the need for an extensive appraisal of alternative financing approaches from a societal perspective. Furthermore, should the monetary cost of capital not vary by financing instrument, selection of an optimal financing approach would have required a narrow appraisal of only qualitative or intangible elements. Instead, this research adopts the imperfect financial market view. The total effective cost of each financing instrument differs and, especially where large sums of capital are required, the choice made can have significantly varying impacts on society. As a result,
the research was expanded to analyse and describe both the monetary and intangible factors. This naturally results in a combination of qualitative and quantitative data.

Another example of the impact of the basic beliefs on the research procedures is found by exploring the third principle, which states that the appraisal should not be prejudiced by a particular political ideology. For instance, if a purely libertarian approach is followed, an expansive appraisal is not required from a societal perspective, since it would be assumed that the markets would produce the best outcome and that private financing should always be the first choice for public infrastructure of an economic nature. Following such a libertarian view would mean that a comprehensive appraisal of other financing instruments is not needed. This appears to be the current view adopted in Australia, where there is a noticeable shift towards reliance on private sector financing for public infrastructure (for example, NSW [2011]), as discussed in Section 1.3.

Since the researcher’s perspectives and first principles inform the entire research approach, it is important to identify these aspects upfront. The situation, complication and first principles adopted were discussed in more detail in Chapters 1 and 2. In combination, these aspects led to the conclusion that the formulation of a comprehensive appraisal framework from the perspective of society was required. Hence, the research proceeded to Stage Two, as will be discussed below.

3.4.2 Stage Two

The study was designed to progress through the next three components to affirm the initial findings and build the foundation for development of a framework:

- An investigation into the link between financing appraisal and economic theory, as well as contemporary financing appraisal approaches and methods (refer Chapter 2).
- A review of how financing decisions are made in practice, by reviewing documented evidence from international HSR cases (refer Chapter 4).
- An overview of project appraisal methods and trends (refer Chapter 5).

Depending on whether the Stage One conclusion or initial research problem could be affirmed by the exploratory research contained in Stage Two, the study was designed to proceed to Stage Three. To start, contemporary financing appraisal theory, approaches and methods were examined. A standard comprehensive literature search was performed to review economic and financial market theory, and how it is linked to financing decisions for
public infrastructure. This revealed that there is a gap in economic and capital market theory with regard to how to decide on a financing approach which is in the best interest of society. The lack of theoretical principles helped to explain the apparently *ad-hoc* nature of decision-making which surfaced in Stage One, given that clear theoretical guidance is not available to public sector decision makers.

Thereafter, the current state of financing appraisal approaches and methods in the public infrastructure field – which has been neglected in the theoretical field – was studied (see Chapter 2, Section 2.4). A range of studies that focus on the analysis of financing options for public infrastructure were reviewed. Publicly available and scholarly literature was identified by way of a standard comprehensive literature search. However, given the theoretical gap which exists, a review of industry and professional documents such as policy, project related, and commissioned reports was performed to augment the review. The literature review contained in Section 2.4 of Chapter 2 was therefore not primarily of an academic nature. Literature that presented conceptual guidance for appraisal or contained an appraisal of financing instruments was filtered out for this aspect. Public infrastructure industry experts were also helpful in identifying relevant documents, which did not surface through the regular scholarly literature searches. A selection of knowledgeable individuals who suggested literature are indicated in Table 8.

Table 8: Public infrastructure industry experts consulted

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Area of expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. Michael Regan</td>
<td>Bond University</td>
<td>Public infrastructure</td>
</tr>
<tr>
<td>Prof. Cameron Gordon</td>
<td>University of Canberra</td>
<td>Financing theory and policy</td>
</tr>
<tr>
<td>Prof. Kevin Davis</td>
<td>Australian Centre for Financial Studies (ACFS), University of Melbourne</td>
<td>Financing theory and policy</td>
</tr>
<tr>
<td>Prof. Deborah Ralston</td>
<td>ACFS, University of Melbourne</td>
<td>Financing theory and policy</td>
</tr>
<tr>
<td>Prof. Deborah Lucas</td>
<td>MIT Sloan</td>
<td>Financing theory and policies</td>
</tr>
<tr>
<td>Dr Daniel Mulino</td>
<td>Member of Funding Australia’s Future Forum, an ACFS initiative. Also at Pottinger, Independent Consultants</td>
<td>Public Infrastructure financing policy and innovation</td>
</tr>
</tbody>
</table>
The data obtained was filtered according to the study scope discussed in Section 3.4. This resulted in a base set of fifteen of the most relevant studies as indicated in Table 9: Base set of documents reviewed in Chapter 2. These studies originated from various developed market economies, and span a period of about thirteen years. The fifteen international studies explored in more detail in this stage had one thing in common: they all performed assessments of public infrastructure financing instruments.

Table 9: Base set of documents reviewed in Chapter 2

<table>
<thead>
<tr>
<th>Source</th>
<th>Nature of document</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brittain (2002)</td>
<td>Scholarly article that performed an assessment of a range of financing instruments at municipal level for Canada, USA and European jurisdictions.</td>
</tr>
<tr>
<td>GAO (2002)</td>
<td>A formal analysis of a variety of existing and newly proposed financing techniques in USA, federal; state and local levels of government. Prepared by a government infrastructure body within the General Accounting Office in support of a submission before the USA Senate.</td>
</tr>
<tr>
<td>ACG (2003)</td>
<td>A consulting report commissioned by the Property Council of Australia. Analysed a set of financing instruments at municipal, state (NSW) and federal level (Australia, international developments).</td>
</tr>
<tr>
<td>Kitchen (2004)</td>
<td>Industry paper developed by an independent economic body, the Atlantic Institute for Market Studies. Reviewed a number of financing instruments, at local government level.</td>
</tr>
</tbody>
</table>
As discussed in Chapter 2, the findings from this portion of the research affirmed the original research problem from Stage One. The findings can be summarized as follows:

- The need for rigour in defining terms.
- The need for more comprehensive appraisal of alternative financing approaches for projects.
- Project appraisal methods (which addresses the investment decision) are mature and analogous, and could guide the development of a financing appraisal.
- The documents reviewed contain components which can assist in the development of an appraisal framework.

<table>
<thead>
<tr>
<th>Source</th>
<th>Nature of document</th>
</tr>
</thead>
<tbody>
<tr>
<td>de Alth &amp; Rueben</td>
<td>Policy document prepared by the Public Policy Institute of California. Reviewed a wide range of financing instruments at local government and state level (California).</td>
</tr>
<tr>
<td>(2005)</td>
<td></td>
</tr>
<tr>
<td>Hanak &amp; Rueben</td>
<td>Research paper prepared by the University of Southern California Keston Institute for Infrastructure. Compared a number of traditional instruments with innovative instruments, at local government and state level for transport and water (California).</td>
</tr>
<tr>
<td>(2006)</td>
<td></td>
</tr>
<tr>
<td>IPA (2007)</td>
<td>Focused on comparing PPPs to public funding/financing across all levels of government.</td>
</tr>
<tr>
<td>Chan et al. (2009)</td>
<td>Productivity Commission (Australia) staff working paper. Presented an in-depth examination of a broad range of financing, funding, and delivery concepts, including an international review.</td>
</tr>
<tr>
<td>Gannon &amp; Smith (2009)</td>
<td>Scholarly journal article that focused on PPPs in the UK, mainly at local government level.</td>
</tr>
<tr>
<td>Abelson (2011)</td>
<td>Independent paper by economist and University of Sydney scholar, which discussed a broad spectrum of financing instruments.</td>
</tr>
</tbody>
</table>
This stage of the research design also shows how research methods were modified in light of what had been discovered through exploration. A review of contemporary financing appraisal methods showed that there was no best practice appraisal framework for financing public infrastructure. If a sufficiently comprehensive financing appraisal method could be found, a more appropriate research approach might have been to enhance or refine the method, or to perform a critical assessment of its components, or to apply the appraisal method to a specific project by way of structured expert interviews, including rating and ranking of appraisal criteria. However, given the absence of a sufficiently comprehensive appraisal approach, formulation of a framework was required. Another example of the iterative nature of the research process was that the Stage Two review of financing appraisal practices for public infrastructure revealed that the terminology and classifications involved in financing public infrastructure was inconsistent and vague. Additional research was therefore required to define and classify the concepts researched, before embarking on the formulation of the selection framework. The results of this research are contained in Chapter 2, Section 2.4.

Stage Two proceeded with a more in-depth study of how financing decisions were actually made for specific public infrastructure megaprojects. HSR was selected for case study research, as explained above. Case studies for preeminent HSR projects representing the main centres of the developed world were selected as follows: Europe (with a special focus on France, given its extensive HSR network and a long history of financing which involved a range of instruments); Japan; and the United States. China was also included, given the large size of its HSR programme and the requirement for vast amounts of capital. The case studies involved obtaining evidence of how the public sector went about making financing decisions, as well as how the projects were financed, and factors influencing financing decisions. This phase is another example of reflexivity in the research, when a shift in the study design occurred in relation to the international HSR case studies.

At first, the method to collect this information was envisaged to take the form of surveying and interviewing experts. When this approach revealed the \textit{ad hoc} nature of financing appraisals, and the lack of formalized and documented processes, this meant that individuals were not able to engage effectively in interviews. The inability to perform effective surveys was further exacerbated by the apparent confidential nature of the data, as well as some language barriers. Therefore, the data collection method changed to mainly a review of documented evidence which could be obtained. In addition to a standard comprehensive
literature review, knowledgeable individuals in the HSR field were asked to assist in identifying and obtaining any evidence on aspects such as the composition of financing approaches, how approaches were selected, who selected the approaches, and any analysis of the costs and benefits (or merits) of different instruments. These individuals were identified by approaching local and international rail industry bodies, in particular the Australian Railway Association (ARA) and the International Union of Railways (UIC). As a result, a range of international HSR experts as indicated in Table 10 were requested to suggest literature to inform the case studies.

Table 10: Experts approached

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Area of expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. David Hensher</td>
<td>University of Sydney</td>
<td>Public transport policy and economics, HSR</td>
</tr>
<tr>
<td>Fred Beltrandi</td>
<td>Steer Davies Gleave (SDG) (Public Transport Policy Advisors, Europe)</td>
<td>European HSR</td>
</tr>
<tr>
<td>Toby Cuthbertson</td>
<td>Leigh Fisher (Public Transport Policy Advisors, UK)</td>
<td>Franchise financing of rail industry</td>
</tr>
<tr>
<td>Peter Thornton</td>
<td>Worley Parsons (Public Transport Policy Advisors, UK)</td>
<td>HSR in China, USA and France.</td>
</tr>
<tr>
<td>Dr Peter Howarth</td>
<td>Interfleet (UK)</td>
<td>Public transport policy</td>
</tr>
<tr>
<td>Norman Tickner</td>
<td>Engineers Australia</td>
<td>Consultant to Taiwanese government, HSR programme.</td>
</tr>
<tr>
<td>Brian Nye</td>
<td>CEO, Australian Railway Association</td>
<td>Australian HSR</td>
</tr>
<tr>
<td>Jeff Fountain</td>
<td>Australian Railway Association</td>
<td>International HSR</td>
</tr>
<tr>
<td>George J. Karpouzis</td>
<td>RailCorp (Australia)</td>
<td>Transport economics</td>
</tr>
<tr>
<td>Tomokazu Minesaki</td>
<td>JR Central (Japan)</td>
<td>Japanese HSR</td>
</tr>
<tr>
<td>Richard Farmer</td>
<td>Department of Infrastructure, Transport, Regional Development and Local Government</td>
<td>HSR project manager (Australia)</td>
</tr>
<tr>
<td>Name</td>
<td>Organization</td>
<td>Area of expertise</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>--------------------------------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Jean de la Chappelle</td>
<td>MD, Alstom HSR (Australian offices)</td>
<td>International HSR</td>
</tr>
<tr>
<td>Gen Okajima</td>
<td>Central Japan Railway Company</td>
<td>Japanese HSR</td>
</tr>
<tr>
<td>Paul Amos</td>
<td>World Bank consultant</td>
<td>Chinese HSR</td>
</tr>
<tr>
<td>Dick Bullock</td>
<td>World Bank consultant</td>
<td>Chinese HSR</td>
</tr>
<tr>
<td>Stephen Alchin</td>
<td>Infrastructure Australia</td>
<td>Infrastructure finance policy.</td>
</tr>
<tr>
<td>David George</td>
<td>CRC for Rail Innovation</td>
<td>Public transport policy research</td>
</tr>
<tr>
<td>Dr Chris Gourlay</td>
<td>CRC for Rail Innovation</td>
<td>Public transport policy research</td>
</tr>
<tr>
<td>Iñaki Barrón de Angoiti</td>
<td>International Union of Railways (UIC)</td>
<td>International HSR</td>
</tr>
<tr>
<td>Prof. Yves Crozet</td>
<td>Transport Economics Laboratory University of Lyon France</td>
<td>French HSR</td>
</tr>
<tr>
<td>Dr Didier van de Velde</td>
<td>Delft University of Technology</td>
<td>Dutch HSR</td>
</tr>
<tr>
<td>Lou Thompson</td>
<td>Thompson, Galenson &amp; Associates</td>
<td>Californian HSR</td>
</tr>
<tr>
<td>Dr Philip Laird</td>
<td>University of Wollongong</td>
<td>Australian HSR</td>
</tr>
<tr>
<td>Michel Masson</td>
<td>CEO, Yarratrams</td>
<td>Australian HSR</td>
</tr>
<tr>
<td>Jean-Pierre Farandou</td>
<td>CEO, Keolis</td>
<td>French HSR</td>
</tr>
</tbody>
</table>

From the nature of case study documentation obtained, it became clear that there was more written on the project appraisal, funding and delivery decisions, than on the financing decision for these megaprojects. The review had to be expanded to include public transport media reports to fill the gaps in data availability. The findings of this phase is contained in Chapter 4, and affirmed the relative incompleteness and inconsistency of finance appraisal methods, that financing appraisals are less mature and developed than project appraisals for HSR projects, and that there is no readily available appraisal framework for financing approaches in the international HSR environment. While the main aim of the case studies was to explore how financing approaches are selected in practice for large public
infrastructures projects, it also proved helpful in analysing and formulating the instrument categories used for financing large public infrastructure projects (in Stage Three).

The next step was to review project appraisal methods. Data was collected by way of a standard comprehensive literature review, given that project appraisal methods are well documented in the academic, policy and industry fields. It confirmed that project appraisal methods are mature and analogous to the financing appraisal process, and could therefore guide the development of a financing appraisal. This was explored in Chapter 5. Stage Two not only consolidated initial findings and helped to refine research questions, but also indicated what type of framework was required. In particular, the overview of project appraisal methods (Chapter 5) indicated the need for a systematic, transparent and comprehensive appraisal approach that appraises the full societal impacts (including economic and social aspects). The findings from Chapter 5 informed Stage Three, whereby the framework developed incorporated lessons from Chapter 5, including the adoption of elements of the BCA and MCA project appraisal approaches.

3.4.3 Stage Three
Stage Three involved the development of the framework components. The inconsistencies and gaps in the current body of knowledge meant that it contributed components and foundational requirements, rather than an integrated appraisal methodology that met the foundational requirements (transparency, being systematic, comprehensive, and societal). Stage Two also indicated that an MCA appraisal method would be the most suitable approach. The results from the Stage One and Two exploratory research had to be synthesized and translated into a financing appraisal, which could be applied to any given public infrastructure project in any developed country in a transparent, systematic, comprehensive way. Since this stage involved formulation, the research shifted to primarily assimilative or synthesizing methods based on secondary data. Formulation of the framework was performed by way drawing on the results of earlier stages’ data gathered, augmented by additional review of literature on the financing of public infrastructure in developed nations.

The first component of the framework required the identification, classification and description of the framework categories to be appraised, which are the complete range of alternative financing instruments available to public sector decision makers. The results of this component of the research are contained in Chapter 6. The classification was required
to aid the appraisal of financing instruments regardless of jurisdiction, type of public infrastructure, and innovation. The main reasons why a set of new financing instrument categories had to be developed were threefold:

- For the framework to be systematically consistent, categories had to be based on the definitions adopted. Therefore, any categorization that was not consistent with the definition of financing required adjustment.
- The categorization had to enable robust process of appraisal. Best practice in categorization requires classes to be mutually exclusive and collectively exhaustive (the MECE principle). This concept holds that, when we separate a set of items into subsets, we need to ensure that there are no overlaps\(^{27}\) (mutually exclusive) or gaps (collectively exhaustive) in the categories (Minto, 1996). Following a MECE approach is important to ensure that the full spectrum of alternatives is initially identified before an appraisal or assessment is performed. This will improve the likelihood of selecting the optimal alternative. In addition, following a MECE approach instils the discipline of identifying all possible alternatives before a robust justification for the elimination of alternatives takes place. A new categorization was required to address overlaps or gaps between categories which existed in the literature.
- The categorization focuses on the unique attributes of financing instruments. As a result, the driver for categorization is the unique attributes of the financing instruments themselves, independent of the delivery and funding alternatives. Any existing categorization of financing in the literature based on delivery or funding aspects was inappropriate and required restructuring.

Table 11 provides a brief summary of how key literature sources relate to the categories developed.

\(^{27}\) Even if financing approaches for public infrastructure projects are likely to include a range of instruments, the classification of component instruments have to be systematic and robust (MECE).
Table 11: Financing instruments considered in the literature

<table>
<thead>
<tr>
<th>Source</th>
<th>Financing categories</th>
<th>Relationship to thesis categories</th>
</tr>
</thead>
</table>
| GAO (2002) | • Grants  
• Tax credit bonds  
• Tax-exempt bonds  
• Direct federal loans                      | Financing categories were consistent with this thesis’ definition of financing. While contents were helpful for development of government financing instruments, the set of instruments are incomplete for the purposes of this thesis as private sector financing is not considered. The content was also limited to the US context. |
| ACG (2003)  | • Government borrowing  
• General taxes  
• User charges  
• Producer levies  
• SPV                                      | Financing categories were inconsistent with this thesis’ definition of financing. Categories included a mix of funding mechanisms (such as taxes, user charges, and levies), delivery (such as SPVs) and financing instruments (borrowing). |
| Kitchen (2004) | • Internal revenue sources  
• General operating revenues  
• Earmarked taxes  
• Reserves  
• Special charges (such as development charges)  
• External revenue sources  
• Grants  
• Borrowing  
• PPP                                      | Some categories were not aligned with this thesis’ definition of financing, but included delivery vehicles (such as, PPPs). The internal versus external categorization was helpful. However, the application was limited to the context of local/municipal financing. Therefore, federal grants were categorized as external financing. This is in contrast with the thesis’ focus, which takes on a broader societal perspective. The financing instrument set was also incomplete for this thesis’ purposes. Loans were not included and there was no distinction between general purpose and infrastructure bonds. |
<table>
<thead>
<tr>
<th>Source</th>
<th>Financing categories</th>
<th>Relationship to thesis categories</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Borrowing</td>
<td>At the high-level, categories were consistent this thesis’ categories (PAYGO overlaps significantly with the ‘reserves’ category adopted in thesis). However, this source did not distinguish equity financing. Categories also included some delivery vehicles in subcategories, such as, leases appropriations funded from borrowing, which overlaps with borrowing. Contents were also restricted to mainly the Canadian and US context.</td>
</tr>
</tbody>
</table>
| Chan et al. (2009)  | Budget appropriations  
|                     | Specific purpose bonds (securitised borrowing)  
|                     | Off-budget financing by government businesses  
|                     | Development contributions  
|                     | PPPs or Private Finance Initiatives (PFIs)                                            | Categories were inconsistent with our study definition of ‘financing’ and included delivery vehicles, such as, GTE and PPP ‘financing’. The contents were helpful for checking the completeness of select thesis categories. However, the contents were restricted mainly to the Australian context. |
| Abelson (2011)      | Taxation  
|                     | Consolidated revenue  
|                     | Infrastructure levies  
|                     | Public sector borrowing  
|                     | General bonds  
|                     | Infrastructure funds  
|                     | Infrastructure revenue bonds  
|                     | Public enterprise borrowing  
<p>|                     | Private sector financing (debt; equity, and mixed).                                 | Categories were inconsistent with this thesis’ definition of financing and included categorization by delivery vehicle, such as, public sector, public enterprise and private sector, although the contents were restricted mainly to the Australian context. |</p>
<table>
<thead>
<tr>
<th>Source</th>
<th>Financing categories</th>
<th>Relationship to thesis categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC (2014)</td>
<td>• Public finance</td>
<td>Categories were inconsistent with this thesis’ definition of financing and included delivery vehicles, such as, public and private sector. There were overlaps between government borrowing and budget appropriations (which was defined to include government borrowing). The contents, however, provided a helpful categorization of private finance by instrument type (equity or debt), investment route (direct or indirect), and investment vehicle (publicly traded, or unlisted). This thesis adapted these concepts in order to refer to the direct source of financing only.</td>
</tr>
<tr>
<td></td>
<td>• Budget appropriations&lt;sup&gt;28&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• General purpose government borrowing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Project-specific infrastructure bonds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Private finance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Equity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Debt</td>
<td></td>
</tr>
</tbody>
</table>


<sup>28</sup> Sourced from general taxation revenue, hypothecated taxes, fees and charges, asset sales, intergovernmental transfers, or government borrowing.
The second component of the framework was the formulation, classification, description and operationalization of a set of appraisal criteria. The results are documented in Chapter 7. The appraisal criteria were also drawn from components found in the large body of knowledge on the financing, funding and project appraisal of public infrastructure. Similar to the framework categories, the development of an improved set of consistent and comprehensive appraisal criteria was required for this thesis to address the inconsistencies in the literature reviewed. The appraisal criteria were also operationalized by way of specifying performance indicators for each of the criteria. The review of project appraisal methods (Chapter 5) informed the operationalization of criteria, and contributed concepts such as project risk premiums and discount rates. However, these concepts had to be modified to address the appraisal of financing, rather than the selection of a project. Table 12 provides a summary of the appraisal criteria applied in the most prominent studies reviewed, and how they relate to the criteria used in the appraisal framework.
Table 12: Appraisal criteria applied in the literature

<table>
<thead>
<tr>
<th>Source</th>
<th>Criteria applied in source</th>
<th>Relationship to framework criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAO (2002)</td>
<td>• Principal and interest payments&lt;br&gt;• Tax credits and taxes forgone</td>
<td>Criteria informed this thesis’ monetary criteria. Incomplete (gaps) set of criteria, as it only included the cost of capital and taxes foregone (some of the monetary aspects identified in this thesis).</td>
</tr>
<tr>
<td>ACG (2003)</td>
<td>• Effectiveness&lt;br&gt;• Efficiency&lt;br&gt;• Equity&lt;br&gt;• Stability/reliability of the revenue base&lt;br&gt;• Administration costs&lt;br&gt;• Compliance costs&lt;br&gt;• Certainty and transparency&lt;br&gt;• Stakeholder support&lt;br&gt;• General equilibrium modelling</td>
<td>Criteria informed some of this thesis’ monetary and intangible criteria. Gaps include flexibility, accountability and a host of monetary criteria developed in this thesis.&lt;br&gt;Given that instrument categories were inconsistent with this thesis definition of ‘financing’ (refer Chapter 6), the criteria also do not consistently apply to our definition of financing instruments. For example, ‘compliance costs’ apply more to funding mechanisms than financing instruments. The study also included the results of a general equilibrium model, which was not adopted in this thesis.</td>
</tr>
<tr>
<td>Kitchen (2004)</td>
<td>• Efficiency&lt;br&gt;• Accountability&lt;br&gt;• Transparency&lt;br&gt;• Fairness&lt;br&gt;• Ease of administration</td>
<td>Given that instrument categories were inconsistent with this thesis definition of ‘financing’ (see Chapter 6), the criteria also did not consistently apply to this research’s definition of financing instruments. Criteria informed this thesis’ intangible criteria. Gaps include monetary criteria and some of the intangible aspects, such as effectiveness, flexibility, degree of control/ownership.</td>
</tr>
<tr>
<td>Source</td>
<td>Criteria applied in source</td>
<td>Relationship to framework criteria</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Hann &amp; Mack (2005)</td>
<td>• Impact on debt capacity (gearing)</td>
<td>The criteria were mainly intangible and from the perspective of raising private financing, and therefore contained gaps. The criteria informed this study’s intangible criteria. Gaps included most of the monetary criteria and some of the intangible aspects, such as effectiveness, flexibility, accountability, transparency.</td>
</tr>
<tr>
<td></td>
<td>• Risk transfer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Project delay</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Access to private sector innovation, expertise, efficiency</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Enabling whole-of-life project planning</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Intergenerational equity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Transaction costs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Government control</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Complexity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Political costs</td>
<td></td>
</tr>
<tr>
<td>Vander Ploeg (2006)</td>
<td>• Advantages</td>
<td>The source had gaps when compared to this thesis’ criteria. It did not define a set of consistent criteria; instead, it balanced advantages with disadvantages of each instrument.</td>
</tr>
<tr>
<td></td>
<td>• Disadvantages</td>
<td></td>
</tr>
<tr>
<td>IPA (2007)</td>
<td>• Cost overruns</td>
<td>The source compared the performance of Public-Private-Partnerships (PPPs) and traditional procurement in terms of relative efficacy in relation to two criteria: cost and time overruns. This was carried out by measuring the cost performance and timeliness outcomes relative to budget for the management and construction of public infrastructure projects. This study focused on the delivery aspects as opposed to the merits of different financing alternatives and, therefore, has limited application in the development of a framework for evaluating financing alternatives for HSR.</td>
</tr>
<tr>
<td></td>
<td>• Time overruns</td>
<td></td>
</tr>
<tr>
<td>Source</td>
<td>Criteria applied in source</td>
<td>Relationship to framework criteria</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------</td>
<td>------------------------------------</td>
</tr>
</tbody>
</table>
| Chan *et al.* (2009) | • Return paid to investors  
• Contingent liabilities to taxpayers  
• Transaction costs  
• Foregone tax revenues  
• Opportunity cost of funds | Given that instrument categories were inconsistent with this thesis’ definition of ‘financing’ (see Chapter 6), the criteria also do not consistently apply to this research’s definition of financing instruments. The source mainly informed the formulation of this research’s monetary criteria. Gaps included taxpayers’ claim to revenue. |
| Abelson (2011) | • Advantages  
• Disadvantages | Given that instrument categories were inconsistent with this thesis’ definition of ‘financing’ (see Chapter 6), the criteria also did not consistently apply to this research’s definition of financing instruments. The source contained gaps when compared to this study’s criteria. The source did not define a set of consistent criteria; instead, it balanced advantages with disadvantages of each instrument. |
| Camane (2013) | • Project risk  
• Transaction cost risk (includes cost of capital)  
• Risk associated with information asymmetry between public and private sectors | Despite inconsistencies with instrument categories and application within a developing country, this source contributed towards the discussion of monetary criteria (such as cost of capital and risk). |
| PC (2014) | • Risk management  
• Transaction costs  
• Exposure to market or other disciplines | Given that instrument categories were inconsistent with this thesis’ definition of ‘financing’ (see Chapter 6), the criteria also did not consistently apply to our definition of financing instruments. Gaps included all the intangible criteria developed in this thesis, as well as a number of monetary criteria (including cost of capital and credit rating impact). |

Source: Based on Henn *et al.* 2012, pp.19–22.
The range of criteria which emerged from the literature as indicated in Table 12 were filtered and adapted to apply to the concept of *financing* (as opposed to funding and delivery), resulting in the following set of criteria:

Table 13: Framework criteria

<table>
<thead>
<tr>
<th>Monetary</th>
<th>Intangible</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Cost of capital</td>
<td>• Effectiveness</td>
</tr>
<tr>
<td>• Contingent liabilities</td>
<td>• Fairness</td>
</tr>
<tr>
<td>• Cost of project delay</td>
<td>• Flexibility</td>
</tr>
<tr>
<td>• Credit rating impact</td>
<td>• Accountability &amp; transparency</td>
</tr>
<tr>
<td>• Taxes forgone</td>
<td>• Stakeholder support</td>
</tr>
<tr>
<td>• Administration &amp; transaction costs</td>
<td>• Degree of public control/ownership</td>
</tr>
</tbody>
</table>

Source: Based on Henn *et al.* 2014, pp.12–15.

### 3.4.4 Stage Four

In Stage Four, the appraisal approach is explained, benchmarks are adopted and the framework is demonstrated by way of an illustration of the Australian HSR project. This part of the research was also assimilative or integrative and informed by secondary data drawn from the various studies that have already been commissioned by the Australian Government for the proposed project. The results are documented in Chapter 8. An MCA appraisal approach, which incorporates elements of BCA was formulated, based on lessons learnt from earlier research stages. This also required modification of concepts developed for *project* appraisal to that of *financing* appraisal. Once the framework was formulated, it was applied at a conceptual level to the Australian HSR project (which originally prompted the research), all with reference to Australian benchmarks available in the literature.

### 3.5 Summary

The research adopted an interpretive paradigm in the formulation of a framework, which amounts to a theory-building research methodology, and relied on exploratory and synthesizing or integrative data gathering methods. Exploratory research was required to identify the variables and factors involved in selecting a financing approach. There was a need for synthesizing research, as the framework includes elements already developed in prior studies. As a result, the research design entailed inductive reasoning. Measures were also taken to improve the quality and trustworthiness of the research methodology, in particular through clear definition of the research question, confirmation of first principles
and continuous reflection on whether the methods employed were relevant for answering the research question.

In essence, the research procedure involved arguing that the method of financing matters given the inefficiencies of financial markets (Chapter 2), followed by an investigation of whether an appraisal methodology or framework for financing existed in current methods (Chapter 2) or in practice (HSR case studies in Chapter 4), and documenting the evidence relating to this. Thereafter, the study established an analogous problem for financing appraisal to that of project appraisal and argued the applicability of BCA and MCA methods to the appraisal of financing (Chapter 5). This paved the way for developing an appropriate appraisal framework for financing of public infrastructure projects (Chapters 6 and 7), which was operationalized and tested at a high-level for a potential Australian HSR public infrastructure megaproject (Chapter 8). The thesis findings are summarized in Chapter 9, which concludes the research.
4 High-Speed Rail Case Studies

4.1 Introduction

Chapter 4 seeks to answer the question of how the choice of financing approach is selected in practice for public infrastructure megaprojects, using High-Speed Rail (HSR) as an example. HSR was selected because it is complex, involves a variety of financing approaches and a long financing history. HSR projects require consideration of multiple aspects when a financing approach is selected. These projects usually cost billions of dollars and take many years to construct. There are also a range of stakeholders to consider, which may include different levels of government, regulators, investors, financiers and the public. The first HSR project was undertaken in the 1960s, and allows for observation of financing models which spans over five decades. Given that HSR is becoming more commonplace throughout the world, it was deemed likely that there may be useful lessons to be learned about how to evaluate and select the best financing outcomes for public infrastructure megaprojects. Chapter 3, Section 3.4 expanded further on the rationale for selecting HSR for case studies of financing public infrastructure projects.

HSR constitutes one of the most significant and technologically advanced developments in terrestrial passenger infrastructure development in the second half of the twentieth century and beyond. By 2014, there was more than 23,000 kilometres of rail track worldwide being used to provide HSR services to an ever-increasing number of passengers who are willing to pay for reduced travelling time and better quality rail transport (Campos & de Rus, 2009; UIC, 2014).

While the main focus is on how capital was raised for the construction of HSR projects and how financing instruments were selected, this chapter also provides a brief background on the way in which these projects were appraised, delivered and funded. This is mainly for contextual purposes, given the link between these concepts and financing as was discussed earlier. Instead of answering the question about which choice of financing instrument or combination of instruments is optimal, the focus is on reviewing the processes involved in selecting a financing approach. Furthermore, it is acknowledged that the financing approach chosen by different country may be context-specific and may not be replicated in other countries. The chapter is structured as follows: Section 4.2 provides an overall contextual background on the financing of HSR across the globe. Thereafter, Sections 4.3 to 4.7 discuss
HSR financing in Japan, Europe, China, the USA, and Australia. The chapter concludes with a summary of chapter findings in Section 4.8.

4.2 Background

4.2.1 Definition of HSR
The International Union of Railways’ (UIC) broad definition of HSR was adopted. Their definition includes all the system elements, comprising infrastructure or lines, rolling stock and operating conditions that are equipped for speeds generally equal to or greater than 250 km/h. The UIC’s definition also makes it clear that HSR usually requires the building of specifically designed lines to allow for such high speeds. Where existing infrastructure was upgraded to allow for slightly lower speeds (typically around 200 or 220 km/h), these systems are also included in the broad definition. In other circumstances, while the infrastructure and rolling stock might be technically capable of these high speeds, local conditions might require speed restrictions for a range of reasons including noise nuisance, or for safety reasons. Such systems are also included in the UIC’s definition of HSR (UIC, 2015).

4.2.2 HSR Project Appraisals
A great deal of literature is available about the economic appraisal of HSR projects. The literature revealed that HSR project appraisal methods for the majority of countries require detailed economic appraisals. Financial and economic Benefit-Cost Analysis (BCA) is the most commonly used appraisal method, while Multi-Criteria Analysis (MCA) and economic impact assessments are emerging as new methods (Steer Davies Gleave [SDG], 2004; Mackie & Worsley, 2013). For example, Adler et al. (2010) developed a BCA methodology to assess infrastructure investments and their effects on transport equilibria by taking into account competition between multiple privatized transport operator types, including HSR and airlines for 27 European Union (EU) countries. Takagi (2005) similarly dealt with a BCA of HSR, and focused on various opportunity cost components. Other HSR BCA type analyses included those of Levinson et al. (1997) (for Los Angeles and San Francisco), Martin (1997) (for Canada); and Vickerman (1997). Van Exel et al. (2002), Gonzalez-Savignat (2004), De Rus and Nombela (2007), Martin and Nombela (2007), Roman et al. (2007), and De Rus et al. (2009) (for various European projects).
Although economic appraisal is usually required as an input into the final investment decision, certain policy objectives such as perceived wider economic benefits, national pride, and wider strategic impacts are also commonly considered in HSR project appraisals (SDG, 2004). The appraisal methods that are commonly required before investing in HSR infrastructure are also regularly assessed and refined by scholars. For example, De Rus et al. (2009) performed an evaluation of the economic appraisal of HSR projects, and found a range of empirical work on this topic. De Rus et al. (2009) produced a critical assessment of the *ex-ante* appraisal that took place for a range of European HSR projects, and suggested an improved appraisal process, based on *ex-post* evaluations of these projects. The appraisal of HSR projects is broadly consistent with general practices and trends for appraising public infrastructure projects. Since project appraisal methods were believed to be helpful in providing lessons to formulate a financing appraisal framework, Chapter 5 expands further on the different types of public infrastructure project appraisals, including Financial and Economic Benefit-Cost Analysis (BCA), Economic Impact Analyses such as wider economic benefits (WEBs) and Multi-Criteria Analysis (MCA) for a wide range of public infrastructure classes. Table 14 provides a summary of the main appraisal methods used for HSR.

Table 14: HSR project appraisal methods

<table>
<thead>
<tr>
<th>Country</th>
<th>Financial BCA</th>
<th>Economic BCA</th>
<th>Multi-Criteria Analysis (MCA)</th>
<th>Economic Impact (WEB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>UK</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>France</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Partial</td>
</tr>
<tr>
<td>Germany</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Partial</td>
</tr>
<tr>
<td>Spain</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Partial</td>
</tr>
<tr>
<td>Italy</td>
<td>Yes</td>
<td>Partial</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Financial BCA</td>
<td>Economic BCA</td>
<td>Multi-Criteria Analysis (MCA)</td>
<td>Economic Impact (WEB)</td>
</tr>
<tr>
<td>----------------</td>
<td>---------------</td>
<td>--------------</td>
<td>-------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>USA</td>
<td>Yes</td>
<td>Yes</td>
<td>Unclear</td>
<td>Unclear</td>
</tr>
<tr>
<td>Australia</td>
<td>Yes</td>
<td>Partial</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Sources: SDG (2004); De Rus et al. (2009); AECOM (2013); Mackie & Worsley (2013)

### 4.2.3 HSR Delivery

The delivery model for HSR systems has evolved over time. While the building of railway infrastructure and the operation of railway services were often historically mainly by the same entities, lately there has been a general move towards separating the ownership of infrastructure from its operations (Dutzik et al., 2011). The resulting model typically involves infrastructure managers providing access to multiple operators at a fee, called an infrastructure or access charge. Operators, in turn, usually charge user fees and often receive government subsidies. Vertical separation also allows for competition between operators, while infrastructure managers remained largely natural monopolies (Crozet, 2012). Figure 10 demonstrates the vertically separated model that is followed in EU countries.

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29 While the EU Policy stipulates opening access to competition for operations, national operations are still mainly publicly owned. However, often international long distance HSR segments, such as between France-England (Eurostar) and France-Belgium (Thalys), are operated by private operators (Texas HSR, 2012).

30 The natural monopoly status may be questioned should other modes, such as traditional rail (not High Speed) and air travel, be considered.
Figure 10 shows that the focus of this research is on financing of the HSR infrastructure, and not on operations. The vertically separated model shown in Figure 10 is evident in the EU and Japan, while ownership and delivery remained integrated in other parts of the world, such as in Russia and China. The delivery model has implications for the financing model followed, including which parties were responsible for financing the infrastructure and how financing was and continues to be recovered (or funded). The financing and funding of constructing the infrastructure is largely separate from subsequent financing and funding of service operations in the vertically separated model (Roll & Verbeke, 1998). The delivery models for each of the case studies are briefly discussed by case study below.

4.2.4 HSR Funding

There are a range of funding sources to recover the cost of financing HSR infrastructure. These include taxes, access charges and farebox revenue (user charges).

**Taxes.** Where government authorities are involved in financing construction, they may recover their investment through tax funding. Examples of taxes which are used to fund HSR
include dedicated taxes, such as fuel taxes, or general taxation revenues, and corporate taxes (Roll & Verbeke, 1998). The EU also imposes environmental charges on operators to fund investment in transport infrastructure in terms of its Trans-European Transport Network (TEN-T) funding programme (Adler et al., 2010).^{31}

**Access charges.** Where delivery is vertically separated between infrastructure and operations, funding for construction is also usually separate from funding of service operations. Infrastructure managers, who are often also responsible for construction finance, recover part or all of their construction financing costs from operators, by way of infrastructure charges (access charges). The formulas for the calculation of infrastructure charges can be divided into marginal and full cost systems. Marginal cost systems charge the marginal cost of adding another train to the system. Full cost systems comprise all elements including initial investment cost. Two ‘in-between’ systems also exist for a range of European countries as depicted in Table 15.

**Table 15: European infrastructure access charging systems**

<table>
<thead>
<tr>
<th>Type of system</th>
<th>Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marginal Cost</td>
<td>Bulgaria, Greece, Ireland, Luxembourg, Netherlands (conventional lines), Norway.</td>
</tr>
<tr>
<td>Marginal Cost Plus Additions</td>
<td>Austria, Czech Republic, Denmark, Finland, France, Portugal, Spain, Sweden, Switzerland, United Kingdom.</td>
</tr>
<tr>
<td>Full Cost Minus Discounts</td>
<td>Belgium, Germany, Italy, Poland, Romania, Slovenia, Slovakia.</td>
</tr>
<tr>
<td>Full Cost</td>
<td>Estonia, Latvia, Lithuania, Netherlands (HSR only).</td>
</tr>
</tbody>
</table>


When the infrastructure access charges paid by the rail operator to the infrastructure manager is close to marginal cost, the rail operator usually does not cover full infrastructure cost and government subsidies must often cover part of the infrastructure cost as a result. When the charges are higher than marginal cost, the operator typically pays for a large share of the infrastructure cost (Teixeira & Pita, 2012).

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^{31} The main objective of the environmental charge is not to generate revenues, but to minimize the level of environmental damage.
4.2.5 HSR Financing Requirements

Financing is a significant hurdle to overcome before a HSR project can be realised. Therefore, it often involves a range of financing instruments and approaches, as well as a number of financiers and investors, as can be seen from the case studies presented in Sections 4.3 to 4.9. The financing of an HSR project involves the selection of an approach to raise the large amounts of upfront capital required to develop a HSR system. As defined in Section 4.2.1, financing sometimes also include the renewing, rehabilitating or reconstructing of an existing rail line to allow for high-speed travel. The development of an HSR system imposes a large financing burden on a country and entails a range of cost elements. Financing is required during all three phases of developing the project, which can be grouped into the pre-project, construction, and operations and maintenance phases. Financing needs are also made up of three main HSR construction cost components, which are as follows (Campos & de Rus, 2009).

Planning and land costs. Upfront planning and land costs, in addition to feasibility studies often represents a sunk cost, usually between five per cent and ten per cent of the total investment.

Infrastructure building costs. These are the civil work costs involved in the construction of infrastructure including terrain preparation and platform building. This component varies widely across projects depending on the characteristics of the terrain, but typically accounts for between 10 per cent and 25 per cent of the total investment. Technical issues and geographic obstacles may easily double this amount (as much as to forty to fifty per cent) for viaducts, bridges, or tunnels.

Superstructure costs. As a rule, superstructure costs make up the rest of the infrastructure costs and consist of all rail-specific and electro-mechanical elements.

A number of studies reviewed the costs of HSR infrastructure, including that of SDG (2004), Esplugas et al. (2009), De Rus (2012) and Mathur (2011). For example, Table 16 contains

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32 These costs vary depending on the nature of infrastructure to be built in each case and the pre-existing infrastructure (Campos & de Rus, 2009).
33 Includes both technical and economic feasibility studies, technical design, land acquisition and others (such as legal and administrative fees, licenses, permits, etc.). These costs may be substantial in some projects (particularly when costly land expropriations are needed).
34 Components include tracks and sidings along the line, signalling systems, catenary and electrification mechanisms, communications and safety installations. Each of these individual elements mostly represents between five and ten per cent of the total investment.
the average costs of HSR in Europe and shows that construction costs are the major cost component in developing HSR systems.

Table 16: Average costs of HSR in Europe

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction of 1 kilometre of new HSR line</td>
<td>EUR 10 million to EUR 40 million</td>
</tr>
<tr>
<td>Maintenance of 1 kilometre of new HSR line</td>
<td>EUR 70,000 to EUR 100,000 per annum</td>
</tr>
<tr>
<td>Cost of an HS train (350 places)</td>
<td>EUR 20 to EUR 25 million</td>
</tr>
<tr>
<td>Maintenance of an HS train (rolling stock)</td>
<td>EUR 1 million per annum</td>
</tr>
</tbody>
</table>

Sources: Mathur (2011); De Rus (2012)

Upfront financing costs are extremely important for HSR, owing to the vast amounts of construction capital required compared to operating costs. For example, the Australian-government-appointed HSR Advisory Group placed financing issues among the most important aspects to be addressed in the future (HSR Advisory Group, 2013). The rest of this chapter discusses how various international countries went about financing these infrastructure megaprojects.

4.3 The Japanese HSR system

The Japanese developed the world’s first dedicated HSR system, called the Shinkansen. The first Shinkansen line started operating in 1964 between Tokyo and Osaka (Tokaido Shinkansen). The Shinkansen HSR system was developed to service both commuting traffic and long distance markets, and initial lines were justified by extremely high traffic levels (Bureau of Infrastructure, Transport and Regional Economics [BITRE], 2010). For example, the Tokaido Shinkansen has up to ten trains per direction per hour (STD, 2004) and has travel demand totals of around 128,000 passengers per day (Hudson, 2011).

The Shinkansen system was subsequently expanded to one of the world’s second largest HSR system. It currently comprises over 2,600 kilometres of high-speed lines (UIC, 2015). The Japanese followed a phased approach to developing their HSR system by investing in HSR lines with higher financial and economic returns first. Later HSR lines had lower

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35 Similar to figures used by the World Bank, which estimated typical construction plus train-set costs outside China to range between USD 35 to 70 million per kilometre, depending on the complexity of civil engineering works, degree of urbanization along route, and total capacity of rolling stock required (Amos et al., 2010).
benefit/cost ratios than older lines, and the decision to build these lines appears to be partly driven by political motives (Ernst & Young [E&Y], 2009).

4.3.1 Delivery

The delivery model for the Shinkansen HSR system has evolved over time from an integrated model for original lines to a vertically separated model for later lines. The original two Shinkansen lines (Tokaido and Sanyo) were constructed, owned and operated by the Japanese National Railways (JNR), which was a government-owned railway body at the time (House of Representatives, 2007; Thompson & Tanaka, 2011).36 A construction scheme was established for the last two of the original lines, Tohoku and Joetsu. Japan Railway Construction Public Corporation (JRCC) was created by government as a special purpose body for Shinkansen construction in terms of the Shinkansen Railway Development Law of 1970 (Ministry of Land, Infrastructure, Transport and Tourism [MLIT], 2011). This paved the way for vertical separation of the delivery model, which is that JRCC was responsible for construction of lines, while JNR became responsible for service operation and infrastructure maintenance only (E&Y, 2009).

JNR was subsequently privatized in 1987 and divided into seven large, regional, privately-owned companies consisting of one freight railway company and six passenger railway companies (JRs) responsible for the operations and management of the service (House of Representatives, 2007; Matsumoto, 2007). HSR infrastructure was originally placed in a separate holding company, while the operating JR companies were charged track fees (or access fees) on the basis of ability to pay. The delivery structure allowed cross subsidisation between profitable and unprofitable routes. Pre-existing HSR infrastructure was later sold to the operating companies (JRs) (SDG, 2004, Nash, 2008). The JRs therefore do not pay access charges on these assets (Thompson & Tanaka, 2011). Today, the three main island JRs (East, Central and West) are private corporations listed on the Tokyo Stock exchange (Thompson & Tanaka, 2011).37

36 E&Y (2009) suggested that there was some early evolution of the business model after the introduction of the first line in 1964, which introduced vertical separation between infrastructure management and operations. They suggest that the JRCC was responsible for constructing HSR lines, while JNR was responsible for service operation and infrastructure maintenance at some point between 1967 and 1987, when privatization took place.

37 While Thompson and Tanaka (2011) indicated that government holds no further ownership interest, SDG (2004) suggested that some of the shares were owned by government through the Japan Railway Construction Corporation (JRCC).
All subsequent Shinkansen railways follow a vertically separated delivery model and were constructed and owned by a public entity, Japan Railway Construction, Transport and Technology Agency (JRTT), while the JRs operate them. However, the principle of basing track charges on ability to pay rather than historic construction cost was maintained for infrastructure (SDG, 2004; Nash, 2008). JRTT leases the infrastructure to the JRIs on a thirty-year basis and they are fully responsible for all operational and maintenance costs of those lines.

In sum, the Japanese delivery model for HSR has developed from an integrated model fully owned by government (JNR) in the 1960s and 1970s, followed by a vertically separated public delivery model (JRCC and JNR). HSR was privatized in 1987 and resulted in private ownership of brownfield infrastructure and operations (JRIs). Japan subsequently settled on a model where the development and ownership of newly constructed HSR infrastructure is retained in public ownership (JRTT). E&Y (2009) concluded that the Japanese government’s current procurement policy recognizes the benefits of retaining public ownership of future HSR assets and levying track charges (access charges) on HSR operators.

4.3.2 Financing
Over time, the Japanese HSR system has undergone a three-stage transition from full public finance for original lines, which were later privatized, and public financing of subsequent line development. Nevertheless, all newly constructed Shinkansen lines were fully government financed. The financing phases are discussed below.

a. **Old line: Loans and budget allocations**
The original Shinkansen lines were mainly financed through the use of government loans. The construction of Tokaido Shinkansen was financed by a combination of interest-bearing loans from the Japanese Government and the World Bank (MLIT, 2011), as well as railway bonds (Matsumoto, 2007). The World Bank loan accounted for 8.6 per cent of the total construction cost of USD 3.7 billion (MLIT, 2011). Given the success in attracting patronage, funding to repay the initial loans came from fare revenue, with all of the initial investment costs recovered by 1971 (Peterman et al., 2009; Ellis et al., 2013). Since then, revenues from the Tokaido Shinkansen have been an important source of subsidies for other

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38 JRTT incorporated all responsibilities of JRCC in 2003. JRCC was created in 1970 as a public funding and procurement entity for HSR, and was dissolved in 2003. Some post 2003 sources, however, still indicated JRCC as the infrastructure owner, including CHSRA (2011).
local lines (Matsumoto, 2007). The Sanyo Shinkansen followed a similar financing model. A construction scheme that enabled the provision of some government financial support was established for the Tohoku and Joetsu Shinkansen lines following the creation of the JRCC (MLIT, 2011). Construction of the Tohoku and Joetsu Shinkansen were financed by interest-bearing loans, as well as some government contributions (grants). For the Joetsu Shinkansen, for example, 87 per cent of the establishment costs came from interest-bearing loans and 13 per cent from a government budget allocation (MLIT, 2011).

The high-levels of public debt resulting from the development and operation of the original HSR lines, then totalling 1,835 kilometres, resulted in government privatizing the rail line in 1987 (Ellis et al., 2013). Lines were first leased, and in 1991 (since operation of the network remained profitable after privatization) the JR s decided to purchase the HSR infrastructure for JPY 9.2 trillion, approximately JPY 700 billion more than the appraised value at privatization (E&Y, 2009; Texas A&M Transportation Institute, 2012). The difference was set aside as part of a Railway Reinforcement Fund, which was created for constructing new Shinkansen lines, as well as increasing the speed of conventional lines, and reinforcing the general commuter transport capacity (Okada, 2009).

b. New lines: Public financing with private funding
All subsequent Shinkansen lines were constructed in the form of public works projects with shared government contributions from the national government (amounting to two thirds) and relevant local authorities (the rest of construction cost) (MLIT, 2011). These lines were funded via commercial leasing agreements with JR, which was also the operator and which financed the rolling stock. Commercial leasing agreements formed a key component in the delivery of the later Shinkansen lines, whereby government was prepared to finance HSR infrastructure in the knowledge and expectation that funding would come from leasing the infrastructure to the JR s. Figure 11 below demonstrates the link between organizational structure and financing (MLIT, 2011).
In addition to user fees, the JRJs are also able to extract non-transport concessions from commercial leases at stations, concourse areas and on platforms. For instance, of the eighteen stations on the Tohoku Shinkansen between Tokyo with Morioka, seven have large-scale department stores and related businesses, including large-scale urban hotels with large conference facilities (Okada, 2009). Examples of commercial development include the JR Central Towers, a high-rise city above the Nagoya station, with significant revenues accruing (around AUD 4.3 billion per annum) from merchandise, real estate, hotels and travel agencies, and further commercial development is expected to open in 2017 (Minesaki, 2011).

4.4 Financing the French HSR
The French were the first to follow Japan in developing a HSR system, and opened their Paris to Lyons line in 1981 (Peterman et al., 2009). This section provides an overview of how the French HSR system was financed, followed by a summary of how the overall European HSR systems were financed. Financing of the French HSR system is discussed in
more detail since it is one of the oldest and largest HSR systems, with a financing model that has changed over time and encompasses a wide spectrum of financing instruments.

The French HSR network, or *Train à Grande Vitesse* (TGV), consists of a large number of high-speed lines, or *Ligne à Grande Vitesse* (LGVs), within the country and connecting with other European countries. France boasts a large network of around 2,000 kilometres of lines, the second longest in Europe after Spain (about 2,700 kilometres) and plans to double the network by 2020 (Ryder, 2012). The financing of the French LGVs is characterized by three distinct phases, as depicted in Figure 12:

**Figure 12: Evolution of French HSR financing**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981 - 1996</td>
<td>Full Public Financing</td>
</tr>
<tr>
<td>1997 - 2006</td>
<td>Public Debt plus Regional &amp; EU Subsidies</td>
</tr>
<tr>
<td>2006+</td>
<td>Public Private Partnerships (PPP)</td>
</tr>
</tbody>
</table>

- **Public Debt**
  - LGV South-East
  - LGV Atlantic
  - LGV North
  - LGV Mediterranean

- **Public Debt plus Regional & EU Subsidies**
  - LGV East (Phase 1)
  - LGV Rhin-Rhône (Phase 1)
  - LGV East (Phase 2)

- **Public Private Partnerships (PPP)**
  - Concessions (LGV SEA & LGV Perpignan -Figueres)
  - Partnerships (LGV BPL & CNM)

Source: Based on Henn *et al.* 2014, p.4.

### 4.4.1 Phase 1: Public Debt

In addition to the need for relieving passenger rail congestion, it has been argued that national pride played an important role in the French government’s decision to build and provide the financing for Europe’s first HSR line from Paris to Lyon (House of Representatives, 2007). The initial French HSR lines were financed mainly by the state-owned national railway company, SNCF (*Société Nationale des Chemins de fer Français*), by way of state
guaranteed commercial loans (Vickerman, 1997; E&Y, 2009, Ellis et al., 2014). The French constructed the more profitable lines first. The initial line from Paris to Lyon (which forms part of the LGV South-East) was financed entirely by public debt. The project was estimated to provide a financial rate of return of approximately twelve per cent, and exceeded the minimum eight per cent required of SNCF (Labatoire Techniques, Territoires et Sociétés [LATTS], 2008). However, rates of return estimated at between fifteen and thirty per cent per year in socio-economic terms were subsequently achieved given the strong traffic and revenue generation ability of the line. Strong returns allowed for the full amortization of the line in the early 1990s, after only about a decade in service. This achievement encouraged the French government to provide a thirty per cent grant to finance the LGV Atlantic, with the remainder being debt-financed (Vickerman 1997; Alstom, 2011). This was followed by the financing of the LGV Mediterranean (or LGV Med), which was the last French HSR project that was completely delivered and financed by the SNCF. Financing instruments for the LGV Med included SNCF debt, a state grant of about ten per cent (to guarantee the minimum required rate of return of eight per cent), as well as EU and local authority grants (Leheis, 2009). The breakdown of LGV Med financing is shown in Table 17.

Table 17: Financing the LGV Med

<table>
<thead>
<tr>
<th>Entities</th>
<th>EUR million (2003 prices)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local authorities</td>
<td>48</td>
<td>1.1%</td>
</tr>
<tr>
<td>EU</td>
<td>20</td>
<td>0.5%</td>
</tr>
<tr>
<td>National government</td>
<td>416</td>
<td>9.4%</td>
</tr>
</tbody>
</table>

It remains unclear from sources consulted where the loans were sourced from. E&Y (2009) indicated that loans were sourced on a commercial basis, guaranteed by the State. Therefore, capital may have been raised from commercial banks or a loan from a European Development Bank, such as the EIB.

Sources simply used the term 'rate of return', which is assumed to refer to the project’s Internal Rate of Return (IRR), for example Financial Internal Rate of Return (FIRR) or Economic Internal Rate of Return (EIRR). These concept are expanded on in Chapter 5, Section 5.2.

France’s national railway company, which is owned by the national government.

The French sources often use the term ‘subsidy’ to describe government grants. This research, however, adopts the term ‘grants’ for financing contributions, while subsidies applies to any subsequent government contributions to funding (servicing capital).
4.4.2 Phase 2: Debt and Government Grants

After the creation of the EU, delivery of the French rail system was vertically separated, with SNCF acting as the operator, while the newly-established Réseau Ferré de France (RFF), became the infrastructure manager. Both bodies are completely government-owned. RFF owned, managed and maintained the lines and contracted SNCF to operate services. The accumulated debt from the existing HSR lines, amounting to around EUR 20 billion, was accordingly transferred to RFF from 1997 (Campos & de Rus, 2009). Two new HSR lines were subsequently built by RFF: the LGV East (Phase 1) in 2007, and the LGV Rhin-Rhône (Phase 1) in 2011 (Alstom, 2011). At this stage, it appears that partisan political pressure played a role in the decision for government to build and finance routes where net financial benefit was low or negative. However, given that the rail reforms mandated a balanced
budget of the Infrastructure Manager, RFF’s capacity for debt financing was restricted and necessitated public grants for any lines not expected to deliver the minimum rate of return required (Leheis, 2009). As a consequence, lines constructed during this phase were financed as follows (RFF, 2010):

- RFF was the sole project undertaker and bore all risk (construction, maintenance, traffic).
- RFF debt-financed a portion of investment cost from European Investment Bank (EIB) loans.43
- Financing was augmented by grants from the French state, local authorities (including regional council, departments, and cities), other neighbouring states (such as Luxembourg for LGV East), as well as EU contributions.

The LGV East project appraisal, for example, estimated financial returns below the level required by the state, prompting additional public grant financing, while the RFF financed only approximately one quarter of the total investment cost (Leheis, 2009). The total investment of EUR 3.1 billion involved 22 financing partners, including the French State, local and regional authorities, the EU and RFF, as depicted in Figure 14 (E&Y, 2009).44

43 The EIB is highly active in financing of European HSR projects and may entail guarantees on a portion of the debt until projects operations stabilizes (E&Y, 2009).
44 E&Y (2009) provided slightly different proportions for financing as follows for the LGV East. Total cost of completion was EUR 3.1 billion, made up as follows: RFF 22 per cent; French state 39 per cent; EU 10 per cent; Luxembourg 4 per cent; Regional authorities 24 per cent and SNCF 2 per cent.
Similarly, the project appraisal for the LGV Rhin-Rhône indicated a low rate of return. However, since lines provided important links with some of the most dynamic regional authorities of the rest of Europe (Vickerman, 1997), the French state and regional authorities involved agreed to invest in the project and the state provided loan guarantees (Leheis, 2009). The total project cost of around EUR 2.5 billion was financed by way of 26 per cent RFF borrowing (EIB loans), with the remainder made up from grants by a range of stakeholders as follows: the French State (31 per cent), French regional authorities (29 per cent), SNCF (4 per cent) and the EU (8 per cent); Switzerland (3 per cent) (E&Y, 2009). The LGV East Phase 2 (Nancy to Strasbourg), which is due for completion in 2016 at a total cost of EUR 2 billion (in June 2008 prices), was likewise financed as follows: RFF debt of

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45 The total cost of the LGV Rhin-Rhône was around EUR 2,312 million, made up as follows: Alsace region: EUR 206 million (8.91 per cent; Burgundy region: EUR 131 million (5.67 per cent); Other regions: EUR 316 million (13.67 per cent); State (AFITF) EUR 751 million (32.48); RFF: EUR 642 million (27.77 per cent); Switzerland: EUR 6 million (2.85 per cent); Europe: EUR 200 million (8.65 per cent). MTETM (2006) provided slightly different numbers as follows: Total cost of around EUR 2,312 million, made up as follows: Alsace region: EUR 206 million (8.91 per cent; Burgundy region: EUR 131 million (5.67 per cent); Other regions: EUR 316 million (13.67 per cent); State (AFITF) EUR 751 million (32.48); RFF: EUR 642 million (27.77 per cent); Switzerland: EUR 69 million (2.85 per cent); Europe: EUR 200 million (8.65 per cent).
26 per cent; national government grants of 34 per cent; grants by regional and local authorities of 34 per cent; while the EU contributed 6 per cent (Railway Gazette, 2009a).

4.4.3 Phase 3: Public-Private Partnerships

By the early 2000s, France’s public debt had reached levels that exceeded the Maastricht limits, but it maintained a firm commitment to continue expanding its HSR network (Crozet & Chassagne, 2013). The large amounts of debt that RFF had inherited also led to a downgrade of its credit rating. The imposition of public debt limits made it much harder to secure public debt financing for further French HSR lines. This prompted a shift in the financing model to involve private financing partners. However, for a range of reasons, including the added financial market pressures following the global financial crisis of 2008/2009, the French government was required to maintain significant support of rail services including its HSR routes. Two PPP financing models were developed and trialled subsequently; concession agreements and partnerships.

Concession agreements involve the private concessionaire assuming responsibility for system availability and maintaining infrastructure quality. Concessionaires take on all design, construction and operation risks, such as traffic risk (Ellwanger & Wilckens, 1994; California High-Speed Rail Authority [CHSRA], 2011). As a reward, the private consortiums are allowed to charge tolls on every passenger and freight train that crosses the tracks at rates established in the concession agreement (Dutzik et al., 2011).

Partnership agreements are similar to concession agreements, except that government takes on traffic risk. This is because these projects are regarded as having large public benefits and government wants to ensure they are being built. Private partners are required to design, build, and maintain the rail lines (E&Y, 2009). Once the infrastructure is operational, public payments are made to the private partner based on an availability scheme, which implies that government assumes demand risk (Alstom, 2011; Railway Gazette, 2011e). Table 18 summarizes how project risks are allocated in the two PPP models, in contrast with the full public financing of previous financing phases:

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47 Moody’s (2012) recently downgraded RFF’s rating from Aaa to Aa1, citing excessive debt.
Table 18: French TGV financing models

<table>
<thead>
<tr>
<th>Risk</th>
<th>Full public financing</th>
<th>PPP (Concession)</th>
<th>PPP (Partnership)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financing</td>
<td>RFF</td>
<td>Private and Public</td>
<td>Private and Public</td>
</tr>
<tr>
<td>Design/Construction</td>
<td>RFF</td>
<td>Private</td>
<td>Private</td>
</tr>
<tr>
<td>Operation and Maintenance</td>
<td>SNCF, RFF</td>
<td>Private</td>
<td>Private</td>
</tr>
<tr>
<td>Availability</td>
<td>RFF</td>
<td>Private</td>
<td>Private</td>
</tr>
<tr>
<td>Traffic</td>
<td>RFF</td>
<td>Private</td>
<td>RFF</td>
</tr>
<tr>
<td>Examples</td>
<td>LGV East, Rhin-Rhône</td>
<td>LGV SEA</td>
<td>LGV BPL</td>
</tr>
</tbody>
</table>

Source: RFF 2010, p.20.

The financing of these PPP projects are discussed below:

a. **Concession PPPs**

**LGV South Europe Atlantic (SEA).** This 300-kilometre double-track high-speed passenger rail extension to the LGV Atlantic connects Tours and Bordeaux, and includes many connections to the existing network (E&Y, 2009). In 2011, the *Ligne à Grande Vitesse Sud Europe Atlantique* (LISEA) consortium was awarded a fifty-year concession. The total financing package amounted to EUR 7.8 billion, of which capital expenditure amounted to EUR 6.2 billion making it the French railway sector’s largest PPP deal to date. Financing was made up of a mix of debt and contributions (grants).\(^{48}\) Around half of the financing requirements were met by the RFF, national and local governments, while the remainder was financed by LISEA (RFF, 2010; CHSRA, 2011). Of the half contributed by public entities, RFF’s share of construction cost amounted to fourteen per cent (Freemark, 2011). While the detailed breakdown of financing instruments employed were not uncovered in the literature review, Railway Gazette (2011c) indicated that it included EIB loans amounting to EUR 1.2 billion, made up of a mix of government-guaranteed and non-guaranteed loans to the consortium and the French state, plus contributions from the Trans-European Transport Network (TEN-T) programme.

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\(^{48}\) Sources use the term ‘contributions’, which is assumed to refer to grants, as defined in Chapter 6.
Perpignan-Figueres Franco-Spanish cross border link. This 44.5-kilometre cross-border HSR link with Spain was commissioned by the national railways of France and Spain, and was also financed by way of a fifty-year concession PPP. The concession agreement took almost five years to finalize. The concession period also had to be extended by three years following project delays outside the control of the concessionaire, which meant that government had to provide financial funding to ensure the financial stability of the concession group (Dutzik et al., 2011). In total, the project required government financing amounting to 57 per cent of project costs (Dutzik et al., 2011), while the EU contributed 25 per cent from the TEN-T budget (based on cross-border mobility benefits) (Railway Gazette, 2011b). Publicly available sources consulted did not clarify how the remainder of financing was sourced, but, based on the model employed, it can be assumed that the concessionaire raised the balance of financing (which amounts to equity financing, as defined in Chapter 6).

b. Partnerships

LGV Bretagne Pays de la Loire (BPL). Once completed (planned for 2016), this 132-kilometre HSR line will connect Le Mans with Rennes. A private consortium, Eiffage Rail Express (ERE), was appointed under a 25-year PPP partnership contract (Railway Gazette, 2012e). The project was financed by way of a partnership model. A partnership model was selected because the project has a number of important public benefits including improved access to major European centres and a significant economic boost to western France, as well as releasing capacity on existing lines for both regional passenger services and freight transport (E&Y, 2009). The project also involved the creation of 10,000 regional jobs during the construction phase, and is seen to contribute to France’s environmental policy (Railway Gazette, 2011c).

Financing of the estimated EUR 3.3 billion project cost included government grants and EIB loans and was made up as indicated in Figure 15:
LGV Contournement Nîmes-Montpellier bypass line (CNM). This 70-kilometre mixed-traffic high-speed line, which is expected to open towards the end of 2017, is mainly justified on the basis of its expected increase in capacity for freight traffic in semi-urban areas. Oc’Via, a consortium consisting of a range of private construction and infrastructure companies and financing partners, was awarded a 25-year partnership contract in 2012 (Alstom, 2011). A unique feature of the project is that the RFF took direct responsibility for constructing stations for the first time (Railway Gazette 2011b; 2012a). Total project costs were estimated at EUR 2.3 billion, financed as follows: Oc’Via to contribute EUR 1.5 billion during the construction phase, including loans from eleven commercial banks, while the EU and national, as well as regional and local public sector entities would finance the remaining EUR 0.8 billion (Railway Gazette, 2012d). Once the track becomes operational, it is planned that eighty per cent of the debts would be refinanced at lower interest payments, given the guaranteed revenue stream from government (Railway Gazette, 2012d).

49 The name Oc’Via was derived from the words Languedoc, which refers to the culture of the relevant French region, and via, which means ‘way’ in Latin.
50 Two new stations at Nîmes and Montpellier.
51 Expected in 2017 (Railway Gazette, 2012d).
4.5 HSR in the rest of Continental Europe and the UK

After the French, further HSR developments followed in Europe and resulted in an expansive network. At the end of September 2014, Europe had over 7,000 kilometres of HSR lines were in operation, with another about 2,900 kilometres under construction (UIC, 2014).

4.5.1 Delivery

After the creation of the European Union (EU) in the 1990s, a number of reforms were implemented to liberalize the rail industry. These included the following:

- Vertical separation between infrastructure management and train operations.
- Infrastructure managers often being required to provide access to multiple operators\(^{52}\) and to maintain a balanced budget.
- Infrastructure managers being allowed to make a return on their investment from access charges.
- Principles for infrastructure charging schemes, such as a requirement to recover only costs that are directly-related to the operation of the train service such as congestion and environmental charges, as well as the ability to apply yield management practices.\(^{53}\)

4.5.2 Financing

The two main types of financing which is evident in the European HSR system are discussed below.

\textbf{a. Full public financing}

This model entails government raising the capital required to construct the HSR system. There are two main categories of public financing alternatives used for HSR: accumulated public funds (or reserves as will be discussed in Chapter 6), or government borrowing (Duzik \textit{et al.}, 2011). Projects are either financed directly by government (which is the case for around forty per cent of rail infrastructure in the EU), or by way of a mix of direct government and national railway company financing (as in France and Italy) (Roll & Verbeke, 1998). While public financing for the European HSR was originally mainly supplied on a national level, EU financing has started to play an increasingly important role since the creation of the EU (Roll & Verbeke, 1998). EU financial support is provided particularly for projects that connect countries and is administered via the TEN-T projects.

\(^{52}\) Different structures emerged across Europe. In some instances, the holding company remained a single entity, with only financial separation between the operators and the infrastructure manager (such as Germany, with \textit{DB Bahn, DB Regio} and \textit{DB Netz}). Other examples of financial and structural separation include Spain’s ADIF and RENFE; and France’s RFF and SNCF (Teixeira & Pita, 2012).

\(^{53}\) Charging different prices for different services during different times.

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programme, the Structural and Cohesion funds, or as EIB loans. Select examples of these financing models are discussed below:

**Belgium:** HSR infrastructure and operations are fully government-owned and financed by government plus EU contributions (Thompson & Tanaka, 2011; AECOM, 2013).

**Germany:** The German Intercity Express (ICE) HSR infrastructure is owned by Deutsche Bahn (DB) Holdings,⁵⁴ the state-owned national railway company. Line construction has financed through a combination of mostly federal financing, augmented by state and local finance. Public financing sources included national public works budget allocations, as well as accumulated on-system revenues, in addition to financing provided by the EU (Ellis et al., 2013). Its corporate structure also allows DB Holdings to borrow from commercial markets. For example, the Nurnberg-Ingolstadt HSR section, built in 2006 at a capital cost of EUR 3.6 billion, was financed as follows (CHSRA, 2011):

- Federal Government: EUR 2.1 billion
- DB: EUR 1.2 billion
- Regional Government and European Union: EUR 0.2 billion each

**Spain:** The Spanish HSR system, Alta Velocidad Española (AVE) opened in 1992. Administrador de Infraestructuras Ferroviarias (ADIF) is the Infrastructure Owner and Operator. Red Nacional de Ferrocarriles Españoles (RENFE) is the train operator. Both entities are state-owned and managed by the Ministry of Public Works and Transport (CHSRA, 2011; AECOM, 2013). The Spanish HSR network development has largely been government and EU financed. EU contributions to financing the Spanish HSR have been substantial. An example is the Antequera-Granada section in Spain, whose total financing package included a 44 per cent EU contribution (Campos, 2009). EU contributions generally include TEN-T funds, Cohesion funds and European Development Funds, as well as loans from the EIB (Thompson & Tanaka, 2011, Texas A&M Transportation Institute, 2012). Spain invests heavily in HSR and views HSR as mostly a government responsibility (Ellis et al., 2014). The country’s Strategic Plan for Infrastructure and Transport stipulates that around 45 per cent of the nation’s total transportation budget be spent on expanding their HSR network (Ellis et al., 2014).

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⁵⁴ DB Holdings is a private joint stock company owned by government. DB Netz AG is the infrastructure operator; while DB Fernverkehr is the train operator (CHSRA, 2011).
Italy: Italy’s HSR, known as Treno Alta Velocità (TAV), was originally sixty per cent privately owned. In 1998 TAV became fully publicly owned, owing to lack of interest in investing in HSR by private owners. The infrastructure is state owned by the Italian Railway\textsuperscript{55} through its infrastructure subsidiary (RFI), as well as through a special purpose entity (TAV), which is responsible for planning and constructing HSR lines. TAV has a fifty-year concession to design, finance and build HSR lines (Thompson & Tanaka, 2011). Upon completion, HSR lines are owned by RFI. While train operations are also still mainly state-owned, a new private entrant Nuovo Transporto Viaggiatori (NTV) began operating some train services on the state-owned HSR lines in 2012 (Texas A&M Transportation Institute, 2012).\textsuperscript{56} The financing sources for the TAV HSR development are largely government grants; government guaranteed loans, as well as EU grants (TEN-T), and EIB loans (Thompson & Tanaka, 2011; Texas A&M Transportation Institute, 2012).

b. PPP financing

Three financing models that involve the private sector have been employed in financing HSR projects in Europe. Table 19 summarizes the HSR PPP financing models employed in Europe. These models, together with select examples, are discussed below.

\textsuperscript{55} FS and its subsidiaries are wholly government owned corporations (Thompson & Tanaka, 2011).

\textsuperscript{56} Note that this refers to operations of trains only, not construction of an additional HSR line. Vertical separation exists between infrastructure provision and operation of services.
Table 19: PPP schemes in Europe

<table>
<thead>
<tr>
<th>Type</th>
<th>Financing Scope</th>
<th>HSR Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Civil Works</td>
<td>Electro-mechanical</td>
</tr>
<tr>
<td>PPP for infrastructure only</td>
<td>Included</td>
<td>Included</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPP for superstructure only</td>
<td>Excluded</td>
<td>Included</td>
</tr>
<tr>
<td>Broad based PPP</td>
<td>Included</td>
<td>Included</td>
</tr>
</tbody>
</table>

Source: Alstom 2011, p.20.

i. **PPP for infrastructure only**

PPP for infrastructure refers to the private sector being responsible for raising capital for the construction and maintenance of HSR civil works and electro-mechanical aspects. Rolling stock is excluded from the PPP contract. The following three PPPs are examples of this type of agreement.

**UK-France (Channel Tunnel Rail Link):** The Channel Tunnel started operating in 1994, and was financed via a Build Own Operate Transfer (BOOT) PPP contract, which was awarded to a consortium of civil contractors and financiers, called Eurotunnel. The contract included a 99-year concession to operate the line (Thompson & Tanaka, 2011). Eurotunnel raised all the finance to develop the line, which included a combination of private sector shareholder equity and debt. Private finance for this project was of unprecedented scale. The financing approach consisted of private sector equity which was raised in a public share offer as well as a syndicated bank loan and letter of credit (Wilson & Spick, 1994). The costs at completion was GBP 4,650 million (in 1985 prices), which amounted to an 80 per cent cost overrun owing to a combination of factors, including expanding safety, security, and environmental demands by regulators (Flyvbjerg et al., 2003). While no public sector financing was used, the concession agreement with the British and French railways may be regarded as an indirect state subsidy (SDG, 2004).
UK: High-Speed 1 stretches for about 100 kilometres between London and the Channel Tunnel, and was developed at a total cost of GBP 5.8 billion by private consortium London and Continental Railways (LCR). LCR raised the capital for infrastructure by issuing government-backed bonds (Railway Gazette, 2010c). Today the thirty-year concession to operate and maintain the infrastructure resides with a consortium of Canadian pension funds, while the state owns the infrastructure and the freehold to the land (AECOM, 2013). All infrastructure management rights will revert to government at the end of the concession period (AECOM, 2013).

Spain: The 344-kilometre, EUR 6 billion Olmedo-Ourense and the 450-kilometre, EUR 4 billion Madrid-Badajoz HSR routes were similarly financed by an infrastructure type PPP (Alstom, 2011). Financing during the construction phase consisted of a forty per cent equity investment by the state-owned infrastructure manager, Administrador de Infraestructuras Ferroviarias (ADIF) and the balance consisted of external equity financing which was raised by a number of private parties (Railway Gazette 2011a; 2011d; 2012c).

ii. PPP for superstructure only

Netherlands-Belgium: The 100-kilometre, EUR 7.2 billion (Hogesnelheidslijn Zuid [HSL-Zuid]) between the Netherlands and Belgium is the Netherlands’ biggest PPP project to date (Prorail, 2008; Van de Velde & ten Heuvelhof, 2008; Crozet, 2012). HSL-Zuid includes a PPP for superstructure only, whereby the private sector party is only responsible for raising capital (or external equity) for the construction and maintenance of electro-mechanical components. Rolling stock is excluded from the PPP contract. While civil works were built the traditional way, with several engineering contracts commissioned directly by the state, construction and maintenance of superstructure is delivered by way of a long-term capacity concession for all electromechanical aspects, such as track, signalling and electricity (Van de Velde & ten Heuvelhof, 2008; Crozet, 2012). Infraspeed is the private sector consortium and the concession holding company. The project’s transport concession was also financed.

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57 HSR was regarded as a way to enable rail to compete with other modes, as well as encouraging regional economic development. The first line, Madrid-Seville, was built to serve the International Exhibition in Seville in 1992. Subsequent construction of a whole network of lines was encouraged by Keynesian policies so as to relieve large-scale unemployment by a major public works programme (Nash, 2008).

58 Sources consulted did not clarify who contributed equity capital, but it is assumed that it was raised by the private parties to the SPV.

59 Consortium composed of construction companies and institutional investors (Fluor Infrastructure, Siemens Netherlands, Koninklijke BAM Groep, Innisfree and HSBC Infrastructure) (Prorail, 2008; Van de Velde & ten Heuvelhof, 2008).
by way of external equity raised by the High-Speed Alliance (HSA) (E&Y, 2009). The project is split up into a multitude of individual contracts as shown in Table 20, and has experienced various delays and cost overruns\(^6^0\) (Van de Velde & ten Heuvelhof, 2008; Dutzik et al., 2011).

Table 20: PPP parties for HSL-Zuid

<table>
<thead>
<tr>
<th>Party</th>
<th>PPP Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ministry of Transport and Public Works</td>
<td>Commissioning body.</td>
</tr>
<tr>
<td>Project Organization Rijkswaterstaat HSL-Zuid</td>
<td>Overall project manager.</td>
</tr>
<tr>
<td>ProRail (Dutch government rail infrastructure manager)</td>
<td>Manages contract between Infraspeed and government, responsible for capacity, reliability and safety.</td>
</tr>
<tr>
<td>Various contractors (consortia)</td>
<td>Civil works: Design and construction of substructure (concrete foundations).</td>
</tr>
<tr>
<td>Infraspeed</td>
<td>Superstructure concessionaire: Design, construction, financing, operate and maintain superstructure for a period of 25 years.(^6^1) Paid by the state for the realized availability of track.(^6^2) The track concessionaire has no commercial responsibility for the usage of the track capacity.</td>
</tr>
<tr>
<td>HSA (High-Speed Alliance)(^6^3)</td>
<td>Transport concessionaire: 15-year concession for provision and operation of a minimum required number of train services on a commercial basis (i.e., no subsidy). Concessionaire owns trains and has to pay state an infrastructure usage charge for right to use the track. This charge was maximized in a competitive tendering process.</td>
</tr>
</tbody>
</table>


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\(^6^0\) A range of problems (illegal collusion among bidders for the construction contracts, poor coordination among the various contracts, and unexpected delays) led to massive cost overruns in the construction of the line, most of which became the responsibility of government (Van de Velde & ten Heuvelhof, 2008; Dutzik et al., 2011).

\(^6^1\) Including rails, overhead wire system, power supply and safety and communication system (Prorail, 2008, Van de Velde & ten Heuvelhof, 2008).

\(^6^2\) Infraspeed receives revenue from the Dutch State, which is determined on the basis of agreed levels of daily availability performance, and independent of the level of traffic. These payments cover the financing, operating and maintenance cost, taxes and the returns on shareholder investment.

\(^6^3\) Contract awarded in competition to consortium composed of NS (state-owned Dutch national railway, owns ninety per cent) and ten per cent is owned by Air France-KLM (Van de Velde & ten Heuvelhof, 2008; Dutzik et al., 2011).
iii. **Broad-based PPP**

**Russia**: A broad-based PPP involves the private sector in financing of civil works, infrastructure and superstructure. The 600-kilometre Moscow to St. Petersburg HSR line is an example of a broad-based PPP, and is planned for completion between 2015 and 2018. Russian state railways (RZD) has implemented a model that includes civil works, electromechanical and rolling stock, and a thirty-year concession for maintenance and operation. The private concessionaire has also been granted the right to determine the location and number of any intermediate stations. Total development cost was estimated at USD 20 billion, of which RZD planned to finance half while the private partner was planned to finance the remainder. Once completed, RZD will make availability payments to the concessionaire, provided that minimum infrastructure performance criteria are met. RZD will therefore bear operational and revenue risk. The Russian government has justified the project on account of its projected significant external economic benefits, including Russia’s hosting of the 2018 FIFA World Cup (Railway Gazette, 2010a; 2010b; 2011f, Texas A&M Transportation Institute, 2012).

The Global Financial Crisis (GFC) of 2008/2009, as well as the ongoing European debt crises, has led to the cancellation of a number of HSR PPPs, as will be discussed below:

**Portugal**: The 180-kilometre, EUR 1.6 billion Poceirão-Caia line was supposed to be Portugal’s first PPP HSR project (European PPP Expertise Centre, 2010). Concessionaires were required to finance 49 per cent of construction costs, while the Portuguese government would contribute 7 per cent and REFER, the infrastructure manager would invest 3 per cent. EU funds were going to finance the remaining component, including EUR 197 million from the TEN-T initiative (Railway Gazette 2009b; 2010c; 2012b). The contract for the first section of the HSR line was awarded in 2010 to the ELOS consortium, but the project was cancelled in 2011, owing to the country’s financial crisis and legal irregularities on the project (McKenna, 2011).

**Poland**: The HSR line connecting Varsovie, Lodz, Kalisz-Ostrowska, Wrocław and Poznań was planned to total 450 kilometres, at a total cost of EUR 7 billion. The project was, however, abandoned in 2011 as a result of insufficient EU funds (Railway Gazette, 2011g).

### 4.6 HSR in China

China was a latecomer in the HSR arena, and started construction of its HSR programme in 2005 with the building of the Beijing to Shanghai HSR line. By 2009/10, it was already the
world’s largest HSR programme in terms of both system length and utilization, and more than the rest of the world’s HSR programmes put together (Amos et al., 2010). By 2012, the Chinese HSR system comprised 9,676 kilometres of HSR lines in operation with plans to expand the network to 16,000 kilometres of dedicated HSR rail lines by 2020 (Fisher, 2012).

The main motivation for China’s HSR was to meet the demand on overcrowded conventional freight and passenger lines, to improve transportation connections between regional authorities, to promote the economies of less developed regional authorities, and to free up freight rail capacity (BITRE, 2010). Another important component of the programme is the Chinese government’s drive for deriving HSR technology transfer benefits, which has been a further reason for keeping the Chinese HSR system in public hands. The Chinese government has formulated a clear strategy of developing their HSR technical abilities during construction of their HSR system (Ellis et al., 2013). The Chinese government has required private HSR suppliers to participate in structured knowledge sharing programmes in order to qualify for the bidding process (Ellis et al., 2013). Once China had acquired the technical ability to develop components for HSR, it was able to use this competency for the further development of its own expanding HSR network, and to export their capabilities. This is evidenced by recent Chinese bids for supplying HSR components, and financing part of the project, for the proposed Californian HSR project (Ashiabor & Wei, 2012; Ellis et al., 2013).

By 2011, China also indicated a slowdown in the rate of investment in railway associated with the GFC-related stimulus programme, thus recognizing the need to monitor government’s resulting debt burden (Rabinovitch, 2011).

### 4.6.1 Delivery

The Chinese HSR system is fully state owned, with all risk residing with the public sector. China Railways High-Speed (CRH) was established in 2007, tasked with the development and operation of the HSR system (Rutzen & Walton, 2011). While planning and regulatory risks are borne by the national Ministry of Railways (MOR), all other risks, including financing risk are shared between the MOR and local governments (Thompson & Tanaka, 2011). Table 21 summarizes the delivery model.

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64 The South Korean government has also identified benefits for the economy of focusing on developing HSR technological abilities (Honan, 2011).
Table 21: Chinese HSR delivery model

<table>
<thead>
<tr>
<th>Structure</th>
<th>MOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ownership</td>
<td>The existing railway is mostly centrally owned (there are also lines owned by local governments). Some of the new HSR lines will be jointly owned by national and local governments.</td>
</tr>
<tr>
<td>Access charges</td>
<td>None. There are charges for electrification. Access is limited to MOR services.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk Allocation</th>
<th>Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning</td>
<td>MOR</td>
</tr>
<tr>
<td>Political/Regulatory</td>
<td>Tariffs are completely regulated by national government.</td>
</tr>
<tr>
<td>Right of Way Acquisition</td>
<td>MOR</td>
</tr>
<tr>
<td>Infrastructure Construction</td>
<td>MOR</td>
</tr>
<tr>
<td>Infrastructure Maintenance</td>
<td>MOR</td>
</tr>
<tr>
<td>Rolling Stock Acquisition</td>
<td>MOR</td>
</tr>
<tr>
<td>Rolling Stock Maintenance</td>
<td>MOR</td>
</tr>
<tr>
<td>Demand and Revenue</td>
<td>MOR</td>
</tr>
<tr>
<td>Financing</td>
<td>MOR</td>
</tr>
</tbody>
</table>

Source: Thompson and Tanaka 2011, p.50.

4.6.2 Financing

Exact details of financing of China’s HSR programme is limited. The sources reviewed indicate that, to date, the system is fully government financed.65

In 2011, the plan was to finance the system from a combination of local and national grants, domestic loans and potentially, international loans including World Bank loans (Thompson & Tanaka, 2011). Freeman and Kroeber (2010) and Ellis et al. (2013) explained that China’s HSR system is mainly financed by government debt, sourced mainly through state-owned banks. Examples include the Beijing-Shanghai high-speed railway, which was mostly

65 However, a few sources indicate a degree of private participation, while the nature of this participation is unclear. For example, Chen and Zhang (2009) and Ellis et al. (2013) suggested active participation by the local and international private sector, through private pension funds, insurance and investment companies, not only in investing in government bonds, but also as stockholders, sharing risk and dividends for the Beijing-Shanghai line.
financed from government bank loans and bonds, as well as contributions from the seven provinces involved. The Nanjing-Hangzhou HSR line was similarly jointly financed by the former Ministry of Railways and the provinces of Jiangsu and Zhejiang (Railway Gazette, 2013). The Shanghai-Hangzhou HSR line was built by the State-controlled Zhejiang Provincial Railway Investment Group, and financed by the Ministry of Railways, the Shanghai and Zhejiang provincial governments and fifteen per cent by the government-owned Baosteel Group (Railway Gazette, 2010d).

4.7 HSR in the United States
The United States is lagging behind most other developed nations when it comes to investing in passenger rail, including HSR. In contrast with the other case studies, passenger rail was privately financed for a period following the two world wars. In 1970, Amtrak, a publicly funded railroad service corporation was created to take over the role from the private sector. The United States has started working towards a HSR system since the establishment of the Japanese Shinkansen in the 1960s. Most of this amounted to designation of corridors and the establishment of structures and legislation required for public investment in HSR. The United States’ HSR programme is targeted for five key mega-regional authorities66 around the country, including a total of 33 States and the District of Columbia. The HSR programme includes segments of only two ‘true’ HSR projects, the Northeast corridor and the California corridor (Rutzen & Walton, 2011; FRA, 2013). The Department of Transport has stated its intent to invest in the development of initial sections of the HSR network and plans to attract private investors once sections are established and operating on a profitable basis (FRA, 2013). The US government has made several finance programmes available for the development of HSR (Ellis et al., 2013), including USD 8 billion in federal funding via the American Recovery and Reinvestment Act of 2009; USD 1.2 billion through annual federal appropriations for FY2009 (FRA, 2013); and USD 9.4 billion in Federal Railroad Administration grants for HSR innovation in 2011 (CFR, 2012). Amtrak was also able to secure USD 950 million in federal finance from the HSR programme to upgrade critical segments of the Northeast corridor (FRA, 2013). Amtrak has also indicated that it is planning to involve private investors in its HSR development plan of the Northeast corridor (Dutzzik et al., 2011).

66 Seattle-Portland, San Francisco-Los Angeles, Charlotte-Raleigh-DC, Midwest hub, and Northeast corridor.
State finance has also been made available for California, including California’s Proposition 1a Assembly Bill (or the Safe, Reliable High-Speed Passenger Train Bond Act), which authorized California to issue general obligation bonds for the development of its HSR system. The California Assembly Bill 32 also involves the implementation of a market based cap-and-trade programme, which aims to raise funds for projects which would contribute to reducing the state’s greenhouse gas emissions. The cap-and-trade programme is expected to meet part of the local funds required for the HSR programme (Ellis et al., 2013). Financing of the California corridor will also proceed in phases and will require a combination of federal, state and other financing sources. As development costs increase, the need for private sources of finance appears inevitable. Recent estimates put the total cost of phase one of the Californian HSR project (from San Francisco to Los Angeles) at USD 68 billion. Foreign involvement is also highly likely, given that the United States is arguably lacking in both HSR technology and expertise, such as rolling stock, signalling and electrification, which could make up about fifteen per cent of the total cost of HSR (Sheehan, 2011). In early 2013, the Californian governor indicated that an investment is sought from China to bridge the nearly USD 58 billion gap between government funding and total project cost estimates (York, 2013).

4.8 HSR in Australia

A number of proposals for an Australian HSR system along the East Coast have emerged since the 1980s. However none of the proposals has been accepted, given the need for significant government subsidies or tax shields to private sector developers in order to make the project economically feasible. The Australian Government commissioned studies indicate that a complete project comprising about 1,750 kilometres of dedicated route between Brisbane, Sydney, Canberra and Melbourne, would cost about AUD 114 billion (in 2012 dollars), and that the public sector would be required to finance the majority of capital costs (AECOM, 2013). The preferred delivery model involves government ownership of the infrastructure, with private sector operations under competitively tendered concession arrangements (AECOM, 2013). The project appraisal shows that the project could produce a positive financial return on investment, as well as positive net economic benefits (AECOM, 2013).

The Australian Government has subsequently commissioned a study by the HSR Advisory Group (2013), which was in favour of the implementation of the project. They also found
that the project timeline (thirty years) and costs are conservative, with the potential for fifteen to twenty per cent cost savings, as well as potential for shortening the construction time. The Australian Government has since initiated the first steps towards protecting a corridor for a potential future HSR network. However, the project has not been approved at the time of writing this study and debate continues about the viability of this potential project.

4.9 Summary findings

A range of countries have invested, or are planning to invest in HSR and some continue to expand their networks. This chapter presented a review of international case studies on the financing of HSR. A number of financing themes emerged from the case studies reviewed in this chapter. A great variety of financing instruments were employed in these case studies, including grants, budget allocations, government loans, development bank loans, loans from commercial banks, public and private bonds, accumulated revenues and external equity finance. Table 22 provides a summary of financing approaches applied in the case studies.

<table>
<thead>
<tr>
<th>HSR System</th>
<th>Comments</th>
<th>Public Sector Debt</th>
<th>Public Sector Grants</th>
<th>External Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japanese Shinkansen</td>
<td>Old lines (before 1987): Largely public sector debt (loans), with some grants. Financing of new lines (post 1987) included funds from asset sales (privatization of old lines).</td>
<td>Included</td>
<td>Included</td>
<td>N/A</td>
</tr>
<tr>
<td>Other Continental Europe and the UK</td>
<td>Full public sector financing (including government debt and grants, EU grants, EIB loans): Belgium, Germany, Spain; Italy. PPP financing: Spain; UK-France; UK; Netherlands-Belgium; Russia.</td>
<td>Included</td>
<td>Included</td>
<td>Included</td>
</tr>
<tr>
<td>China</td>
<td>Primarily financed by government debt, sourced mainly through state-owned banks. Other financing sources include local and national public sector grants, international loans including World Bank loan.</td>
<td>Included</td>
<td>Included</td>
<td>N/A</td>
</tr>
</tbody>
</table>
This chapter showed that there does not appear to be one clear financing approach that fits all HSR system developments. Nevertheless, a number of common themes emerged regarding the financing of HSR, as will be discussed below:

The case studies showed that appraisal of HSR projects are better documented than the financing appraisal. This literature review confirmed that, while there are well-recognized methods for establishing the economic case, as well as for appraising the delivery model for public infrastructure projects, these processes are less well articulated when it comes to the appraisal of financing methods. The case studies also showed that there is a link between project appraisal and project financing. Project appraisals played an important role in the choice of financing approaches. For example, project appraisals in France were employed to determine the maximum amount of debt financing employed by the GTE responsible for HSR infrastructure delivery.

Investing in the most profitable portions of the HSR network first appears to make future financing easier. This phased approach has been observed in the case studies, including those of France, Japan and the United States. Such an approach is helpful, as the success of prior projects makes financing of new projects less problematic or risky – regardless of whether private or public sector financing is involved. For example, in France, central government support was initially required and was later augmented by EU and local finance once earlier projects proved to be successful.

The emergence of PPP financing models can be observed in the HSR case studies. While most of the initial HSR lines were publicly financed, private sector involvement in the delivery and financing has emerged in the last decade. France pioneered private involvement in HSR when it developed its PPP framework in 2006 and trialled two PPP models. Further HSR projects involving private financing soon followed. The move towards including private partners in HSR financing appears to be driven by a range of fiscal constraints such as the requirement for EU countries to achieve Maastricht criteria for their debt-to-GDP ratios, as well as the impact on financial markets following the global financial crisis. PPP models range in terms of risk transfer to the private sector, with some involving greater risk bearing by the private parties (such as the Russian model, where private parties shared in financing risk from the construction stage), while others meant that government still

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67 Other international examples include Taiwan (Taipei-Kaoshiung); Shanghai’s MagLev; California, Brazil’s São Paulo to Rio de Janeiro.
remained responsible for the majority of risks (including a number of French PPPs). A number of HSR PPPs were recently cancelled, mainly owing to insufficient funding from the EU, and the financial crisis following the GFC. However, given the recent and ongoing nature of these PPPs, it is too early to assess the full impact of these financing models or judge their ultimate success or failure.

Government financial support appears to remain inevitable for the construction of HSR lines, even when PPP arrangements are selected. Full public financing of HSR projects still overshadow PPP financing models, which often includes significant government financing and/or guarantees. Full public sector financed models include Belgium, Germany, Spain; Italy and the original French TGV lines. Even projects which involve private financing often require government financing in excess of half of the capital cost. Recent examples include the Netherlands-Belgium High-Speed Line South (public sector contribution of 86 per cent), the Perpignan-Figueres connection between France and Spain (57 per cent public investment), and the Tours-Bordeaux line in France (50 per cent public investment). Even projects originally intended to be fully privately financed eventually required substantial government financing. Two prominent examples of this are the UK’s High-Speed 1 line and Taiwan’s HSR system, where government investment was required in the form of public sector loan guarantees and the purchase of partial or full ownership of the companies that built the lines (Dutzik et al., 2011).

The growing decentralization of government financing can also be observed. Regional authorities and local governments can contribute significantly to financing an HSR project. The case studies demonstrate that regional authorities and local authorities can play a significant role in financing HSR. Examples include the LGV East, East Rhin-Rhône and BPL, which have benefitted from local finance, which amounted to 24, 29 and 35 per cent respectively. Similarly in Japan, local communities were expected to contribute to the financing of HSR (E&Y, 2009).

The case study review also shows that countries often adopt a variety of financing and ownership models over time. Financing models used in countries with a longer track record in HSR development, such as France and Japan, have often changed to adjust to the external environment, such as the EU debt limitations. For example, in Japan, HSR financing and ownership models underwent a full circle of changes, with initial lines financed and owned by government, then privatized, while subsequent lines were government-owned and
financed again. Similarly, in China, financing has also shifted from central government financing, to later including provinces and state-owned corporations, while government has expressed a desire to further diversify finance options to include private and international investment in future developments. The United States has also adopted a structured phased financing approach, with developments falling into three tiers, with each tier earmarked for different financing approaches, beginning with full government financing and later involving private sector equity. The case studies also highlighted the fact that countries apply different financing models to different sections of their respective HSR networks. Depending on the expected financial performance and other social considerations emerging from project appraisals, different financing alternatives were employed for different sections of the HSR systems. For instance, the French allocated the financially viable components of lines with lower traffic risk to private parties, thereby exchanging public capital expenditure for operating expenditure. Where traffic risk was too high, government assumed responsibility through availability payments and refinancing.

In addition, the case studies indicated that the choice of financing approach has important ramifications in terms of financing costs, project delays and other impacts. For example, we saw that the involvement of many role players in the financing of HSR can significantly delay projects. This applies to involving private entities, as well as multiple layers of government. Examples include the Perpignan-Figueres HSR line connecting France and Spain, for which the concession agreement took almost five years to finalise. Likewise, the HSL-Zuid in the Netherlands was similarly delayed by several years (refer Section 4.5.2). The choice of financing approach can also have major implications for ongoing financing costs, as evidenced by the RFF, whose credit ratings were downgraded in 2012, as a result of its excessive debt levels.

Furthermore, the research revealed that the trend towards vertical separation has also impacted on the way systems are financed. When the delivery model is vertically separated, it offers an opportunity to create a more transparent division – not only of infrastructure management, and operations, but also of financing. Separation allows for a closer alignment between the natural monopolistic natures of the track infrastructure that usually requires public financing, while operation lends itself more naturally to competition and private financing. Separated infrastructure managers are also often structured as corporations which can access loans or issue bonds on international markets, such as the French RFF, DB in Germany and the JRCC in Japan.
Finally, and perhaps most importantly, the case studies showed that the choice of financing approach emerged from a range of circumstances, but not from a conscious and rigorous selection process. Instead, financing models appear to have developed in response to externally imposed factors, such as debt limitations associated with the Maastricht criteria in the EU, as well as the global shift to PPP delivery models, and the GFC. The history of the French HSR system demonstrates this point. France started off employing full state-level public debt financing, which appeared to be motivated in part by national pride to develop Europe’s first HSR network. Once sections of the country enjoyed the benefits of HSR infrastructure, partisan political pressure motivated further public debt financing for routes where net economic benefit was low or negative, augmented by grants from the local and regional authorities, and the EU. Once these routes were in place, the impacts of preceding financing choices contributed to national debt levels that exceeded Maastricht debt limits. Given the constrains imposed on public debt financing at that stage, the country was forced to resort to PPP type financing models, including private sector equity contributions. To attract private financing partners, the French government was required to make significant government contributions and/or bear patronage risk. Such an approach, however, is argued to expose society to moral hazard should they be left liable for the consequences of undue risk-taking by the private parties in question (Keefer & Knack, 2007). In essence, French HSR development spanning over three decades resulted in different financing instrument choices. However, whether the selection process has been optimal, or rather merely expedient given the circumstances, remains debatable (Henn et al., 2015). Other examples of political motivations driving financing decisions for the development of HSR include Russia’s hosting of the 2018 FIFA Football World Cup, as well as China’s and South Korea national HSR technology development drives.

In conclusion, the main aim of the HSR case studies was to explore how financing approaches were selected in practice for large public infrastructures projects. However, the research was not able to uncover any documented systematic appraisal process whereby the range of financing instruments were formally appraised by the public sector decision makers in the process of selecting an approach which is in the best interest of society. A number of early findings by the literature review contained in Chapter 2 were therefore established in these case studies. In particular, the case studies confirmed: (a) the relative incompleteness and inconsistency of finance appraisal methods; (b) that financing appraisals are less mature and developed than project appraisals; and (c) that there is no readily available appraisal
framework for financing approaches in the international HSR environment. Nevertheless, the case study research also helped to provide a better understanding of the categories of financing instruments available for financing such projects, as will be discussed in depth in Chapter 6. While there were limitations in terms of information availability regarding the finer details of the composition of financing instruments selected for all the case studies, as was discussed in more detail in Chapter 3, Section 6, this did not detract significantly from the development of informative chapter findings. The case studies also looked briefly at how these projects were delivered and funded. In addition, a review was provided of the appraisal of the HSR projects and the implications of the results of investment appraisals for how projects were financed. Chapter 5 continues to investigate public infrastructure project appraisals methods further, to ascertain whether these methods might inform the development of a finance appraisal framework.
5 Economic Appraisal of Public Transport Projects

5.1 Introduction
This chapter presents an overview of public infrastructure project appraisal methods and trends. Chapter 2 revealed that financing appraisal methods are less mature and developed than project appraisals. Given the maturity levels of appraisal approaches for public infrastructure projects, a high-level review of project appraisals was performed to guide the development of an appraisal framework for financing instruments. The focus of this chapter is on identifying lessons from project appraisal methods and trends that are transferable to the appraisal of financing, as well as to select an appropriate appraisal method for selecting a financing approach. Public transport projects were selected in view of the complexities involved in appraising these projects. Where relevant, HSR appraisals were included for contextual purposes and for consistency with later chapters. The most prominent policy guidance documents on public transport project appraisals of Australia, New Zealand and the United Kingdom were briefly reviewed.

This chapter is structured as follows. Section 5.2 provides a broad overview of project viability concepts which are important to understand project appraisal methods, this is followed by an overview of the two most prominent appraisal methods, Benefit-Cost Analysis (BCA) and Multi-Criteria Analysis (MCA) respectively in Sections 5.3 and 5.4, as well as a comparison in Section 5.5 of the two approaches. This is followed by Section 5.6, which reviews a range of project appraisal policy documents in terms of the extent to which the selection of a financing approach might already be addressed in existing policy documents. Finally, Section 5.7 outlines lessons for formulating a financing appraisal framework.

5.2 Project Appraisal Concepts
Appraisal of public infrastructure projects are required to decide whether to invest in a project or not, as well as to filter various projects or projects options in order to select the
most beneficial project. The investment decision typically precedes the financing decision, as indicated in Figure 16 (refer Chapter 2).68

Figure 16: Public infrastructure decisions

Source: Based on Henn et al. 2012, p.2.

Selecting which project to invest in involves a range of concepts. Hunsucker (2012, pp.18–19) make a distinction between admissibility (“given a project’s cost and benefits, should the project be undertaken?”) and preferability (“in the case of multiple admissible projects, which is to be preferred?”). The investment decision for public infrastructure, therefore, should consider a project’s viability in relation to other projects, based on three common indicators: Net Present Value (NPV); Internal Rate of Return (IRR) and Benefit-Cost Ratio (BCR). We distinguish between Financial Internal Rate of Return (FIRR) and Economic Internal Rate of Return (EIRR), with the latter referring to a broader concept, which includes not only financial cost and benefit considerations, but also broader economic considerations, such as externalities and spill-overs.69 NPV refers to the discounted value of a project’s estimated future cash flows, IRR is the implied discount rate associated with a project’s anticipated cash flows, and BCR is the ratio of a project’s total benefits to its total costs. Where positive externalities occur, projects are likely to be economically viable in a shorter

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68 Figure 16 shows the way in which effective investment decisions should be made. However, in reality these decisions are not always made in this way, given undue external pressures, which may lead to distorted decision making (Hann & Mack, 2005).
69 Discussed in Chapter 2, Section 2.2.
time frame; and may or may not achieve financial viability at a later stage. Therefore, government investment in an economically viable project would be justifiable, even if the project was not commercially viable. For example, a toll road project may lead to a reduction in pollution and congestion on subsidiary parallel roads, benefits which are difficult for the owner of the toll road to capture. When the owners include the private sector, they would require a project to be financially viable before they would invest in it without any government assistance (Hann & Mack, 2005). Not all public infrastructures have the potential to be financially viable. Furthermore, marketable public infrastructure, such as toll roads where the private sector participant in a PPP delivery model is allowed to charge user charges (toll fees), has the potential of generating a commercial rate of return.

Another important concept in project appraisals is the project life over which the appraisal is performed. The duration of the benefit and cost streams included in the appraisal may differ from the project life (or ‘lifetime’ of the project itself) or its technical life (which is the presumed depreciation period of project assets). For instance, the European Commission requires that the project analysis timelines not exceed the economically useful life of a project, and stipulates 25 years for roads and 30 for railways (Hunsucker, 2012).

Project appraisals usually make allowance for project risk in the demand, economic and financial assessments (PC, 2014). A public infrastructure project may be exposed to a range of risks during its lifetime including bid, construction, demand; financing; regulatory; technological and political risks (Clark et al., 2001, Committee for Economic Development of Australia [CEDA], 2010; E&Y, 2009). An example of project risk is the inclination to systematically overestimate project revenues and underestimate project costs and timeframes (or optimism bias) for public infrastructure projects (Flyvbjerg, 2003; Flyvbjerg, 2005). Flyvbjerg (2009) identifies examples where final projects cost exceeded budgeted costs by as much as fifty to one hundred per cent for a range of international public infrastructure projects. Asymmetric information may also impact on selecting the most appropriate project appraisal metric or IRR (Chan et al., 2009). Asymmetric information refers to the uneven distribution of information concerning the risk-return characteristics of projects to be financed between different parties involved in its financing and delivery. The phenomenon is particularly problematic for large-scale infrastructure projects involving multiple participants, and where a project proponent potentially possesses more information regarding the financial viability of a project than a potential investor. By way of illustration, the implication of asymmetric information is that government may expect a higher return
(and/or lower risks) on a public infrastructure project than what the market estimates. Government’s estimation may be more reflective of the real project viability if government has better access to information or expertise to estimate a project’s risks and returns than the market. International benchmarking of costs and benefits, as well as transparency of project appraisal, is recommended to improve project estimations (Flyvbjerg, 2009).

Governments traditionally used to start off with performing an economic analysis in order to determine whether it should develop public infrastructure projects. However, there is evidence of an emerging emphasis being placed on financial analysis as opposed to economic analysis of public infrastructure projects which considers society’s welfare. It is argued that economic analysis should take precedence and this requires a thorough understanding of societal aspects and welfare economics. Along with the shift towards private involvement in the financing of public infrastructure, governments have become more reliant on external advisors from the private sector financial and investment field to appraise projects. Indeed, Snyder and Luby (2012) have raised concerns about such external advisors’ objectivity, insight and incentives to consider societal welfare. Similarly, a recent shift towards establishing the financeability (also known as ‘bankability’) of a project from the outset has been observed, as was the case for the proposed Melbourne to Brisbane Inland Freight Rail Corridor (Hann & Mack, 2005). In Australia, the major driving force for this focus on attracting private finance is the perceived Australian Government’s current surplus fetish (as described in Chapter 1, Section 1.3).

The methodological frameworks for ‘evaluating’ (when it takes place ex post) or ‘appraising’ (when it takes place ex ante) public infrastructure projects are grouped into mainly single criterion methods (or a monetary approaches), and multi-criteria methods (non-monetary approaches). Benefit-Cost Analysis (BCA) falls into the first category, while Multi-Criteria Analysis (MCA) clearly falls into the second category. The two main appraisal approaches are outlined in Sections 5.3 and 5.4 and includes a discussion of their respective strengths and weaknesses.

5.3 Overview of Benefit-Cost Analysis Methodology

Benefit-Cost Analysis (BCA) determines the value of a project in monetary terms by calculating whether the benefits involved in undertaking a particular project offset the costs and achieve efficient use of resources. In sum, BCA employs money values as its aggregation unit (Tudela et al., 2006). As introduced in Section 5.2, there are three essential
project performance indicators for a BCA project appraisal, being its NPV (criterion for acceptance is $\text{NPV} \geq 0$), IRR (criterion for acceptance differs by project) and ratio of benefits versus costs (an indicator of the profitability of the project with the value ‘1’ representing the threshold for an acceptable project) (Martin, 1997; Diakoulaki & Karangelis, 2007; Barfod et al., 2011; Suksri et al., 2012). Inflation is normally removed from BCA analysis of projects, while performance indicators are normally expressed in (current) constant terms. The reason is that inflation would seem likely to impact equally on project costs and benefits (or nearly so).

BCA is the most commonly applied evaluation and appraisal mechanism for public infrastructure projects, and is usually required for large-scale public infrastructure projects (Abelson, 2008). In a substantial review of Australian project appraisal documents, manuals and guidelines, Douglas and Brooker (2013) reported that a project appraisal process based on BCA is favoured in Australia, and dates back over forty years. For example, NSW Treasury requires a BCA process for all projects costing above AUD 10 million. Other examples of the use of BCA include the United Kingdom, Europe, the United States, Canada, Japan, and New Zealand (refer Sections 4.2.2 and 5.6).

There has been a trend towards expanding the appraisal from pure economic aspects to broader socio-economic criteria. As a consequence, greater support for performing BCA appraisals within a wider MCA-type decision making framework has been observed (Douglas, 2013). Recent developments in the assessment methodologies and techniques involved in economic appraisal of projects include Economic Impact Analyses which consider second-order impacts, or wider economic benefits (WEBs) such as agglomeration economies, the use of productivity tools, valuation of reliability enhancement benefits, labour pooling, efficiency and the use of computable general equilibrium models (GHD, 2012). Other examples of the consideration of WEBs in project appraisals include Joint Transport Research Centre (2008); Abelson (2010), Chen and Hall (2012); Hof (2012); Thomopoulos (2013); Hensher (2014); Hensher et al. (2014) and Beyazit (2015). At this point in time, the metrics for both WEBs and productivity tools are regarded as overly subjective and not appropriate to replace traditional BCA metrics. As discussed in Section 2.5.3, other criticisms levied against the use of general equilibrium models include possible double-counting, inconsistency in calculations, lack of transparency and the relative immaturity of models (Dixon, 2009; Tavasszy, et al., 2011; Hof, 2012). Most public policy documents require BCA appraisals to exclude any second-order impacts such as WEB and
productivity aspects, but it is acceptable to consider these aspects informally to complement the formal BCA (DIRD, 2013).

5.3.1 BCA Types
Three general types of BCA exist, namely a financial, economic and social BCA. For a large public infrastructure project, the BCA usually commences with the quantification of the investment plus running cost of a scheme, compared with direct benefits and cost savings. This represents the financial BCA, and only addresses investment, monetary revenues, and operating costs. An economic BCA expands the financial BCA by adding any implied consumers’ surpluses, externalities, and in the general shadow-pricing of inputs and outputs. A social BCA enhances the appraisal further by also incorporating equity considerations. Whereas the first two BCA types need to pass the efficiency test, a social BCA also has to pass an equity test. These tests are applied either sequentially or simultaneously (Martin, 1997). The inclusion of equity considerations involves weighting the utilities of the various income groups affected by the project (Martin, 1997; Barfod et al., 2011).

An economic and social BCA adds significant complication to the appraisal process, since a social surplus (the sum of users’ surplus, producers’ surplus, and, sometimes, non-users’ and public sector surplus)\(^7\) is a prerequisite for project acceptance (Tudela et al., 2006). Economic and social BCAs involve the weighting of consumer surpluses and the calculation of external costs and benefits, especially if they refer to non-tradable goods such as environmental quality, human health, and biodiversity (Martin, 1997; Diakoulaki & Karangelis, 2007). Externalities are usually quantified by applying valuation techniques derived from economic welfare theory or from data derived from relevant studies and often causes a lot of debate (Diakoulaki & Karangelis, 2007, Martin, 1997). After quantification of all the project costs and benefits has been achieved, an inter-temporal discount is applied to translate future costs and benefits to present day values by means of a social discount rate, thereby enabling the comparison of future and present values (Beria et al., 2012). Finally, sensitivity analyses are usually performed to check the robustness of results and investigate the impact of the most uncertain parameters (Diakoulaki & Karangelis, 2007).

\(^7\) A surplus refers to the difference between users or producers willingness to pay and willingness to sell for a good, and the effort required to obtain the good.
5.3.2 BCA Strengths and Weaknesses

The key benefit of BCA is that it is a very common and mature appraisal technique that is relatively well understood by a range of decision makers, especially as it relates to direct monetary costs and benefits. It is regarded as being compatible with the mechanisms applied in the private sector markets for selecting projects (Abelson, 2008). While it is often difficult to express the impacts of non-traded goods in monetary terms, progress has been made in the appraisal of externalities (Diakoulaki & Karangelis 2007).  

Since BCA is based on the monetization of all costs and benefits of a project, it has limitations in terms of dealing with non-quantifiable effects, which are usually treated by description only and various assumptions are established (Wellman & Spiller, 2012). Even socio-economic BCA appraisal methods for public infrastructure projects (such as the Danish public transport appraisal policy) do not provide any specific guidelines on how to include other strategic impacts, but merely suggest describing and keeping in mind such impacts during when appraisals are carried out (Barfod et al., 2011). Examples of such non-quantifiable impacts associated with public infrastructure include sustainable mobility and urban quality of life or any aspects involving values (such as fairness) (Beria et al., 2012).

BCA is also limited in dealing with different stakeholder opinions and public participation in the decision-making process (Tudela et al., 2006; Suksri et al., 2012). Public infrastructure project appraisals often involve significant complexity, since there are often trade-offs between different aspects and various stakeholders with often conflicting criteria (Suskri et al., 2012). Each scenario presents advantages and disadvantages, and conflicts between socio-political, economic, technical and environmental aspects. Hence, it is often impossible to determine a single scenario that satisfies all stakeholders (Diakoulaki & Karangelis, 2007; Huang et al., 2011). Diakoulaki and Karangelis (2007) suggest that the inability of conventional appraisal approaches such as BCA to address these complications formally and transparently results in policy makers sometimes resorting to informal and highly subjective, or instinctive decision-making. This shortcoming of BCA is seen as a motivator for the move to adopt MCA techniques (Huang et al., 2011; Suksri et al., 2012), as discussed below.

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71 Quantifying the costs and benefits of non-market goods (such as time or environmental costs) requires translation into the common numerary by means of the willingness to pay or by deriving prices from substitute markets (hedonic prices method) (Beria et al., 2012).
5.4 Overview of Multi-Criteria Analysis Methodology

Multi-Criteria Analysis (MCA) involves an appraisal process whereby a range of quantifiable and intangible aspects are applied in order to analyse different projects or project options in order to select the most desirable alternative. There is a growing awareness that, besides the social costs and benefits associated with large public transport infrastructure projects, other impacts that are more difficult to quantify should also influence the decision-making process (Barfod et al., 2011; Suksri et al., 2012). Recognition of this requirement has led to the adoption of multi-criteria approaches in the United Kingdom and a range of other European countries, including Germany and Spain (refer Sections 4.2.2 and 5.6.4).

MCA requires the specification of project objectives and its corresponding attributes or indicators, both qualitative and quantitative (Tudela et al., 2006). Thereafter, MCA applies scoring, ranking and weighting to project appraisal criteria, based on appraiser’s judgements in order to determine the optimal outcome (Beria et al., 2012). The project or policy measure that achieves the highest aggregate score or the highest aggregate preference index represents the best compromise among the alternatives under consideration (Diakoulaki & Karangelis, 2007). A typical MCA appraisal process involves the following five steps (Huang et al., 2011):

- Definition of the alternative projects being appraised
- Definition of the appraisal criteria
- Analysis of the impacts associated with the criteria
- Evaluation of the effects of the alternative projects in terms of each of the selected criteria
- Aggregation of appraisal or judgements

In essence, multi-criteria methods resolve conflicts in decision criteria by aggregating either performances or individual preferences in each single criterion by translating these into relative weights of importance. MCA allows for stakeholder inputs in the decision-making process and may include common citizens, political actors or industry experts (Beria et al., 2012).

5.4.1 MCA Types

Three main classes of multi-criteria methods have emerged, namely Analytic Hierarchy Process (AHP), Multi-Attribute Utility Theory and Outranking (Tudela et al., 2006). Of these, AHP is the most frequently used and well known multi-criteria technique (Linkov et
Analytic Hierarchy Process (AHP) was developed by Saaty (1994). AHP is one of the most common MCA techniques and organizes tangible and intangible aspects in a systematic and simplistic way (Awasthi & Chauhan, 2012). AHP requires the following process (Tudela et al., 2006; Huang et al., 2011, Awasthi & Chauhan, 2012):

- Decomposition of a complex decision making process into a hierarchical structure of criteria, sub-criteria, attributes and alternatives
- To this hierarchy, a set of weights are added
- Once weights are specified, the hierarchy is folded back, thereby resulting in a final weight per project option being appraised, which is used to rank alternative project options.

The hierarchical structure or ‘probability tree’ consists of the ultimate goal of the project at the top, with subsequent levels of primary criteria; sub-criteria; and any additional sub-criteria; ending with discrete options under consideration at the bottom. The elements of the hierarchy can consist of any aspect of the decision problem, and allows for the inclusion of both tangible and intangible, robust measurement and rough estimations, as well as thoroughly and poorly understood aspects (Beria et al., 2012). Given that the hierarchy is often constructed with the help of various stakeholders (such as experts, decision makers and the general public), it requires careful facilitation to avoid double-counting of attributes (Tudela et al., 2006). The weights added to the hierarchy reflect the relative importance of the hierarchy components and allow decision makers to select the best compromise solution (Tudela et al., 2006). The original procedure developed by Saaty (1994) requires these weights to be calculated from pair-wise comparison matrices, for each nest in the hierarchy. Analytic Network Process is an extension of AHP. This technique uses pair-wise comparisons of criteria and asks how much more important one is than the other without making assumptions about the independence of higher level aspects from lower level aspects, or the independence of the elements within a certain level (Huang et al., 2011).

Keeney and Raiffa (1976) developed Multi-Attribute Utility Theory, which adds another dimension to the MCA appraisal approach by transforming scores at any level into utility functions (following von Neumann and Morgenstern, 1944). Consistent with the axioms of decision theory, the project alternative with the highest utility would be the most preferred...
alternative (Huang et al., 2011). Multi-Attribute Utility Theory can be especially useful when no clear hierarchical structure or interactions between attributes are evident.

Outranking approaches (including Preference Ranking Organization Method for Enrichment Evaluation and Elimination and Choice Expressing Reality) requires conducting various ‘votes’ amongst dimensions in order to select the best alternative (Huang et al., 2011). An alternative’s score on a specific dimension indicates how well it compares to other alternatives, while the objective of calculating an overall score per alternative is not merely to identify a single correct answer, but to facilitate a deliberate process for stakeholder involvement. Examples of outranking approaches include the Regime method and the Technique for Order Preference by Similarity group of methods. The Regime method uses pair-wise comparison to create a synthetic index in its appraisal of alternatives, while the Technique for Order Preference by Similarity group of methods compares a set of alternatives by calculating the distance between each alternative and the ideal, as well as the worst alternative (Beria et al., 2012).

The MCA types differ somewhat in the approaches that they adopt for calculating ratings and weights, with each having its own techniques for assigning and combining values, information and knowledge requirements, as well as the mathematical properties of calculated scores. The fundamental process for applying multi-criteria methods, however, remains unchanged (Huang et al., 2011). Furthermore, it has been found that, while the choice of multi-criteria method may be impacted by a range of factors, such as availability of specific expertise and software tools, the method selected does not significantly alter the outcome (Tudela et al., 2006; Huang et al., 2011).

5.4.2 MCA Strengths and Weaknesses

Multi-criteria methods are most useful in a complex policy-making context, where there are potential projects that have significant economic, social and environmental impacts and various stakeholder groups, rather than other traditional appraisal approaches (Suksri et al., 2012). Barfod et al. (2011) points out that there has been a growing awareness of late that, aside from the social costs and benefits associated with transport, other impacts that are more difficult to monetise should also influence the appraisal process. As a result, MCA is

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72 The ideal alternative is the one that performs best on each dimension; and the worst alternative performs worst across the weighted dimensions. Distances are calculated based on one of several possible distance measures, such as the Euclidean distance measure (Huang et al., 2011; Awasthi & Chauhan, 2012).
growing in popularity and techniques are maturing. MCA is also credited with better quality decisions; enhanced decision-making satisfaction, as well as increased decision maker productivity (Barfod et al., 2011). MCA allows for formal inclusion of aspects other than pure financial ones, including intangibles such as noise, accidents and air pollution, in addition to public opinion, especially when accurate information about project alternatives and their potential impacts can be provided on a timely basis to society (Tudela et al., 2006). MCA is particularly beneficial in including stakeholder views and different objectives in decision-making in a practically useful and technically valid manner, especially when we deal with criteria that are difficult to quantify, and which require trade-offs (Huang et al., 2011; Suksri et al., 2012). Some MCA studies have explicitly incorporated local community groups and other stakeholders’ views via focus groups, surveys, and other research techniques into the selection process (Huang et al., 2011). MCA provides an understandable and systematic methodology to organize technical information and convert it to a set of ranked project alternatives. Not only does it help to quantify decision makers’ and stakeholders’ inputs, but also it provides a framework for identifying selection criteria (Tudela et al., 2006; Suksri et al., 2012).

The adoption of MCA tools in public infrastructure projects has increased considerably over the last two decades (Diakoulaki & Karangelis, 2007). MCA-based approaches are frequently applied to utility and public transport projects, including formal adoption of MCA appraisal frameworks for the public transport projects by the French and Dutch governments (Barfod et al., 2011). The growing adoption of MCA methods is ascribed to increased decision complexity, data availability, the need for performing comparative appraisal of various project scenarios and a push for transparency by regulatory and stakeholders bodies (Huang et al., 2011). In addition, it allows for trade-offs in a transparent manner, so it is also useful in resolving conflicts by clearly revealing preferences and priorities (Lee et al., 2009). MCA is also described as an appraisal method which is well-suited to public infrastructure projects, since it is well-structured, coherent, straight-forward and flexible (Barfod et al., 2011).

MCA techniques clearly presents decision makers with a range of benefits, however, there are also potential weaknesses which need to be addressed. The subjective allocation of criteria weights by individuals is the main criticism against multi-criteria methods, which renders MCA susceptible to manipulation (Abelson, 2008). In contrast to the BCA method,
which assumes the availability of empirical data, data in MCA are derived or interpreted subjectively as indicators of decision makers’ preferences (Barfod et al., 2011). These preferences often differ by decision maker. The final outcome of the appraisal depends on who the appraisers are. Hence, the choice of decision makers is critical with respect to deciding the outcome of this analysis because MCA involves subjectivity. As a result, transparency and systematic processes are crucial (Barfod et al., 2011). Rigorous application of the MCA techniques can introduce objectivity and transparency in the process which counter the risk of manipulation. For example, the determination of weights can be addressed by rigorous MCA techniques, such as AHP which derives weights in a quasi-independent fashion by utilizing pair-wise comparisons and make it hard to favour open biases (Barfod et al., 2011).

5.5 Combining MCA and BCA
The joint use of BCA and MCA is becoming more commonplace, given their complementary nature. The respective outcomes of BCA and MCA methods are often different, owing to dissimilarities in their theoretical foundations (Tudela et al., 2006). The difference between the outcome of a BCA and MCA process depends on a range of factors, including the kind of impacts considered, how well stakeholders understand impacts, uncertainties in estimating external cost values, assumptions, and technique applied to derive weights (Diakoulaki & Karangelis, 2007). BCA translates a project alternative’s entire social welfare function of into one final numerary, based on physical measures, models and values prescribed in policy documents. The output from a BCA becomes one of the important inputs to consider when selecting an approach. BCA generates a ranking of alternatives to assist in the decision-making process. A BCA appraisal is often applied as a filter in the selection process, and aims to inject objectivity in the decision. The results derived from a BCA are often used as a starting point, with the ultimate decision involving additional qualitative aspects, including subjective expert analyses (Han, 2013). MCA applies a range of criteria and includes qualitative aspects in the analysis. MCA uses decision makers’ ranking as an input and weights it alongside other stakeholders’ rankings. There are two common ways of combining the BCA and MCA methods (Beria et al., 2012):

- Developing BCA and evaluate the soft (indirect or intangible) effects with MCA.
- Developing a MCA for a broad screening of options, followed by a BCA appraisal of public expenditures and consumer surplus.
Examples of public infrastructure project appraisals that applied a combination of BCA and MCA include Lee et al. (2009) and Sayers et al. (2003), while Barfod et al. (2011) used a composite model combining MCA with BCA for the appraisal of the economic and strategic impacts associated with transport projects. The United Kingdom, Germany and Spain also currently use a combination of BCA and MCA for HSR project appraisals (refer Section 4.2.2). Other examples of public transport project appraisals based on a combination of MCA and BCA are as follows (Beria et al., 2012):

- Sweden, Netherlands, the United Kingdom use BCA augmented with a specific appraisal for impacts that are difficult to be monetized.
- An MCA that includes BCA as one of the criteria is used in Belgium, Austria and Greece for transport investment appraisal.
- France has recently adopted MCA tools, and claims that BCA is weak in stimulating stakeholders’ interactions and to elicit larger public debate.

5.6 Project Appraisal Policy Documents

This section summarizes select countries’ project appraisal methodologies, with a view to extract lessons which can be transferred to the development of an appraisal framework for the financing of public infrastructure. The review also considered to what extent the financing decision is addressed by the project appraisal policies. For illustrative purposes, prominent policy guidance documents on large-scale public transport project appraisals in Australia, New Zealand, the United Kingdom and Europe are briefly reviewed.

5.6.1 Australia

The Australian Transport Council’s National Guidelines for Transport System Management (ATC, 2006) is applied in the appraisal of public transport projects.73 The guidelines suggest the following eight-stage project review process:

- Objective setting
- Policy choices
- System planning
- Identifying initiatives

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73 At the time of writing this chapter, these guidelines were undergoing a review. In the meantime, the 2006 guidelines remain in place.
In essence, the guidelines require a threefold filtering process which includes an adjusted BCA that incorporates monetized, as well as non-monetized impacts.

Figure 17: Three-staged appraisal process


Figure 17 demonstrates that the first filter is the Strategic Merit Test, which uses a largely qualitative assessment of the strategic fit of each proposal, including how well the initiative contributes to the transport system objectives and strategies. Projects that past this test go through to filter two, which is called the rapid appraisal and involves an indicative BCA. Should a project pass the secondary filter, it will proceed to the third filter, which requires a detailed analysis of the monetary and non-monetised impacts of the project, based on a comprehensive BCA. Infrastructure Australia (IA) contends that, because Wider Economic Benefits (WEB) calculations are still in its infancy, they should be treated separately to the traditional BCA. However, IA is prepared to consider WEB calculations, where appropriate, as complementary ‘texture’ in its decision-making process (IA, 2013). The guidelines furthermore suggest that overall funding and financial arrangements must be managed for the programme during phase seven (programme delivery). However, the National Guidelines
for Transport System Management (ATC, 2006) clearly states that it does not provide any guidance on selecting the financing approach.

In addition to the ATC’s guidelines, there is a separate policy document that deals with the procurement of public infrastructure. This was developed by IA and is called The National Public Private Partnership Policy Framework (IA, 2008). All projects above AUD 50 million must undergo this assessment. More recently, IA has indicated that its input is generally required for projects over AUD 100 million (IA, 2014). This document describes a Procurement Options Analysis, which aims to guide the selection of a public infrastructure project’s delivery model and contract type. The procurement decision rests mainly on a comparison of the whole-of-project-life impacts of public versus private project delivery. It includes a qualitative and quantitative appraisal.

The quantitative appraisal stipulated a Value-for-Money (VFM) assessment using the Public Sector Comparator (PSC) which is defined as follows:

A benchmark against which VFM of private sector bids is assessed. It is typically a cost estimate based on the assumption that assets are acquired by the Public Sector through conventional funding and that the procurer retains significant managerial responsibility and exposure to risk.

IA 2008, p.iv

The PSC is calculated as follows:

\[
PSC = \text{Raw } PSC \text{ (or base costing)} + \text{Competitive Neutrality} + \text{Transferred Risk} + \text{Retained Risk}
\]


Figure 18 shows an extract of the five-point qualitative rating system which is suggested for decision makers:
The document suggests that PPPs are most suitable for projects that are of a sufficient scale and long-term nature, and which involve complex risk profiles and opportunities for risk transfer, as well as opportunities for private sector innovation and measurable outputs specifications. The policy document also provided definitions of important concepts such as the discount rate to be applied when the delivery involves private investment, which is defined as:

The Risk-free Rate plus that portion of the Systematic Risk Premium transferred to the private sector as compensation for the Systematic Risk borne by them.

IA 2008, p.iv

The prescribed methodology also confirmed the need to only include systematic risk in benchmarking the cost of private provision, and not project specific risks that are diversifiable. Systematic risk is defined as ‘market-wide risks that affect all asset classes and cannot be reduced by diversification’ and includes demand risk, asset residual value, insolvency or financial difficulty brought about by an economic downturn, as well as inflation’ (IA, 2008, p.v).

The document furthermore stated that the investment and procurement (or delivery) decisions are separate, and that the investment decision is required before the procurement decision. An underlying principle of the policy document is that the preceding steps of the project appraisal has already established that the investment should go ahead based on merit, with the remaining decision being whether to procure through traditional (public sector) means or through PPP delivery. However, the terms ‘financing’ and ‘procurement’ (or delivery) were used interchangeably in the document.
The National Public Private Partnership Policy Framework (IA, 2008) additionally emphasized the need for careful consideration of decision support tools, ensuring that appraisers have sufficient expertise and knowledge of the public infrastructure environment, and that any formulae or methodologies that conceal their logic or fail to demonstrate the reasoning involved should be avoided. The document also warned against overreliance on one tool, and suggests that it would be wise to triangulate the results from more than one tool. Another important principle emphasized in the policy document is the need for objectivity in the analysis, and a warning to steer clear of ideologically driven decisions which are not justified by a robust Value-for-Money (VFM) assessment.

In summary, the appraisal methodology that these policy documents stipulate involves an approach that includes both qualitative and quantitative elements. From a financing perspective, however, apart from determining the merits of private versus public delivery (which has implications for the source of financing), neither of the two documents offers any specific guidance on assessing alternative financing instruments in order to select the best approach for society. That said, the policy documents do offer valuable advice regarding the qualities that should be considered in the selection of an appraisal mechanism; for instance, the need for triangulation of results, and the importance of objectivity. The policies also include definitions of key concepts and appraisal principles, such as systemic risk, which also have implications for appraisal of financing instruments. The documents also provide insight into the difference and proposed order of the investment and procurement (delivery) stages involved in project appraisal, all of which is important context for the appraisal of financing approaches. All these aspects are transferrable to the development of a framework for the appraisal of a suite of possible financing approaches for a public infrastructure project.

5.6.2 The United Kingdom

The UK Department for Transport’s Transport Analysis Guidance (TAG) provides the requirements for appraisal of public transport projects. The introductory guidelines of TAG (DOT, 2005) provide a diagrammatical summary of the required appraisal approach, as demonstrated in Figure 19.

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74 Triangulation refers to the process of assessing the research results from multiple points of view to improve accuracy (Neuman, 2011). Triangulation of research means that more than one research approach or method is used to compare results, and improve confidence in findings.
Figure 19: Appraisal process

Source: DOT 2005, p.3.

Figure 19 shows that a comprehensive appraisal process is required that incorporates an understanding of both the current and future situations, what objectives the infrastructure needs to achieve, stakeholder consultation, and intangible impacts such as distributional equity, practicality and public acceptance. While the TAG documents offer significant guidance on the appraisal of projects, the guidelines offer no direction in the appraisal of different financing approaches or instruments. The guidelines (DOT, 2012) require the calculation of a BCA that appraises the net social impacts of public transport projects. The guidelines provide a useful overview of the different appraisal measures involved in a BCA-oriented appraisal, where every effect can be expressed in monetary terms by way of a range of performance indicators including Net Present Value (NPV), Benefit-Cost Ratio (BCR), and the Net Present Value/Cost Ratio (NPV/C) (TAG, 2005). Two BCA methods are accepted: a willingness-to-pay approach, or a calculus of net social benefits and costs (TAG, 2012). The benefit of applying the willingness to pay approach is that it helps to unpack the
different impacts on various economic interest groups, such as car users versus public transport users, versus taxpayers, etc. This method is especially valuable when there is private sector involvement in the delivery and financing of public transport, particularly given their requirement for commercial sustainability. The same holds for public sector agencies that are expected to operate on a quasi-commercial basis. In addition, the guidance document also distinguishes between *(ex-post)* evaluations (which take place after the event and uses historic data) and *(ex-ante)* appraisals, which use estimations and takes place before the project.

5.6.3 New Zealand

The New Zealand Transport Agency’s Economic Evaluation Manual (NZTA, 2010) sets out the policy for public transport project appraisals in New Zealand. The appraisal procedures involve a BCA that includes both financial and social factors. The guidelines document also addresses some aspects of the appraisal of PPP delivery, which is termed ‘private financing’ in the documents. Decision makers are also warned against double-counting any appraisal aspects. There is limited mention of some financing aspects, including a suggestion to adopt the private sector service providers’ weighted average cost of capital (WACC) as the performance indicator for the private sector’s required rate of return. However, the manual does not offer any guidance on the appraisal of the various financing approaches available.

The New Zealand Transport Agency’s Procurement Manual (NZTA, 2011) for activities funded through the National Land Transport Programme focuses on providing guidance on the consideration of PPP delivery for public infrastructure based on a Value-for-Money (VFM) approach. This document indicates that there is no guidance on the selection of the particular financing or financing approach.

5.6.4 Europe

The European guidelines for project appraisal is summarized in a document called Developing Harmonised European Approaches for Transport Costing and Project Assessment (HEATCO) (IER, 2005). The HEATCO document suggests an in-depth appraisal process, initially based on BCA, with wider impacts being considered subsequently in an MCA approach (refer Figure 20).
NPV is suggested as the main BCA indicator to establish whether a project is sufficiently beneficial. Depending on the context, it suggests the use of BCR and the ratio of NPV and public sector support (RNPSS) as additional performance indicators. The guidelines also emphasize the clear drawing of boundaries in terms of impacts, whether they be macro-economic or micro-economic. The guidelines explain that, while the wider macro-economic impacts, which are also known as Wider Economic Benefits (WEBs), of a project should ideally be considered, they should not be included in the BCA. The reason for this is that calculation of WEBs by way of general equilibrium models is often not practical given that the level of sophisticated analysis and refinement required is not typically available within the departments who are involved in performing appraisals. Therefore, the HEATCO guidelines suggest a partial equilibrium approach that only considers direct impacts, based on the following summary calculation:

However, where indirect socio-economic effects are likely to be significant, the HEATCO guidelines suggest the quantitative modelling of results by way of a general equilibrium model, in particular a Spatially Computable General Equilibrium (SCGE) model. Where resource constraints, data availability, or concerns regarding the reliability of such models pose a problem, a qualitative appraisal is recommended instead. Notable intangible impacts should be monetized wherever possible. If that is not possible, intangible impacts should be presented in a qualitative manner, and explicitly included in the appraisal process following an MCA approach, whereby impacts are allocated weights by decision makers and expressed relative to the monetised impacts resulting from the BCA appraisal. Consideration of distributional or intragenerational issues is also formally addressed in the prescribed appraisal. Intragenerational equity is defined as any differential or disproportionate impacts as a result of a given project being implemented on different social groups. These social groups may be defined in terms of income distribution, or on the basis of race, gender, location, age, skill or health. It is recommended that intragenerational equity issues be quantified by way of adjusting the size of weights allocated to project benefits and costs in the NPV calculation. The policy also reminds appraisers to consider possible optimism bias when evaluating project costs.

The HEATCO (IER, 2005) document makes a clear distinction between investment appraisal and analysis of the financing approach and recommends that no adjustment be made for the type of financing selected in the project appraisal, the reason being that the net investment costs for a project remain the same regardless of how it is financed. However, the document very clearly states that “the method of financing will have financial and distributive impacts” and it is therefore important that a separate appraisal of alternative financing approaches be made (IER, 2005, p.15). The document consequently also does not attempt to offer any guidance on the appraisal of alternative financing approaches.

<table>
<thead>
<tr>
<th>Overall Economic Impact</th>
<th>Change in transport user benefits (Consumer Surplus)</th>
<th>Change in system operating costs and revenues (producer surplus and Government impacts)</th>
<th>Change in costs of externalities (environmental, accidents, etc.)</th>
<th>Investment costs (including mitigation measures)</th>
</tr>
</thead>
</table>

5.7 Summary findings

This chapter reviewed public infrastructure project appraisal methods and trends. Project appraisals involve assessment of the investment decision, which usually involves a BCA or MCA, while the procurement or delivery appraisal is typically based on a Value-for-Money (VFM) assessment which applies Public Sector Comparator (PSC) benchmarks. The policy documents reviewed make distinctions between the investment and delivery stages of project appraisal, as well as emphasizing the need for clear boundaries between the concepts of project appraisal and financing appraisal. For example, the European HEATCO (2005) guidelines stipulate that no adjustment should be made for the type of financing selected in the project appraisal. This distinction reinforces the Fisher Separation Theorem (Fisher, 1930), which was discussed in Chapter 2, Section 2.3.

A review of the key project appraisal policy documents for public transport in select countries also showed that while the appraisal of projects are dealt with in depth and utilize mature appraisal processes, the policies do not attempt to provide guidance on the appraisal of different financing instruments. Procurement (delivery) appraisals do address aspects of the financing decision, particularly the question of whether delivery should be public or private, yet they do venture into how a detailed appraisal of the different financing options within this broad public/private split should be performed. This review showed that public infrastructure appraisal policies fail to provide guidance on performing a focussed assessment of the range of financing alternatives once a project appraisal has been completed. This is consistent with the findings of Chapter 2, i.e., that no clear financing selection framework exists for public infrastructure projects in theoretical, academic and other commissioned studies which focus on the financing aspect.

The review indicated that there are a range of appraisal approaches for transport projects. These can be broadly categorized into BCA and MCA. There is a trend to combine quantitative and qualitative, as well as monetary and intangible elements, in project appraisals in order to incorporate the broad spectrum of considerations and stakeholder views involved in assessing public infrastructure projects. In essence, BCA synthesizes the performances of various scenarios in terms of the different appraisal aspects by translating results into monetary terms. MCA addresses the difficulty of incorporating non-economic variables, such as noise, accidents, and air pollution into, BCA. MCA aggregates results by applying relative weights of importance to a set of criteria, which include monetary and non-monetary aspects.
Both BCA and MCA approaches have their fair share of supporters and opponents, with the main criticism usually stemming from the treatment of the intangible appraisal aspects, as discussed in sections 5.3.2 and 5.4.2. While both methods can be performed scientifically and systematically, there remains a degree of human judgement in the ultimate appraisal process. The normative judgments implicit in the development of the proposed appraisal framework were outlined in Sections 1.3 and 3.4.2. MCA aims to formalize these judgements by allocating all decision criteria transparent ratings and weights. Therefore, when an appraisal is performed, the normative judgments of the appraisal panel would determine the weights allocated to each criterion. Given its complementary nature, and the respective strengths of BCA and MCA, an approach combining elements of both BCA and MCA appears to be ideal in a complex decision-making environment where multiple economic, social and financial impacts would result from a public infrastructure project. Public infrastructure projects fit this description and often require trade-offs between multiple criteria and often conflicting objectives of many stakeholders, as well as significant monetary and intangible impacts. As discussed in Section 5.5, BCA and MCA approaches are complementary. As a result, combining BCA and MCA can arguably lead to better-informed decisions, because a combined approach can incorporate the objective nature of BCA with the transparency and ability to involve stakeholders of MCA. A combined approach also affords decision makers the opportunity to triangulate results.

A review of project appraisal practices, policies and trends indicates that there are a number of similarities between the type of problem, solution and decision makers that are involved in both the appraisal of projects and financing approaches. The problem that both types of appraisals aim to solve is complex, involves a range of quantitative and qualitative criteria, and encompasses various stakeholders. Both project appraisals and financing appraisals are aimed at assisting public sector decision makers in analysing and filtering alternatives to choose the most beneficial approach for society. For example, project appraisal policies in both New Zealand and Europe emphasize the need to perform the appraisal from a societal perspective, which includes not only tangible, but also the intangible aspects, given that it is public infrastructure that is under consideration.

The body of knowledge and policy documents on project appraisals also contributes a range of aspects, including definitions, best practices and lessons learnt, that are transferrable to the development of a framework for appraising financing approaches. Europe’s public transport project appraisal policy documents (IER, 2005) suggests that, where non-
monetised impacts, such as intragenerational equity are expected to have a marked effect on the appraisal, these impacts should be formally included in an appraisal which combines MCA and BCA. The HEATCO documents advise that intangible impacts should be monetized where possible. But where monetization is not possible, intangible aspects should be presented in a qualitative manner and explicitly included by following an MCA approach whereby impacts are allocated weights and expressed relative to the monetized impacts resulting from the BCA appraisal. The European policy documents reviewed also warn against overreliance on one tool and the benefits of triangulating results from more than one tool. In addition to providing guidance on methodologies for monetizing non-monetary aspects, there are also other technical aspects discussed in the literature on project appraisal that appear to be helpful in consideration of financing appraisals. These include discount rates and possible performance indicators (such as the possible performance indicator for the required return on private sector equity investment suggested in New Zealand’s public transport policy documents). The European policy documents similarly outlines a range of performance indicators and metrics, which renders the appraisal process practical and implementable.

Other important principles emerging from the review of project appraisal practices, policies and trends include: (a) the tendency to restrict the BCA to first-order impacts only; (b) instructions to include only systematic risk in the procurement appraisal; (c) warnings to critically assess the incidence of asymmetric information and optimism bias; and (d) to avoid any form of double-counting in appraisals. The documents also provided guidance on the size of projects that require comprehensive appraisal. For example, Infrastructure Australia requires detailed procurement appraisals for projects in excess of AUD 50 million (IA, 2008). In addition, Infrastructure Australia becomes involved in detailed project appraisal reviews for public infrastructure projects over AUD 100 million (IA, 2014). There were also practical examples of qualitative rating methods in the documents reviewed, such as the five-point scale adopted by Infrastructure Australia (2008). All these aspects and considerations are transferrable to the development of a framework for the appraisal of a suite of possible financing approaches for a public infrastructure project.

It is notable that most policy documents make it clear that the main aim is to provide guidelines, principles, and performance indicators. The policies state that authorities should be amenable to considering new and improved calculation and modelling methods, and to also allow for geographical or jurisdictional differentials, as long as they do not compromise
the rigour of the appraisal. The review furthermore identified other general critical success factors for effective and objective appraisals. Critical success factors include decision makers having access to sufficient expertise and knowledge of the public infrastructure and financing environment, and that government should remain in control and be responsible for an appraisal process that seeks to promote *societal* welfare and not rely too heavily on private sector financial advisors from the investment community (as discussed in Section 5.2). All these principles offer important lessons for the formulation of an appraisal mechanism for financing approaches. Financing instruments and approaches available for consideration by public sector decision makers for the financing of public infrastructure are discussed in Chapter 6.
6 Financing Instruments

6.1 Introduction

This chapter articulates the various financing instruments that typically make up a financing approach for large public infrastructure projects. This includes an identification, classification and brief description of the four main instrument categories used to finance the construction of large public infrastructure projects, these being reserves, loans, bonds and external equity. For contextualization, examples of how these instruments are used in practice to finance public infrastructure projects are listed, including Australian examples. Together with Chapter 7, this chapter provide the building blocks to develop a Multi-Criteria Appraisal (MCA) of financing instruments. Table 23 shows the typical steps involved in a MCA process and how this relates to the chapters.

Table 23: MCA process steps matched to chapters

<table>
<thead>
<tr>
<th>Step</th>
<th>Alignment with chapters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition of the alternatives being appraised</td>
<td>Financing instruments in Chapter 6 (Sections 6.4 to 6.7)</td>
</tr>
<tr>
<td>Definition of appraisal criteria</td>
<td>Monetary and intangible criteria in Chapter 7</td>
</tr>
<tr>
<td>Analysis of the impacts for the alternatives being appraised</td>
<td>Discussion of monetary and intangible impacts by instrument in Chapter 7</td>
</tr>
<tr>
<td>Appraisal of the effects of the alternatives in terms of each of the selected criteria</td>
<td>Performance indicators in Chapter 7</td>
</tr>
<tr>
<td>Aggregation of the appraisal</td>
<td>Appraisal approach in Chapter 7</td>
</tr>
</tbody>
</table>

Source: Based on Huang et al. 2011, p.3579.

Chapter 6 is structured as follows: Section 6.2 explains the rationale and background to the classification of financing instruments. Section 6.3 follows with a description of how the categories were formulated from the public infrastructure financing literature reviewed, while Sections 6.4 to 6.7 present overview of each of the four main financing categories developed. The delivery and funding approaches also require discussion, because the way that infrastructure is funded, delivered and financed may influence and interact with each other. For example, external equity financing (refer Section 6.7) is only really compatible with a PPP delivery approach (refer Section 6.8.3). The various funding mechanisms and
delivery vehicles that accompany the financing instruments are briefly discussed in Sections 6.8 and 6.9. Section 6.10 concludes the chapter.

6.2 Important Considerations

The aim of the appraisal approach being developed is to enable public sector decision makers to analyse complex financing solutions. Given the large sums of capital typically required to build public infrastructure projects, a financing approach that incorporates a portfolio of financing instruments is often needed. The instrument categories presented in this chapter are the components from which public sector decision makers can select in order to determine the alternative financing approaches to be considered for any given public infrastructure project. There is also a range of hybrid financing instruments. These display a combination of characteristics from the four major categories, such as converting infrastructure bonds, which start off as debt, and later convert to equity (Mulino, 2013), or subordinated debt, which has elements of both equity and debt (PC, 2014). The categories presented in this chapter allow for the appraisal of many permutations and combinations of the instrument categories. By breaking down and allocating the components involved in a portfolio of instruments within the framework categories, a systematic analysis and appraisal of financing solutions can be achieved. This allows the compilation of a financing approach incorporating the best possible combination of financing instruments, and in their optimal proportions.

Not all financing instruments are always available in any given jurisdiction. Since different countries have different public finance systems, not all of the examples of financing instruments discussed in this chapter are available to governments; for example, government-issued revenue bonds are prevalent in the United States, but are currently not available in Australia. Political systems vary, which may also impact the financing environment. For example, Westminster parliamentary democracies, such as those of the United Kingdom, Canada, Australia and New Zealand, require budget appropriation approval following debate. However, in the United States, with its presidential system, the legislative body has more of an ‘activist’ role in endeavouring to influence appropriation parameters. There are also other forms of non-Westminster parliamentary systems evident in the OECD.75 These differential systems of governance may serve to restrict the range of

75 Non-Westminster parliamentary systems (in Sweden); semi-presidential systems (in France and Germany) (Chan et al., 2009).
financing instruments available within individual countries to a subset of those discussed in this chapter.

Given the scope of the thesis (refer Chapter 3, Section 3.4), financing categories were developed from the perspective of society at large, as represented by government. When the public sector in a country raises capital directly, or through a Government Trading Enterprises\(^\text{76}\) (GTE) or Special Purpose Vehicle (SPV), the nation by implication incurs financing costs and intangible impacts associated with the financing approach selected. An overview of these delivery vehicles is provided in Section 6.8. The categories are also defined in terms of the direct source of capital for the public infrastructure project. This has implications for the formulation of categories, as will be discussed in Section 6.3.

This chapter does not endeavour to provide a full overview of all the possible financing approaches within each instrument category, for this has already been done in the literature, and continues to be carried out as new innovations emerge and are proposed. Chapter 2 introduced a wide body of knowledge that deals with providing comprehensive overviews of financing instruments. Examples abound and include PC (2014), Abelson (2011), Chan \textit{et al.} (2009), Vander Ploeg (2006), Kitchen (2004), and GAO (2002). These other sources presented substantial overviews, including advantages and disadvantages, risks, applications and innovations of financing instruments, how they are funded, and how they are delivered or procured.

### 6.3 Formulation of Categories

The comprehensive study by Vander Ploeg (2006) developed a MECE set of classifications for each of these dimensions, called the triple-two rule. The triple-two rule states that the three dimensions and their respective two subcategories cannot be expanded, and remains constant regardless of new developments. According to the triple-two classification, there are only two boundary ways to finance, two boundary ways to fund, and two boundary ways to deliver public infrastructure. Governments can either borrow or use accumulated funds to finance infrastructure. Likewise, funding is restricted to a choice of either taxes or user pays, while delivery can be provided either publicly, through government, or through non-governmental bodies such as members of the private or non-profit sector. However, private sector equity financing is not covered by the two categories suggested in the triple-two

\(^{76}\) Or public trading enterprises (PTEs).
classification. The categories developed by Kitchen (2004), which distinguished between internal versus external financing sources, were adopted – albeit in a slightly different context from that originally applied by Kitchen.\textsuperscript{77}

Figure 21: First-level categorization of financing, funding and delivery

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure21.png}
\caption{First-level categorization of financing, funding and delivery}
\end{figure}

Source: Adapted from Henn et al. 2012, p.7.

The first-level classification presented in Figure 21 was adopted as the boundary classes for the proposed appraisal framework. These boundary classes or highest level of classification took precedence when subcategories were developed. While these boundary components are restricted, the range of instruments and methods within these categories are broad, and combinations are common. For example, Public-Private Partnerships (PPPs) that combine elements of the boundary components (direct public provision versus contracting-out to the private sector) is common for delivery of public infrastructure.

\textsuperscript{77} Kitchen (2004) applied this classification within the context of municipal financing; therefore, federal grants fell within the external category, yet would fall within our internal category, which is from society’s perspective.
Figure 22 shows that finance instruments can be classified according to the source of finance; that is, whether they are raised internally or externally from the perspective of society at large (as represented by government). Internal financing includes those categories of financing where the government of a country, or one of its GTEs\textsuperscript{78} finance infrastructure from accumulated financial resources currently at their disposal. By way of contrast, external financing entails those instruments employed when the entity raises capital from the private sector. Chan et al. (2009) offer a similar classification for financing vehicles, but introduce the notion of capital markets – as opposed to the term ‘borrowing’ put forward by Vander Ploeg (2006) – to allow for inclusion of equity contributions from the private sector. Including external equity renders the categorization collectively exhaustive. While internal financing refers to the accumulation of reserves, external financing requires further sub-categorization into its various financing instruments for a meaningful appraisal, thereby resulting in three sub-components, namely loans, bonds and equity.

Debt is the advancement of credit in exchange for the repayment of the capital plus interest at a certain point in future. We further distinguish between two types of debt financing instruments, these being the bonds and loans. Simply stated, debt is a source of instant funds whereby future cash flows are capitalized to the present and capital servicing is delayed (ACG, 2003; Vander Ploeg, 2006; PC, 2014). Borrowing is typically favoured when accumulated funds are insufficient to finance the public infrastructure (Kitchen, 2004). Governments sometimes provide debt to assist in the financing of public infrastructure projects such as the M2 Toll road in Australia, where the New South Wales Roads and Traffic Authority provided mezzanine debt\textsuperscript{79} (Hann & Mack, 2005). Debt is pursued as a  

\textsuperscript{78}SPVs are not mentioned, given that SPVs are usually formed for a specific project, and therefore, would not normally invest in another project. Refer to Section 6.4.  

\textsuperscript{79}Mezzanine debt, is also called sub-debt, and has higher priority in payment in the event of default than equity capital, but lower priority than senior and secured debt (Hann & Mack, 2005).
financing instrument by all the public infrastructure delivery types including government departments, GTEs, and SPVs. GTEs are increasingly employing borrowing in their own right from government, or from private capital markets. 

The capital market issues and trades financial instruments with an original maturity of greater than one year (Kidwell et al., 2011). Since capital assets are not usually highly marketable, delivery vehicles prefer to finance infrastructure with long-term debt or external equity to lock in their financing cost for the life of the project (Kidwell et al., 2011). Capital market financing is employed by a range of delivery vehicles, including government departments, GTEs, as well as various forms of private sector and PPP entities (SPVs). Since the scope of this study encompasses the immediate source of capital (discussed in Section 6.2), when private sector entities use corporate bonds to raise capital in order to invest in a public infrastructure project, this is classified as external equity financing given that the private sector entity is contributing equity to the project via involvement in a PPP or SPV. Two types of capital market instruments can be distinguished, public equity (or stock markets) and bonds. Equity implies that investors obtain ownership in the assets, as opposed to becoming creditors when participating in the bond market (Kidwell et al., 2011). When equity is raised directly from investors, as opposed to raising capital on the stock market, this is defined as private equity in this study. Four main categories of financing instruments that collectively make up the components of any financing approach for public infrastructure emerge from this classification. These are reserves, bonds, loans and external equity. Table 24 shows how the classification of financing instruments fits together, including sample mechanisms within each instrument category.

80 Marketable public infrastructure is defined as public infrastructure that generates significant private benefits, its consumption can be measured, individual users can be identified and charged, non-payers can be excluded, operating and capital costs can be measured and usage often varies between individuals (Chan et al., 2009).
Table 24: Classification of financing instruments

<table>
<thead>
<tr>
<th>Internal</th>
<th>External</th>
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<td></td>
<td>Capital Markets</td>
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<tr>
<td>Reserves</td>
<td>Financial Intermediaries &amp; Corporations</td>
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<td></td>
<td>Public Equity</td>
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<td></td>
<td>Debt</td>
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<td></td>
<td>Bonds</td>
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<td></td>
<td>Loans</td>
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<td></td>
<td>Private Equity</td>
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<tr>
<td>• Government budget appropriations</td>
<td>• Listed infrastructure and utility stocks</td>
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<td>• Accumulated special property levies</td>
<td>• General purpose bonds (such as, General Obligation Bonds)</td>
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<tr>
<td>• Reserves and reserve funds (such as, retained earnings, asset sales)</td>
<td>• Specific purpose bonds (such as, revenue bonds, project bonds)</td>
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<tr>
<td>• Equity injections from GTE retained earnings.</td>
<td>• Government loans</td>
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<tr>
<td></td>
<td>• Development bank loans (such as, World Bank loans)</td>
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<td></td>
<td>• Commercial bank loans</td>
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<tr>
<td></td>
<td>• Privately raised from financial institutions/corporate investors</td>
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<tr>
<td>Hybrids: such as, converting infrastructure bonds; subordinated debt</td>
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</tbody>
</table>

Source: Based on Henn _et al._ 2014, p.11.
An overview of the four main financing instrument categories developed is provided below.

### 6.4 Reserves

Reserve financing refers to the financing of public infrastructure from accumulated internal financial resources (Vander Ploeg, 2006). Governments often contribute significantly to the financing of large public infrastructure by way of investing funds at their disposal. Such funds are collected from various revenue sources, including general operating revenues from taxes and levies, proceeds from asset sales or the reinvestment of retained earnings (Kitchen, 2004). Government reserves are administered as budget appropriations, intergovernmental grants and contributions, savings in reserves and reserve funds, or other cash on hand (Vander Ploeg, 2006).

In Westminster parliamentary democracies, such as Australia, budget appropriations are provided for financing the acquisition, construction and maintenance of capital assets. Therefore, when a budget appropriation process is required, public infrastructure can only be financed following debate and approval laws by the executive (government) that compel or permit the executive to spend revenues in accordance with purposes, amounts and timeframes approved by legislature (Kennedy, 2002). Governments are generally required to collect and deposit government revenue into the General Fund (or consolidated revenue). This section deals only with those budget appropriations sourced from an accumulation of government revenue. Government budget appropriations can be made to a government department, or a GTE, or a SPV, in which case budget appropriations are often made in the form of community service obligations (ACG, 2003). Budget appropriations may be funded either from taxes levied by the financing entity, or could involve a transfer or grant from another public entity. When budget appropriations are tax funded, we distinguish between general or consolidated tax revenues and hypothecated taxes, which are specific infrastructure-related taxes, such as fuel taxes or development taxes (Abelson, 2011).

When financing is funded from a reserve fund, operational and capital reserves that have been built up through saving a portion of current revenues from previous years are withdrawn to finance new infrastructure. Financing from retained earnings, which is relevant in the case of government-owned or controlled entities (GTEs) that produce goods or services on a commercial basis, also falls into this category.
6.5 Loans
Loans refer to borrowing capital from commercial or development banks (such as the World Bank, or the EIB), as was discussed in Chapter 4. Loans may be secured or unsecured. This category includes both direct and indirect loans. Direct loans are made directly to entities, while indirect loans refer to infrastructure loans or debt funds (PC, 2014). Bank debt may be sourced from local or international banks. While bank debt is mostly used as short to medium term financing (two to ten years), it is possible to raise long debt (around twenty years) on some projects (Hann & Mack, 2005).

6.6 Bonds
Bonds are long-term interest-bearing certificates of debt issued on the capital markets. Bond market instruments come in many different forms, including bullet bonds, amortizing bonds, and inflation-indexed bonds (Hann & Mack, 2005). Recent innovations in bond markets include the use of infrastructure revolving funds and infrastructure banks, as well as the use of so-called smart debt (Vander Ploeg, 2006). In the Australian context, the bond market can be broadly categorized as either government bonds (including both Commonwealth Government and state securities) or corporate bonds issued by financial and non-financial corporations, euro bonds and various hybrids (Kidwell et al., 2011). In Australia, the corporate bond market is small by international standards. However, there is evidence of a deepening Australian corporate bond market, and that market forces appear to be growing the demand for these bonds, in particular project bonds (IA, 2014).

81 Loan repayments may be secured against some form of collateral, including an income stream or asset (Hann & Mack, 2005).
82 Bullet bonds: allows for lump sum repayments of the principle during the life of the bond, while interest is paid over the life of the loan. Amortizing bond: usually requires equal payments which include both interest and principal over the life of the loan. Inflation-indexed bonds: provides interest payments and principal repayments that increase with the rate of inflation.
83 Revolving funds: revolving loan funds pool financial capital from various levels of government and then borrow from the pool to debt-finance infrastructure. Infrastructure banks: a revolving loan fund, but specifically dedicated to financing surface transportation in the United States. Smart debt: based on the principle that borrowing to finance infrastructure is merited, and aims to improve investment in infrastructure by growing public and political support for more tax-supported debt.
84 Long-term borrowing of large amounts of capital in bonds denominated in currencies other than the country where it is issued.
85 Hybrid securities are financial products which hold a combination of characteristics.
86 Recent research by the Office of the Infrastructure Coordinator also found that total annual issuance has recovered to levels approaching pre-global financial crisis levels, that new issuers are entering the market and that market forces that may lead to greater appetite for infrastructure debt (project bonds) from institutional investors (PC, 2014).
by a private sector investor in order to invest the funds raised in a public infrastructure project, it forms part of the external equity category (Section 6.7). The reason being that external equity is defined as investment of capital by private sector investors. The original source of funds being invested in the public infrastructure by such private investors is essentially irrelevant when the MCFA framework is applied. From society’s perspective, regardless of the source of funds being invested by the private sector, the cost of such capital remains the returns required by the private sector. The cost of funds to private sector investors who issue bonds to invest in the project is likely to differ and would consist the bond rate paid.

Government bonds can be issued by either budget entities or GTE’s and may be issued on the domestic or overseas markets (ACG, 2003). In Australia, GTEs, as well as sub-national governments, are required to borrow through the Central Borrowing Authority (CBA), while these entities may be able to issue bonds directly in other countries (Chan et al., 2009). Long-term government bonds are the most common form of public sector borrowing, often with a maturity of ten years or more, and are usually serviced out of general taxation. Public sector entities typically repay debt from the budget’s Consolidated Funds (funded by taxation, user charges or even the sale of assets), while non-budget debt is normally serviced from the underlying revenues of the GTE, such as user charges (ACG, 2003, Abelson, 2011).

Bonds are further classified as either general purpose or specific purpose bonds. General purpose bonds refer to capital market borrowing activities for general purposes including the financing of public infrastructure. General purpose bonds are normally issued against the general credit of the entity who delivers the project and the underlying assets consist of multiple sources of cash flows (Dailami & Hauswald, 2003). Public sector issued bonds for Western governments are usually regarded as being free of default risk, given that they are backed by the full faith of government (Kidwell et al., 2011). For example, in Australia, government bonds, such as treasury bonds, are issued by the federal and state governments. Witness, for example, the NSW Waratah Bond Programme, which makes bonds available to the retail market that are guaranteed by the NSW government (IA, 2014). Specific purpose bonds are issued against the infrastructure asset or the expected revenue stream arising from the asset, such as lease payments and user charges or fares. The

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87 Waratah Bonds are issued by the NSW Treasury Corporation and are applied as loans to the NSW Government and its GTEs to finance public infrastructure and other activities (NSW, 2014).
repayment of both the principal and interest of revenue bonds are normally restricted to funds from project revenues and when default of the project occurs, bondholders have no recourse to the liquidation of assets or the distribution of proceeds to creditors (Chan et al., 2009). For example, some types of revenue bonds (such as zero-coupon bonds) delay the repayment of debt (including interest) until the project is able to generate its own revenues (Brittain, 2002). Since revenue bonds are issued with the expected future revenues as security, it shifts some of the risk to bondholders, without the bond issuer giving up any ownership or control (Burleton, 2002). Specific purpose infrastructure bond innovations include asset-backed borrowing, where municipalities issue bonds against the current value of existing assets, as opposed to their powers of taxation (as would be the case for a general obligation bond) or even the expected future revenue from an infrastructure project (as for a revenue bond) (Vander Ploeg, 2006). At the local government level, funding sources include local improvement levies (special assessments or benefit assessments) and Tax Incremental Financing (TIF), which are discussed in Section 6.9.4 below.

Project bonds issued by corporate entities are also categorized as specific purpose bonds. Project bonds are a type of corporate bond where the issuer raises finance for a particular capital investment project, whereby financial obligations and investor returns are paid solely from project cash flows (Dailami & Hauswald, 2003). Depending on the jurisdiction, project bonds may be issued by either public sector companies (or GTEs) or by private sector corporate entities. When project bonds are issued by the private sector, it falls within the external equity category, while public sector issued project bonds are classified as specific purpose bonds. Public sector issued specific purpose infrastructure bonds have been used by various levels of the OECD governments and quasi-government entities (such as water boards and utility commissions) since the 1800s. The use of specific purpose infrastructure bonds is common in the municipal bond market in countries such as the United States and Canada, where they are called revenue bonds.

In the past, the Australian Government similarly issued project-specific government infrastructure bonds, but were phased out as a result of financial reforms in the tax concessions on infrastructure bonds for a period in the 1990s (Abelson, 2011; PC, 2014). Tax advantaged financing instruments are often criticised for lack of transparency, since these instruments are not explicitly costed nor subjected to the same political scrutiny as other financing instruments such as intergovernmental grants (Chan et al., 2009). Financing instruments which are tax advantaged are also considered to be a crude way of dealing with
biases in the tax system or any project-related externalities, together with a tendency to increase investment distortions and tax minimization for individuals on high marginal tax rates (Abelson, 2011).

The bonds issued by infrastructure funds are very similar to project specific infrastructure bonds. In both cases, government raises money from the public via bonds for the purpose of constructing infrastructure. However, in the case of Infrastructure bond funds, they may allocate money to a range of infrastructure projects, while an infrastructure revenue bond is more likely to be project specific. Financing by an Infrastructure bond fund may be funded from general tax revenue or from a hypothecated tax source, such as a fuel levy. Both infrastructure funds and revenue bonds may be tax advantaged, typically in the form of a tax concession on the interest from the bond. Revenue bonds are normally tax-exempt in the United States, while this is not the case in Canada.

6.7 External Equity
External equity is defined in this study as investment capital raised from private sector investors. This is in contrast with governments investing their own accumulated funds (reserves) into a public infrastructure project, which might effectively be regarded as internal equity investment. Note that the private investors’ original source of funds being invested in the public infrastructure is irrelevant for the purposes of the MCFA framework. For example, even if a private investor raised the capital from a bank (debt) to invest in the project, the cost of the capital to society is still the returns required by the private investor and not the interest rate charged on debt by the private investor’s lender. External equity can be raised publicly on the capital markets (stock market), or privately from financial institutions and other corporate investors. External equity can also be either raised directly for a particular project or indirectly into a general investment fund (PC, 2014). This research focuses on government (via a GTE or SPV) financing the construction of new public infrastructure and, therefore, the emphasis is on primary issue on the stock market to finance construction.

Private equity financing by financial intermediaries includes involving investments banks, superannuation, or insurance companies, and for megaprojects often requires a consortium of banks, with a lead investment bank. A construction company may also invest in a separate SPV established for construction of a public infrastructure project, or through listed or unlisted infrastructure trusts and general investment funds. Examples of listed public infrastructure projects that fall into the private equity subcategory in Australia include
Sydney Airport and Transurban – the owner of a portfolio of toll road assets in Australia and North America. Listed public infrastructure investors may include entities that act as operators, contractors, developers of projects, or more diversified conglomerates operating in infrastructure sectors (PC, 2014).

In the past, private sector equity contributions to public infrastructure projects came mainly from major construction companies and equipment suppliers. However, given a number of limitations in that model, external equity for major public infrastructure projects is increasingly being sourced through independent infrastructure investors and infrastructure funds, such as the Macquarie Infrastructure Group. Superannuation funds invest in public infrastructure projects either by investing in listed and unlisted assets or through their investments in listed companies that invest in infrastructure assets and in other investments such as index funds. However, superannuation funds prefer investing in brownfield projects, where there is less uncertainty regarding project performance (IA, 2014). Examples of superannuation fund investments in Australian brownfield projects include Australian Super’s direct holding in Port Kembla and Port Botany. For the purposes of this thesis, however, the financing of brownfield projects and privatized public infrastructure companies remains outside its scope. The shift of debt financing for public infrastructure from mainly bank debt, to capital markets, and finally towards long-term investors, is a global trend (Wyman, 2014). This is shown in Figure 23.

88 Limitations include that it was often simply a reinvestment of profit margins from the construction of the asset, and regularly resulted in increased costs; therefore, it did not assist sufficiently in risk transfer in the long term, as it was generally short term in nature. It was also limited in amount and very expensive (Hann & Mack, 2005).
Notable innovations which aim to take advantage of the growing prominence of superannuation funds in financing public infrastructure, include initial superannuation offerings and converting infrastructure bonds (Pottinger, 2013). Initial superannuation offerings are based on the concept of initial public offerings (IPO), which is often employed when public infrastructure is privatized. Initial superannuation offerings combine the characteristics of a conventional IPO with private ownership of the infrastructure. Converting infrastructure bonds also aim to attract financial investors such as pension funds which are seeking long-term inflation linked returns. A converting infrastructure bond is a hybrid mechanism that includes characteristics of both debt and equity, and combines a conventional Design Build Operate PPP delivery contract with the forward sale of the asset. The mechanism entails the use of initial government debt, which is transferred to the long-term investors as equity and off government’s balance sheet once construction is completed.

6.8 Delivery Categories

The financing categories discussed above can be analysed by delivery entity or funding source. The delivery decision for public infrastructure was defined earlier as determining who should be responsible for providing the public infrastructure and encompasses an end-to-end process, which may involve various parties, including the development of specifications, procurement, obtaining finance, building and operating the asset. Table 25

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89 The name ‘Initial Superannuation Offerings (ISO) was proposed, as superannuation is currently the most likely set of investors. However, Pottinger (2013) pointed out that the vehicle is not limited solely to superannuation funds, as it is able to accommodate both institutional and private superannuation investors, as well as other investors that are pursuing stable, inflation-protected long term investment returns.
illustrates how the different delivery entities relate to the financing categories described above. It shows that reserve financing applies to all the delivery methods, as does loans and bonds. External equity financing applies to PPP delivery and not to delivery by government departments or GTEs.\textsuperscript{90}

\textsuperscript{90} Theoretically speaking, however, should GTEs not be fully owned by government, they may be able to raise external equity.
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<tr>
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<th>Financing Category</th>
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<td>Internal</td>
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<tr>
<td>First Level</td>
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<tr>
<td>Second Level</td>
<td>Reserves</td>
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<tr>
<td>Delivery</td>
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<td>Included</td>
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<td>Government Department</td>
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<td>Government Department</td>
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Legend: N/A – Not Applicable
The two boundary delivery vehicles, public and private sector delivery, as well as the combination of these two, PPPs, are discussed below.

6.8.1 Public Delivery

As discussed in Chapter 2, public delivery of public infrastructure arises from the nature of public goods; that is, these infrastructures embody considerable externalities, economies of scale and inelastic demand. Public provision of publicly used infrastructure usually occurs through a government department or a GTE, which operates at arm’s length from the larger governing operation. In Australia, the federal system allocates the main responsibility for infrastructure development to state and local governments. Federal government is a major source of finance for large infrastructure, even if delivery is largely the province of states and local governments. Examples include telecommunications infrastructure prior to privatization and, more recently, the National Broadband Network (NBN) scheme. Federal funding sources include various income and company taxes, import duty, and fuel excise. Since federal government has access to more revenue, intergovernmental transfers from the Australian Government to State and Local governments are an important source of infrastructure finance for state and local governments (PC, 2014).

Private participation in public delivery is generally limited to contracting private players to provide aspects of the infrastructure, such as the design, construction or rehabilitation of specific infrastructure components following a competitive tendering process (Vander Ploeg, 2006). In the traditional model of public delivery, the infrastructure is publicly owned and operated by public servants in a government department. However, the private sector may be contracted to provide aspects of the delivery, while the infrastructure remains in government ownership and control. Franchising is an example of private involvement in the operation of government-owned infrastructure. Government franchising entails government owning infrastructure assets and being responsible for financing new investment. Franchisees are responsible for managing the asset, and typically make no equity investment contribution to the investment, although they could possibly raise finance for capital maintenance and extensions (Chan et al., 2009).91

GTE delivery of financing of public infrastructure entails the raising of capital through legally independent enterprises, such as airport or seaport corporations. GTEs are corporate

91 Australian franchising examples include the provision of bus services in Adelaide and Perth, urban and light rail in Melbourne, and water supply and sewerage in Adelaide.
entities, with an independent board of directors, and are subject to Corporations Law. Government has a controlling interest and may own GTEs either fully or partly (Abelson, 2011). Therefore, these can be regarded as government businesses, which mainly use off-budget financing. Goods and services are provided on a commercial basis, with user fees covering costs either fully or partially (with government subsidizing the remainder), while some sell their services directly to government. In Australia, for instance, the main sources of GTE financing are retained earnings, budget appropriations and borrowing. GTE budget appropriations are usually made as an equity injection or as payments for community service obligations. GTE borrowing includes security instruments such as corporate bonds or project bonds; as well as bank loans (Chan et al., 2009). Financing costs are usually serviced from user charges for the services provided. However, when a GTE incurs a financial deficit, government may be obligated to fund the deficit from tax revenue (Abelson, 2011).

6.8.2 Private Delivery

Private sector delivery of infrastructure traditionally refers to private companies financing, designing, building, owning, and operating their own infrastructure, and charging users a fee. While the private sector may be contracted to design, build, own and operate public infrastructure, funding often still includes government grants, subsidies, and utilization or availability fees. This type of private delivery involves full private equity financing of public infrastructure, and may include assets such as toll roads, water supply companies and airports. The public funding of such infrastructure essentially recognizes the positive externalities associated with provision of the infrastructure.

The delivery of brownfield projects may also be transferred from the public to private sector. Examples of switching infrastructure that was historically delivered on a public basis to private delivery include privatization and leasing arrangements. For example, in Australia, large sections of public infrastructure were privatized from the 1990s onwards, including airports, power stations, ports, rail freight, motorways, and the gas industry (Wellman & Spiller 2012). While privatization changes delivery from the public to the private sector, the public sector remains responsible for delivery when leasing is employed. Leasing involves purchasing the right to use a capital asset for a specified period of time, while

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92 Amendments to Australia’s National Competition Policy (NCP) in the 1990s included the adoption of private participation in infrastructure financing and development at all levels of Australian Government provision for third party access to nationally significant infrastructure, introduction of competitive neutrality and restructuring of public sector monopoly businesses to increase competition (Parliament of Australia, 1995).
ownership remains with the lessor. Leasing is more common for relatively small highly technological assets with short life spans that carry significant risk of obsolescence over the short term, and present a maintenance challenge, such as computer equipment and software, IT networks, specialized security equipment, communications system, and motor vehicles (Vander Ploeg, 2006). These companies obtain their own private investment capital and all workers are privately employed. Governments, however, still play an important role by regulating these private entities to ensure that a monopoly position is not exploited and that universal access is provided at a reasonable price. Such private companies may also receive government subsidies.

6.8.3 Public-Private Partnership Delivery

A PPP is defined as a “contract between a public sector authority and a private party where the private party assumes substantial financial, technical and operational risk in the project” (Kidwell, 2011, p.752). The OECD (2010) emphasizes the long-term nature of the partnership, while most formal definitions of PPPs note the private financing aspect (IA, 2008; Rossi & Sivitillo, 2014). PPPs usually involve shared risks and returns during the construction and operational phases, while the assets are often transferred to government at the end of a long-term PPP contract (Haughton & McManus, 2012). PPP financing is normally securitized by the revenue that the infrastructure is expected to generate, as well as by the asset itself. Nonetheless, government remains ultimately responsible for service delivery, and policy formulation to protect society’s interests (Galea & McKee, 2014; Rossi & Sivitillo, 2014).

Proponents of private sector delivery claim that PPP delivery provide whole-of-life cost savings and increased efficiency by delivering higher quality services or at a lower cost than public sector (SDG, 2004; IPA, 2007; Roerich et al., 2014). However, these benefits may not always eventuate and findings about the efficiency benefits of PPPs are inconclusive (Haughton & McManus, 2012; Crozet & Chassan, 2013; Siemiatycki, 2013; Liu & Wilkinson, 2014).

Australia, the United Kingdom and France have had extensive experience with PPPs in public infrastructure financing (Yescombe, 2007; Liu & Wilkinson, 2014). For example, in Australia, PPPs have accounted for more than half of total infrastructure investment in recent years, and private financing innovations include the formation of the Macquarie
Infrastructure Group,\textsuperscript{93} a world-leading Australian listed toll road investment fund (Wellman & Spiller, 2012). The Build Operate Transfer model of PPPs has been most popular in Australia and has been adopted widely in Sydney, Melbourne and Brisbane to deliver road transportation projects (Haughton & McManus, 2012; Wellman & Spiller, 2012).

PPP delivery models typically involve the creation of a SPV or stand-alone business to deliver the project by arranging the design, financing, construction, ownership, and operation of a new infrastructure asset (Rossi & Sivitillo, 2014). The provision of a revenue stream to ensure a return on investment is essential for SPV projects. User charges form an important component of SPVs funding sources, however, public sector contributions, or operating subsidies are regularly required (such as budget funding or community service obligations (ACG, 2003; Liu & Wilkinson, 2014). Governments are often forced to share responsibility for delivery with the private sector given externalities and other characteristics which usually render public infrastructure uncommercial for full private sector provision (PC, 2014). Governments also usually share in the financing aspect, often by way of government grants and credit enhancements. Australian examples include a federal government grant to the Victorian Comprehensive Cancer Centre, and a combination of federal, state and local grants to the Gold Coast Rapid Transit project, and the NSW Convention Centre (PC, 2014). Credit enhancements by government are often required for the private parties in a PPP to access capital markets (E&Y, 2009; Liu & Wilkinson, 2014). Projects with guaranteed government payment streams qualify for more debt. Lenders usually require the private sponsor to make equity contributions in order to obtain debt (MPIR, 2004; IA, 2014).

\section*{6.9 Funding Categories}

Funding refers to the mechanisms employed to service the capital raised through the financing approach selected. There is often a direct link between a particular financing instrument and funding mechanism, which affects the impacts that a financing instrument may have on society (for example, its flexibility, refer Section 7.4.3). The two main categories of funding, as was discussed earlier, are taxes and user fees. These two main categories are presented below, together with a breakdown into general and hypothecated taxes. Special property charges, which are considered a hybrid of taxes and user fees, are also discussed. Finally, funds can also be sourced from asset sales, which convert a historical

\textsuperscript{93} A unit of the Macquarie Investment Bank.
stream of taxes and user fees into a lump sum when a public infrastructure asset is sold, and may be applied to finance public infrastructure (defined as reserve financing – refer Table 24). Table 26 shows the relationship between funding and financing.

**Table 26: The relationship between financing, funding and delivery**

<table>
<thead>
<tr>
<th>Delivery</th>
<th>Financing category</th>
<th>Financing instrument examples</th>
<th>Funding mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public sector financing</td>
<td>Reserves</td>
<td>Budget appropriations</td>
<td>Consolidated revenue (Taxation); accumulated infrastructure levies; reserves and reserve funds (such as, retained earnings, sale of assets (capital recycling); equity injections from GTE retained earnings.</td>
</tr>
<tr>
<td></td>
<td>Debt</td>
<td>General purpose bonds</td>
<td>Taxation/user charges/sale of assets (capital recycling).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Infrastructure revenue bonds</td>
<td>Project revenue (including user charges).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Infrastructure funds</td>
<td>Hypothecated tax revenue.</td>
</tr>
<tr>
<td>GTE financing</td>
<td>Debt</td>
<td>GTE borrowing</td>
<td>User charges/taxation supplements.</td>
</tr>
<tr>
<td>Private sector financing</td>
<td>Debt</td>
<td>Private debt</td>
<td>User charges, government contributions (taxation), shadow tolls, subsidies, community service payments, and guaranteed repayments.</td>
</tr>
<tr>
<td></td>
<td>External equity</td>
<td>Private &amp; public external equity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hybrids</td>
<td>Mixed private instruments</td>
<td></td>
</tr>
</tbody>
</table>

Source: Adapted from Abelson 2011, p.2.

**6.9.1 General Taxes**

This category refers to the financing of infrastructure from government’s consolidated general tax revenues. General taxes are widespread levies which are legally imposed on the broader society, and are usually applied to support governmental programmes which benefit the wider community. In a federal system, different general tax mechanisms are applied at the different levels. For example, the main taxes collected by federal government in Australia are income tax, company tax, Goods and Services Tax (GST), and fuel tax (excise), while the major state taxes are payroll tax, taxes derived from contracts and conveyancing (stamp duty), land tax, motor vehicle registration and transfer, and racing and gambling taxes. At
Australia’s local government level, the only tax available is municipal rates or general property rates (ACG, 2003).

6.9.2 **Hypothecated Taxes**
Hypothecated taxes refer to the earmarking of taxes, where revenues from certain taxes are assigned to specific government expenditures and funds are kept separate from general revenues (Jones, 2000). Examples include fuel and other motor vehicle taxes used in some countries primarily to finance transport infrastructure (Yates, 2002). They are called dedicated taxes in the United States, and hypothecated taxes in Australia, the United Kingdom and New Zealand. Hypothecated taxes may also be supplemented from other government revenue sources. The degree of deduction may differ from narrowly specified (for a specific infrastructure project), or more broadly for specific capital purposes (such as roadway rehabilitation), or for infrastructure in general (such as a capital fund for a specific city or other jurisdiction). Hypothecated taxes are often accompanied and administered through trust funds, infrastructure funds and reserves (Abelson, 2011).

6.9.3 **User Fees**
User fees are generally applied as a price or a fare for the use of the services provided by infrastructure facilities (ACG, 2003). User fees are usually applied to recover the costs of infrastructure that are marketable or marginally marketable. User fees are also more commonly associated with debt financing than financing from reserves, since user fees trickle in to government coffers over the lifetime of the asset and can only be used to fund reserve financing if it is first saved in a reserve fund (Vander Ploeg, 2006).

6.9.4 **Special Property Charges**
There are a host of property-related mechanisms employed to fund the financing of public infrastructure. These are similar to hypothecated taxes or levies, but are grouped together given their property specific nature and particular impacts. Property-related funding mechanisms have an established history in Australia and overseas. While there is, at present, substantial interest in a range of broadly defined value capture instruments as an innovative and supposedly ‘new’ form of raising funding to finance infrastructure, value capture instruments already exist in Australia in many variations (ACG, 2003). These forms of funding have been in use in Australia since the 1920s to service the financing of major infrastructure projects such as the Sydney Harbour Bridge, as well as basic infrastructure
such as roads and drainage as part of new subdivision developments (PC, 2014).\textsuperscript{94} Some of these charges may be collected upfront, and as such may fund the financing of infrastructure by way of accumulated government funds (as described in Section 6.4). The majority, however, are collected post construction, and would therefore be associated mostly with capital market financing. Since some of these instruments are accumulated upfront to finance infrastructure, such as development charges, and others are applied after the infrastructure has been built to service debt (such as TIF financing), it is debateable whether development contributions constitute an accumulation of taxes or should be considered a user fee (Kirwan, 1989; Neutze, 1997).\textsuperscript{95}

Developer infrastructure charges, or development contributions, in particular are increasingly being pursued in recent decades as an alternative source of capital for a wider range of infrastructure, in part owing to a policy shift towards the use of ‘economic’ instruments since the 1970s (Chan \textit{et al.}, 2009). Developer infrastructure charges\textsuperscript{96} are defined as a wide range of special taxes or levies that “require developers to provide infrastructure or make payments commensurate with development-related infrastructure needs” (ACG, 2003, p.viii). They are “legally enforceable up-front contributions towards the cost of new or upgraded infrastructure required as a direct result of a new development” (Chan \textit{et al.}, 2009, p.118). Since these charges can be collected upfront, they may be accumulated to fund internal financing instruments (accumulated government reserve financing).

In contrast to development contributions, land value uplift charges\textsuperscript{97} do not constitute a new charge. Instead, this constitutes the earmarking of existing charges on property values that are levied on property owners benefitting from nearby infrastructure upgrades or provision (Vander Ploeg, 2006). They are particularly popular where developers and property owners are expected to benefit from uplifts in land values from public investment in new transport

\textsuperscript{94} Recent Australian examples include general developer charges under Section 94 contributions; Transport Levies (new block release levy); North Sydney Centre Levy; Affordable Housing Levy; Value capture levies; Impact fees and Parking Levis (ACG, 2003).

\textsuperscript{95} The distinction between it being an upfront user charge or tax lies in the relationship between the size of the contribution versus the benefit derived from the infrastructure. The argument is made that where benefit is equal to contribution (nexus exists between development, infrastructure and contribution), it is equivalent to an upfront user charge for future infrastructure services. When a nexus does not exist, it is considered as a tax (Chan \textit{et al.}, 2009).

\textsuperscript{96} The following terms are also used: development contributions, development cost charges, or producer levies.

\textsuperscript{97} Term includes land value capture, land value increment taxes, valorization taxes, capital value charges, or betterment taxes.
corridors (ACG, 2003). Examples include Tax Increment Financing (TIF), Transit Oriented Development (TOD) and joint development. TIF combines the earmarking of property taxes with a special version of the revenue bond and is predominantly used in the USA for restoring and redeveloping urban brownfield or blighted areas (ACG, 2003). TOD and joint development entails government acquiring land for a new infrastructure project, with that land then being leased to private developers and the lease proceeds being used to fund the infrastructure financing, such as light rail development and other public transport modes (Smith & Gihring, 2006; Miller & Hale, 2011). A related concept is development impact fees, which is a type of development contribution whereby the developer is required pay for any costs associated with unanticipated development demands or to compensate for any harmful effects on the environment (ACG, 2003).

6.9.5 Intergovernmental Transfers and Grants
In this category, funding consists of grants and contributions received from other parts of government, such as from the federal government to local and state governments. Transfers may include tax revenue sharing between different layers of government. While grants are often decided on an annual basis and are made available on an ad-hoc basis, revenue sharing is typically a multi-year agreement. Both transfers and grants may be either conditional (dedicated to specific expenditures) or unconditional (Vander Ploeg, 2006). It is not uncommon for the federal government to require matching funds from sub-national jurisdictions, such as the Gold Coast Rapid Transit project in Australia, which employed a combination of federal, state and local government contributions (CEDA, 2010; E&Y, 2010; PWC, 2011).98

6.9.6 Capital Recycling
Capital recycling involves government privatizing mature public infrastructure and explicitly hypothecating the proceeds to the financing of new public infrastructure projects (PC, 2014). Capital recycling involves the formal linking of the sales of an existing government-owned infrastructure asset with the investment in new infrastructure. It is therefore a source of funds for reserve financing (discussed in Section 6.4). The notion of capital recycling has, for example, gained significant interest in recent times in Australia, especially given current fiscal policy that effectively imposes debt limits (discussed in

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98 Discussed in Chapter 7, Section 7.5.
Chapter 1, Section 1.3). Abelson (2011) found that a variety of impact scenarios could eventuate from capital recycling, each with its own offsetting benefits and costs to taxpayers. The net impact on society of each scenario is determined by a combination of any efficiency benefits which are derived from privatization and the achievement of a market price for assets sold (Abelson, 2011). The creation of the Natural Heritage Trust in Australia is an example of this approach. This project involved the recycling of some of the proceeds following a partial privatization of Telstra in 1997 in order to invest in five public infrastructure projects (PC, 2014).

6.10 Summary
This chapter developed and described the financing categories that form part of the appraisal framework. From a review of the literature on the financing of public infrastructure projects, four financing instrument categories, namely reserves, loans, bonds and external equity, emerged. Reserve financing is a form of internal financing for the public sector and mainly involves financing from accumulated taxes, fees and asset sales. Loans, bonds and external equity are external sources of financing for public infrastructure. Bonds are further divided into general purpose and specific purpose infrastructure bonds, while external equity may be public or private. Together, these main instrument categories form the basis of analysis. Within these categories there are a multitude of subcategories and hybrid instruments. The main categories presented in this chapter form the main components from which a financing approach for public infrastructure can be built, given that a combination of instruments are often required, particularly for large projects.

In addition, the funding and delivery categories proposed for the appraisal framework were briefly presented. It was also discussed how the funding and delivery components match and relate to the financing instrument categories, for example, infrastructure funds are mainly funded by hypothecated taxes, while SPV delivery may require external equity financing. The latter is important context for consideration in Chapter 7. Chapter 7 examines the various dimensions and societal impacts of each of the financing forms, and provides a framework for comparative assessment of the different financing instruments in the context of specific planned infrastructure projects. The funding and delivery aspects have implications for the impacts of each instrument in terms of the criteria discussed in Chapter 7. Together with the categories presented in Chapter 6, these form the key elements of the appraisal framework.
7 Appraisal Criteria, Impacts and Approach

7.1 Introduction

This chapter identifies, classifies and describes the proposed framework components (consisting of the criteria, impacts and approach) for the appraisal of financing instruments for large public infrastructure projects. For the sake of convenience, the framework is hereafter referred to as the Multi-Criteria Financing Appraisal (MCFA) framework. Chapter 2, Section 2.4 showed the range of criteria that emerged from the key literature which were reviewed. Given the inconsistencies raised in earlier chapters, criteria were filtered and customised to apply to financing aspects (as opposed to funding and/or delivery aspects). The criteria raised in the literature was summarized and synthesized with the aim of achieving a set of criteria that aims to be MECE (Mutually Exclusive, Collectively Exhaustive – refer Chapter 3, Section 3.4.3). The following criteria have been adopted:

Table 27: Framework criteria

<table>
<thead>
<tr>
<th>Intangible</th>
<th>Monetary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness</td>
<td>Cost of capital</td>
</tr>
<tr>
<td>Fairness</td>
<td>Contingent liabilities</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Cost of project delay</td>
</tr>
<tr>
<td>Accountability &amp; transparency</td>
<td>Credit rating impact</td>
</tr>
<tr>
<td>Stakeholder support</td>
<td>Taxes forgone</td>
</tr>
<tr>
<td>Degree of public control/ownership</td>
<td>Administration &amp; transaction costs</td>
</tr>
</tbody>
</table>

Source: Adapted from Henn et al. 2014, pp.12–15.

The impacts and effects of the alternatives in terms of each of the selected criteria are operationalized in this chapter by way of recommended performance indicators. Where possible, performance indicators are monetized, while intangible indicators require ratings by experts. Hence, a range of factors that may affect the ratings allocated to intangible criteria are also discussed. Together with the financing instruments discussed in Chapter 6, the criteria, indicators and benchmarks presented in this chapter form the key building blocks of the proposed MCFA framework.

99 In other words, criteria are translated to a measure which would allow empirical observation, in this instance by way of performance indicators and metrics.
The chapter is structured as follows: Section 7.2 starts off with a discussion of the important considerations for interpretation of the adopted set of criteria. Section 7.3 defines the proposed monetary criteria, as well as their respective performance indicators. Section 7.4 defines and discusses the intangible criteria, as well as a range of factors that will affect how financing instruments would perform in terms of each of these criteria. Section 7.5 shows how criteria are combined and applied in the proposed MCFA. Section 7.6 discusses the key factors for a successful appraisal process, followed by Section 7.7, which concludes with a summary of chapter findings.

7.2 Important Considerations

Six key aspects are important when considering the contents of this chapter. First, the appraisal criteria and indicators are defined from a national societal perspective, given that the objective of the MCFA framework being developed is to assist public sector decision makers in selecting a financing approach which is in the best interest of society at large. When government incurs a financing cost, it imposes a cost on the society of that country. Alternatively, when a benefit accrues to government (and assuming government acts in the interest of society), society should benefit. A societal view means that the distributional and equity impacts on the majority of society should be considered. For example, it would make a significant difference to the society of a country if the gainers are overseas financiers who expropriate profits (or economic rent) from the financing approach adopted. These aspects were addressed in more detail in Chapter 2, Section 2.2.

Second, because this research focuses on the financing decision in particular, the choice of financing instrument should not be expected to address any perceived or real shortcomings of project investment or delivery vehicle appraisals. In short, we cannot expect to fix bad investment decisions with the financing approach. Nevertheless, similar to previous chapters, funding and delivery aspects are briefly mentioned where relevant, for contextual purposes.

Third, the impacts of a financing instrument are discussed by individual financing instrument category (reserves, bonds, loans, external equity). Large public infrastructure projects often require a combination of instruments. Therefore, the framework was also developed to appraise a combination of instruments and assist in determining the appropriate make-up of these instruments. The appraisal of a combination of instruments is therefore also addressed in Section 7.5.
Fourth, in the interest of consistency, the assessment of financing approaches is viewed from an *ex-ante* perspective. Criteria and indicators are therefore discussed in terms of estimated or anticipated metrics. The term ‘appraisal’ was adopted to distinguish an *ex-ante* analysis from *ex-post* ‘evaluations’ (similar to the approach followed by Dabla-Norris, 2011 and TAG, 2005).  

Fifth, the framework only formally includes the first-order impacts of financing decisions only. This is consistent with the lessons learnt from project appraisal methodologies (discussed in Chapter 5). For example, while an optimized financing approach for a public infrastructure project may lead to improved economic growth in the country, these secondary impacts are not included.

Sixth and finally, the framework is intended to inform and guide appraisal of potential financing approaches by presenting considerations and learnings from the literature. Performance indicators and benchmarks provide a baseline for appraisal and are representative of a synthesis of current thinking and literature. Judgement and application by knowledgeable appraisers, informed by detailed analysis, would be required when applying the framework to a particular project. Accordingly, factors that impact on the appraisal are also discussed. The criteria, their performance indicators, and how they apply to the framework are discussed below.

### 7.3 Monetary Criteria

This section introduces the monetary criteria, starting with an explanation of how the concepts are interpreted, followed by suggested performance indicators that can guide appraisers in their assessment of the various financing instruments, as well as aspects that would have to be included in deliberations for each of the criteria.

#### 7.3.1 Cost of Capital

The cost of capital concept is the base for calculating the *Effective Cost of Financing* (ECF) (refer Section 7.5) by instrument, and involves different types of costs for different instruments. Given that the *cost of capital* criterion involves different types of cost for different financing instruments, the proposed performance indicators also differ by instrument, as will be discussed below.

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100 While an *ex-ante* approach is adopted here, the framework could also be applied *ex post*, in which case the realized or actual indicators and metrics could be used.
a. Cost of Capital for Reserves

Given that reserve financing refers to the financing of public infrastructure from accumulated internal financial resources, reserve financing is often regarded from a narrow financial perspective as the ‘least expensive’ option as it avoids the interest costs involved with debt. However, reserve financing involves an opportunity cost, since the use of reserve financing implies that the funds are no longer available to finance other projects. By not financing other projects, society sacrifices the economic returns that it could have enjoyed if it had invested in those projects. In the presence of fiscal limitations, Martin (1997) suggested that the cost of capital is the average IRR of project(s) that could not be pursued given the lack of reserve capital. For public infrastructure, the full opportunity cost to society is represented by the EIRR, which includes externalities and spill-overs. Public infrastructure projects should have net positive externalities and public benefits. Therefore, the average ex-post EIRR of such projects should exceed their FIRR. These concepts were explored in more detail in Chapter 5, Section 2. The average annual nominal EIRR percentage of public infrastructure projects that are similar to the projects that would be passed over is suggested as the performance indicator.

b. Cost of Capital for Loans

Loans, which refer to borrowing capital from commercial or development banks, require the payment of finance servicing cost. The contracted finance servicing costs is mainly reflective of a lender’s perceived exposure to risk associated with the loan, including credit risk and inflation risk (Homer, 1963). The prime rate reflects a commercial bank’s lending rate to prime customers. This framework nominates the nominal annualized prime rate charged by commercial banks as the performance indicator for this component. The actual benchmark rate can be expressed in terms of discounted prime rate, or prime plus a margin, depending on the lender’s assessment of the borrower’s risk profile. There are a range of factors that could alter a lender’s risk exposure and, as a result, the interest rate charged. The most significant aspects include whether the loan is secured or unsecured and the creditworthiness of the delivery vehicle, as well as whether the loan is provided to the private sector or government. In the absence of loan guarantees by government, the finance servicing cost is also usually lower for almost any Western government than it is to most private entities.

101 The risk that borrower will default on their debt.
involved in the financing of public infrastructure (Kay, 1993). Therefore, the interest rate charged to government (including GTEs) is likely to be discounted.

The cost of capital associated with bank loans are normally larger than for government bonds, but are still significantly lower than private sector equity, because debt is normally repaid before external equity in the event of financial complications (PC, 2014). For customers with lower credit ratings, such as when financing is raised by an SPV, the commercial bank lending rate for financing large public infrastructure projects could vary by as much as 70 to 150 basis points above the prime rate (Hann & Mack, 2005). However, any government guarantees would reduce the interest rate on such loans.

Different types of debt also have different levels of claim on the borrower’s cash flows, which may alter the interest rate. Senior and secured debt, for example, has the highest priority of payment, while mezzanine or subordinated debt falls in between the traditional debt instruments and external equity in terms of priority of payment. Finally, when governments provide loans, they usually offer more attractive conditions than commercial banks. This may also be the case for loans from development banks. For example, government or development bank loans may charge lower interest rates and longer repayment periods instead of focusing on financial gain, as would be the case for commercial banks.

c. **Cost of Capital for Bonds**

Bonds involve finance servicing cost in the form of bond rates which are paid to bond holders. General purpose bond rates are mainly determined by the financial strength of the borrowing entity, since these bonds are typically issued against the borrowing entity’s general credit standing and the underlying assets consisting of multiple sources of cash flow. Bond rates are also sometimes indexed with inflation, which eliminates significant uncertainty for potential investors over the term of the bond (Abelson, 2011). When general purpose government bonds are used to finance public infrastructure, a long-term government bond rate, expressed as a nominal annualized percentage, is suggested as the performance indicator for the cost of capital. Countries may employ different bond maturity terms, such as the thirty-year bonds which are popular in the United States, while twenty-year bonds are

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102 As discussed in Chapter 6, seniority of claim refers to the priority of payment in the case of financial distress. An instrument with higher priority or seniority of payment would normally be preferred by debtors, since it exposes them to reduced credit risk.
popular in Australia. When government bonds are used, there is a range of other aspects that also determine the bond rates, including the fiscal imbalance, governance discipline and public debt management practices, as well as credit ratings of the borrowing entity (Chan et al., 2009). Should any significant changes in these aspects be anticipated, the benchmark rate adopted may require adjustment. In countries where local and state governments are able to issue bonds in their own capacity, the bond rate for that entity needs to be adopted. These bond rates may differ from federal government bond rates, in view of the potentially different risk profile, as well as the relative size of bond issues.

Governments, GTEs or SPVs may also issue project bonds or specific purpose infrastructure bonds to finance public infrastructure projects, in which case the risk of default is transferred to the project’s expected revenues (and sometimes assets), as opposed to the entity delivering the project. For example, in the United States, creditors normally do not have recourse to government’s general taxation funds or the liquidation of the assets financed when they buy revenue bonds (Chan et al., 2009). Bond yield rates for these specific purpose infrastructure bonds are mainly determined by a credit analysis of the project’s income sources. The structure of bonds also impacts on the bond rate. For instance, bullet bonds that involve a large repayment only upon maturity are riskier for lenders than amortizing bonds, whereby lenders receive a series of smaller repayments spread over the life of the loan and will require a higher return than amortising bonds (refer various bond types in Chapter 6). An upwardly adjusted general purpose government bond rate is suggested as the performance indicator for specific purpose infrastructure bonds.

d. Cost of Capital for External Equity

External equity investment in public infrastructure by the private sector also imposes a cost of capital on society. When external equity is employed to finance public infrastructure projects, there is an opportunity cost because equity investors are entitled to dividends and capital gain on their investment. The performance indicator adopted for the cost of capital for employing external equity is the private sector market’s average annual rate of return for similar projects, expressed as a nominal annual percentage. Hann and Mack (2005) suggested a similar measure, based on the implied discount rate associated with cash returns to equity. The portion of revenues remaining with the public sector, if any, is usually determined by a revenue sharing agreement. Hence, the cost to society when a financing approach that includes external equity is employed is determined by government’s loss of project revenues, since government foregoes some or all of the revenues. The gap between
anticipated public and private sector returns for the Sydney Airlink PPP project clearly demonstrates this concept. It was expected that government would receive only a 2 per cent rate of return, while the private sector rate of return was estimated at 23 per cent (Hann & Mack, 2005).\textsuperscript{103}

The required return on private sector equity financing is dependent on the market’s risk to return trade-off calculation.\textsuperscript{104} Depending on the type of infrastructure financed, public infrastructure may offer investors a number of attractive investment advantages, including low sensitivity to swings in the economy and markets, low correlation of returns with other asset classes, and long-term stable and predictable cash flows (Leviäkangas, 2007; Camane, 2013). Nevertheless, there is a variety of risk that requires consideration. Equity financing is the riskiest form of investment. This is for a number of reasons. The return on equity is uncertain and, furthermore, equity investors are also first in line to bear losses if a project encounters serious difficulties. Given that large public infrastructure projects often have a capital structure that consists of a combination of financing instruments, other financing instruments, such as debt, have greater seniority of claim on a firm’s cash flows (Hann & Mack, 2005; PC, 2014).

In exchange for accepting this greater proportion of risk, equity investors require higher returns than the finance servicing costs required by debt providers (HM Treasury, 2012). Hence, the rate of return required by external equity holders is higher when the gearing ratio (debt to equity) is higher, thus reflecting this greater risk to equity holders. This differential between external equity financing and financing by government (typically, taken as the general purpose bond rate) is commonly referred to as the private sector equity premium. Critics of the trend towards private sector financing of public infrastructure and PPP projects regard private sector financing as too expensive and contend that the increased cost of capital is unlikely to ever be offset by the productive efficiencies with which it is often credited. Governments sometimes offer use of concessional loans and government guarantees to SPVs, which is reflective of government’s view that the market generally overestimates the risks involved in investing in public infrastructure (DIRD, 2013). In other words, the private

\textsuperscript{103} These estimates did not eventuate, since the private sector went insolvent within six months, when demand estimates were not achieved (Hann & Mack, 2005).

\textsuperscript{104} The Capital Asset Pricing Model (CAPM) is typically used by the private sector to guide the determination of an appropriate minimum rate of return for investment in infrastructure, if a well-diversified portfolio is assumed (Snyder & Luby, 2012; Camane, 2013).
sector risk premium is often excessive on account of information asymmetry and over estimation of the risk, as was discussed in Section 2.3. Government or the economic regulator needs to ensure that a balance is maintained between protecting the public interest and providing sufficient returns for the private sector, all the while avoiding excessive profits. The United Nations (UN) defines fair returns as sufficient to cover the cost of financing and to meet contractual obligations (Economic and Social Commission for Asia and the Pacific [ESCAP], 2011).

The equity premium is determined by a range of factors, and is mainly dictated by the amount of risk of ownership that is being transferred to the private investor. In terms of the Modern Portfolio Theory, only systematic risk should be considered in establishing the cost of equity (Markowitz, 1952; Sharpe, 1964, Tobin, 1958). This is consistent with lessons learnt from project appraisal methods, as was discussed in Chapter 5. However, there is a discrepancy between the theoretical equity premium and the high premiums demanded by the private sector. This is commonly known as the private sector ‘equity premium puzzle’ (Mehra & Prescott, 1985) which is linked to a combination of private sectors’ strong risk-averse attitude and other factors. For example, Spackman (2001) found that institutional structure and the way in which managers are incentivized contribute to the equity premium puzzle. Delivery vehicles involving the private sector in the financing of public infrastructure are also characterized by contractual complexity. Depending on the level of maturity of a PPP procurement process, this often adds to the uncertainty for private investors.

7.3.2 Contingent Liabilities

When government is involved in the financing of public infrastructure, society is sometimes burdened with a range of financial claims, or contingent liabilities, such as the need to fund cost overruns on construction, and/or shortfalls in operating accounts (Chan et al., 2009). The classic Markowitz (1952) and Tobin (1958) model (also known as Modern Portfolio Theory) postulates that risk can be reduced by diversifying investments. Arrow and Lind’s seminal work (1970) on the variability risk associated with public sector investments concluded that, given certain assumptions, the cost to taxpayers associated with variability risk becomes generally negligible, since it is spread so widely. Therefore, only risk that

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105 Other factors include the amount of competition in capital markets, cyclical changes in investors’ risk appetite, and the prevalence of financial engineering and asset leveraging (Chan et al., 2009).
cannot be reduced by diversification should be priced for (Lucas, 2014). Such risk is normally referred to as systematic or market-wide risk, with these risks co-varying with the economy and affecting all asset classes (IA, 2008). Spackman (2001) made the point that the cost of systematic risk associated with a single megaproject amounting to over a third of a country’s national annual income would, however, become substantial to society, regardless of population size. Yet this scenario is unlikely in an OECD country such as Australia, where national income averaged at AUD 1.55 trillion in 2014 (Australian Bureau of Statistics [(ABS), 2014]). Even for a megaproject like the proposed Australian HSR, at around seven to eight per cent of GDP, the cost falls far short of a third of national income.

The identification of the systematic component of risk often requires expert input and analysis given that there is a link between project specific and systematic risk. This is because the economic environment, and therefore systematic risk, affects a project’s performance. For instance, operating costs are subject to inflation, and interest rates affect a project’s debt service obligations (Leviäkangas, 2007). The Traditional Capital Asset Pricing Model (CAPM), which is commonly applied in project valuation, refers to a project’s sensitivity to systematic or overall risk level as a project’s beta (Leviäkangas, 2007). In terms of the Markowitz model, the value of risk to government is determined by its ability to diversify and control the risk (Snyder & Luby, 2012). For instance, government controls many of the policies that affect revenue risk associated with its portfolio of infrastructure, including economic development policies and other infrastructure investments.

When governments employ reserves or debt to finance a project, all of the contingent liabilities remain with government. Even if a project fails financially, governments remain responsible for servicing debt, and contingent liabilities are not transferred to a lender. This concept is related to, but different from the credit risk which lenders consider in costing debt (discussed in Section 7.3.1 c). When a combination of public and private sector financing is used, contingent liabilities are normally shared between the public and private sector. The allocation of risk and therefore how much remains with society is determined by the

106 Leviäkangas (2007) and Hunsucker (2012) suggested that the underlying assumption of diversification arguably do not hold for private investors in the case of large public infrastructure projects, as well as the divergent abilities of the public sector versus the public sector to diversify its risk given the vast size of government’s investment portfolio.

107 Spackman (2001) analysed two aspects of undiversifiable risk, namely variability risk (uncertain project returns) and optimism bias. The comment appears to be made in the context of a small or developing country.

108 Beta is defined as the “covariance between asset return and market portfolio divided by variance of market return, the value of beta indicates the risk of the asset” (Leviäkangas, 2007, p.21).
contractual agreements associated with the delivery vehicle and financing arrangements. Various commentators, including Marques and Berg (2011) and Eriksen and Jensen (2010), suggested that risks should be assigned to the contractual party that is better able to mitigate or to bear them. The UN (ESCAP, 2011) added that the financing approach needs to ensure fair incentives and returns to all financing partners, based on their level of involvement and assumption of risk. Examples of risk transfer associated with private financing via PPP delivery include shifting the design and construction risk and/or performance risk to a private supplier (Kee & Forrer, 2002).

Table 28 contains a representative risk matrix that shows the typical risks associated with a PPP project, and how they may be allocated, as well as the common PPP risk drivers. Table 28 shows that, while it may be possible to allocate some risk to private investors, society is often still left with significant risk during all the phases of a project. The risks indicated in Table 28 are project related, and can be expected to include systematic risk components, as was discussed earlier. Even when projects are exclusively delivered and financed by the private sector, governments may provide overt or implied project guarantees, which imposes contingent liabilities on society. Explicit guarantees include direct government loans and loan guarantee programmes, funding of GTE deficits from tax revenues and other forms of government contributions to the servicing and repayment of capital through paying for particular services, or by paying shadow tolls (Abelson, 2011; Lucas, 2014). Abelson (2011) made the point that, when such payments are guaranteed and unconditional, it is debateable whether there is any material difference between public and private financing on the contingent liability borne by society, since the impact on government’s fiscal position and liability is the same. Implied risk refers to the residual risk to society that government may have to rescue a project should private parties default on their financial obligations, even if these risks have been contractually allocated to the private sector (PC, 2014). This risk usually pertains to critical infrastructure assets where there is a need for continuity of services, which pressurizes government to remain ultimately responsible (Yescombe, 2007). When government rescues failing public infrastructure projects or adopts risks for which the private financing partners should be held responsible,

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109 An example would be where the private supplier carries the risk for designing and constructing the infrastructure, followed by performance and reliability of the service throughout its usage period.

110 Government payments for services when no user charge is levied (Abelson, 2011).
this introduces potential moral hazard (Keefer & Knack, 2007; Baily & Asenova, 2009; Adler et al., 2010; Liu & Webb, 2011; Pottinger, 2013).111

Table 28: Example of a risk allocation matrix for a particular PPP project

<table>
<thead>
<tr>
<th>Phase</th>
<th>Risk</th>
<th>Example risk drivers</th>
<th>Who bears the risk?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and construction</td>
<td>Project design</td>
<td>Inadequate planning, substandard design versus user requirements, lack of system integration, delayed construction permits</td>
<td>Yes     Yes</td>
</tr>
<tr>
<td>Financing and Refinancing</td>
<td>Cost and availability of financing and refinancing, counterparty and government-sponsored risk</td>
<td>Yes          Yes</td>
<td></td>
</tr>
<tr>
<td>Construction (overruns and delays)</td>
<td>Equipment and raw material costs, labour costs, construction firm and subcontractor expertise, complexity of project, long-lead equipment delays</td>
<td>Yes      No</td>
<td></td>
</tr>
<tr>
<td>Site</td>
<td>Availability of the site (land acquisition, right of way), quality of the site (geological conditions, contamination), zoning permits</td>
<td>Yes       Yes</td>
<td></td>
</tr>
<tr>
<td>Environmental and social</td>
<td>Delayed permits, environmental constraints for construction and operation, stakeholder opposition, mitigation costs</td>
<td>Yes       Yes</td>
<td></td>
</tr>
<tr>
<td>Operational</td>
<td>Operations and maintenance costs</td>
<td>Labour costs, raw material inputs, poor design</td>
<td>Yes     No</td>
</tr>
<tr>
<td>Performance and availability</td>
<td>Operational efficiency, system underperformance, service interruptions, innovation risk</td>
<td>Yes       Yes</td>
<td></td>
</tr>
</tbody>
</table>

111 Moral hazard occurs when an entity takes undue risks when they do not have to bear the full consequences.
<table>
<thead>
<tr>
<th>Phase</th>
<th>Risk</th>
<th>Example risk drivers</th>
<th>Who bears the risk?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Private Investors</td>
<td>Government</td>
</tr>
<tr>
<td>Demand risk</td>
<td>Lower demand than forecast, poor macroeconomic conditions, price elasticity</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Across</td>
<td>Political and Regulatory</td>
<td>Lack of currency convertibility, changes in laws/regulations, expropriation, termination, breach of contract</td>
<td>Yes</td>
</tr>
<tr>
<td>phases</td>
<td></td>
<td>Foreign exchange</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Force majeure</td>
<td>Natural or man-made events, such as earthquakes, floods, hurricanes and civil war.</td>
<td>No</td>
</tr>
</tbody>
</table>


The performance indicator for the systematic risk that remains with society proposed for the framework being developed is calculated with reference to the market’s estimation of risk as indicated by the private sector risk or equity premium (discussed in Section d). As discussed earlier, the private sector equity premium usually exceeds systematic risk because there are capital market inefficiencies such as information asymmetry and agency problems.112 In an empirical study, Camane (2013) found that these issues were an important factor in the selection of financing instruments by governments. When firms have more information than investors and/or financiers (in other words, information asymmetry), they demonstrate a clear pecking order in their preference for financing instruments, whereby retained earnings (reserves) would be preferred to debt, short-term debt to long-term debt, and debt over equity (Myers & Majluf, 1984).

In performing the calculation of the appropriate benchmark for the contingent liabilities, appraisers need to be careful not to adopt an industry-standard risk premium. The public infrastructure literature lists a range of concerns with applying a standard rate, including

---

112 Agency problems arise when there is a conflict of interest and differential objectives and understanding of risk between firms (delivery vehicles); managers; shareholders; and debt holders. Problems arise in the presence of asymmetric information and when it is impossible to determine the outcome of all contingencies (an incomplete contract). These aspects were also touched on in Chapter 2, Sections 2.2 and 2.3.
significant overcompensation for optimism bias by the private sector (Ball et al., 2003; SDG, 2004; Blanc-Strange, 2007; Vickerman, 2007; Vecchi et al., 2013). For the framework being developed, it is suggested that the private sector risk premium be discounted to account for market inefficiencies, the private sector’s strong risk aversion, and diversifiable risk components. In addition, when risk is shared between society and the private sector, the premium needs to be adjusted accordingly so as to reflect only the contingent liabilities that remain with government and the broader society.

The systematic risk for any given project requires individual consideration. There is a large body of knowledge on the failings and merits of different risk appraisal methods for public infrastructure, given the complexities involved in quantifying risk, including pioneering methods such as Taylor’s expansion, stochastic (or Monte Carlo) simulation and method of moments (Hunsucker, 2012; Espinoza, 2014). Should a full estimation of project-specific risk not be possible, Hunsucker (2012) suggests that the approach adopted by the Dutch government represents a pragmatic alternative. The Dutch government normally estimates the risk premium by establishing the covariance between forecast net project benefits (a proxy for returns) and forecast GDP growth (a measure of market returns). This is compared to benchmarks based on ex-post information for similar projects. There is merit in the views of Hunsucker (2012), who concluded that even a measure of project-specific risk premium derived from qualitative analysis is likely to yield better results than the common method of adopting an industry standard risk premium. The qualitative rating of risk by a panel of experts performed by Camane (2013) is one example of such an approach.

In addition to establishing a project specific systematic risk premium, the benchmark adopted for the contingent liabilities performance indicator is impacted by the way that the project is financed. For example, short-term loans introduce higher refinancing risk than long-term debt instruments, or bonds (DIRD, 2013). The impact of the financing instrument and its tenure on risk can also be demonstrated by arguments that early involvement of longer-term equity financing creates stronger incentives to manage an infrastructure project’s lifetime risk than shorter-term debt financing, which is often used in the early stages of newly constructed infrastructure (PC, 2014).

7.3.3 Credit Rating Impact

The credit rating of an entity has a major impact on its cost of capital. Credit rating agencies like Moody’s, Standard and Poor’s Rating Services (S&P) or Fitch Ratings grade entities’
creditworthiness and provide qualitative statements on their financial obligations. These statements sometimes include forward-looking indications of credit rating changes (called outlooks and watch lists) in the event of major corporate events such as mergers, which may impact the entity’s existing credit rating (Bannier & Hirsch, 2010). Table 29 shows an example of the credit ratings applied by Standard and Poor’s Rating Services.

Table 29: Standard & Poor’s ratings

<table>
<thead>
<tr>
<th>Grade</th>
<th>Rating</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Investment Grade</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AAA</td>
<td>Extremely strong capacity to meet financial commitments. Highest rating.</td>
<td></td>
</tr>
<tr>
<td>AA</td>
<td>Very strong capacity to meet financial commitments.</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>Strong capacity to meet financial commitments, but somewhat susceptible to adverse economic conditions and changes in circumstances.</td>
<td></td>
</tr>
<tr>
<td>BBB</td>
<td>Adequate capacity to meet financial commitments, but more susceptible to adverse economic conditions.</td>
<td></td>
</tr>
<tr>
<td>BBB-</td>
<td>Considered lowest investment grade by market participants.</td>
<td></td>
</tr>
<tr>
<td><strong>Speculative Grade</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BB+</td>
<td>Considered highest speculative grade by market participants.</td>
<td></td>
</tr>
<tr>
<td>BB</td>
<td>Less vulnerable in the near term, but faces major ongoing uncertainties to adverse business, financial and economic conditions.</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>More vulnerable to adverse business, financial and economic conditions, but currently has the capacity to meet financial commitments.</td>
<td></td>
</tr>
<tr>
<td>CCC</td>
<td>Currently vulnerable and dependent on favourable business, financial and economic conditions to meet financial commitments.</td>
<td></td>
</tr>
<tr>
<td>CC</td>
<td>Currently highly vulnerable.</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>A bankruptcy petition has been filed or similar action taken, but payments of financial commitments are continued.</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Payment default on financial commitments.</td>
<td></td>
</tr>
</tbody>
</table>

Source: Jacquot 2014, p.3.

An entity’s credit rating affects its access to external capital, as well as the finance servicing cost for future projects. These ratings are not prescriptive for borrowers, but nevertheless play an important role in determining the finance servicing cost for borrowing entities (Munso, 2011). For example, Gilbert and Pike (2008) performed an empirical study that compared the cost of capital for financing public infrastructure by Canadian municipalities, and found discrepancies based on the credit rating, population and issue size, with credit
rating being the main factor. A high credit rating allows the borrowing entity to raise low-cost debt easily (Lucas, 2014), while a downgrade has the opposite effect given the flight to quality, which induces investors to shift capital away from riskier investments to safer vehicles (Chen et al., 2010). Preservation of an entity’s credit rating therefore remains an important consideration.

Debt financing could result in a credit rating downgrade. While loans may be available at lower credit rating levels, an investment-grade credit rating from an agency such as S&P or Moody’s is a prerequisite for accessing capital through bond markets (Wyman, 2014). A credit rating downgrade occurs when the amount of debt is viewed to be excessive and likely to impact on the entity’s default risk. Credit rating agencies regard public debt as excessive when the growth in debt becomes fiscally unsustainable, and is especially an issue when considering tax supported debt (Sheehan & Gregory, 2013). Tax-supported public debt would become fiscally unsustainable when the debt levels are steadily rising at a faster rate than the growth in operating revenues out of which the interest and principal must be serviced (Hyman, 1999; Gruber, 2007; Rosen & Gayer, 2007; Abelson, 2008). Even GTE borrowing can impact on government’s credit ratings, despite being described as ‘off-budget’ (Chan et al., 2009). Credit rating agencies take government guarantees into account when they determine the owner government and GTE’s credit ratings. In general, when there is an explicit credit guarantee, this is reflected in the owner government’s credit rating as a contingent liability. Implicit guarantees usually affect the relevant agency’s credit rating, but may not change government’s overall credit rating (PC, 2014).

The impact of a credit rating downgrade would be larger for entities with lower credit ratings. For example, Huang and Huang (2002) found that credit risk for investment grade bonds (defined as those with a credit rating of Baa and above) of all maturities accounted for only a small fraction (typically twenty to thirty per cent) of the observed corporate treasury yield spreads. Yet for bonds involving a high default risk (junk bonds), the credit risk accounts for a much larger portion of the yield spreads.

Scoring the credit rating impact of debt is determined by whether it is likely to amount to a credit rating downgrade. The adjustment to credit rating would normally come after the

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113 Ratings agencies use the ratio of tax-supported debt to consolidated operating revenue as a key ratings criterion for governments (Sheehan & Gregory, 2013).
114 It is reported in GTE’s financial statements rather than in government’s budget.
increased borrowing; however, the announcement of a very large borrowing project, which would substantially increase government debt levels, could lead to a ratings downgrade that may impact on the cost of financing. The performance indicator suggested for this criterion is the cost of capital premium associated with any credit rating downgrade anticipated, expressed as a nominal annual percentage. This needs to be estimated by a project panel on the basis of the probability of a downgrade in the current fiscal environment, and given the government’s annual financing requirements.

7.3.4 Taxes Forgone
This criterion addresses any foregone revenue associated with tax advantaged financing instruments. Both infrastructure funds and specific purpose bonds may be tax advantaged, typically in the form of a tax concession on the interest from the bond. Revenue bonds are normally tax exempt in the United States, while this is not the case in Canada (Chan et al., 2009).

The performance indicator for this criterion represents the estimated present value of the total amount of tax revenue that society sacrifices over the life of the project by virtue of issuing tax-advantaged financing instruments. The marginal corporate tax rate multiplied by the bond rate, expressed as a nominal annual percentage, is proposed as the performance indicator. This approach was also adopted by GAO (2002).

7.3.5 Cost of Project Delay
This criterion addresses the costs incurred when a project is delayed as a result of the financing instrument selected.\(^{115}\) The three most prominent costs associated with project delays which are identified in the literature is inflation, the value of lost services (assuming the project delivers net benefits to society) and bridging finance (Vander Ploeg, 2006; Chan et al., 2009). When a project is delayed, the cost of constructing the assets may increase. Such project-specific inflation\(^{116}\) could even offset any interest savings of avoiding debt. A delay of the project also imposes an opportunity cost on society since society foregoes the

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\(^{115}\) Given that this criterion speaks to the costs involved in project delays attributable to the financing approach in particular, this is different to the potential cost and time overruns included in calculating the risk premium to indicate society’s contingent liabilities, as was discussed in Section 7.3.2.

\(^{116}\) Inflation is normally removed from BCA analysis of projects, since it would seem likely to impact equally on project costs and benefits (or nearly so). The resulting project NPV is normally expressed in (current) constant dollar terms. However, the cost of delay associated with the choice of financing instrument selected is a different concept, and does not have an offsetting income dimension. Therefore, the inflation associated with project delays needs to be included in the Effective Cost of Financing.
net value of lost services arising from slower delivery of projects. Project delays may also necessitate the use of bridging finance, or short-term loans, which are used to keep the projects on hold. The costs involved with bridging finance would only apply should government need to borrow from banks in order to keep the project on hold.

Arranging and implementing the various financing instruments often has different implications for the timely delivery of a project. The complexity involved in tendering and contracting private sector equity finance for public infrastructure is highly time consuming, and has been found to delay project initiation significantly for large public infrastructure projects (ACG, 2003; PC, 2014).\textsuperscript{117} When an infrastructure project is financed from reserves, or accumulated funds, project completion may be delayed as a result of constraints on cash flow. Reserve financing could, for instance, also be delayed when a funding mechanism such as developer contributions is accumulated. Developer contributions are notorious for resulting in disputes, which can obviously cause project delays (Jones, 2000; Nera, 2006).

Project delays associated with accumulating reserve financing can be avoided by using debt that enables near-immediate access to finance (Kitchen, 2004). When applied to reserve financing, the cost of project delay as a result of the financing instrument selected is not to be confused with the opportunity cost associated with the cost of capital of reserve financing, which is the lost benefits associated with cancelling or foregoing other projects (refer Section 7.3.1).

The suggested performance indicator for this criterion involves a composite measure consisting of the main delay costs identified, namely project-specific inflation, the value of lost services and any bridging finance used. This indicator can be translated into an annual cost of capital premium by expressing the costs as a nominal percentage. The GDP deflator can be used as a proxy for inflation on public infrastructure construction costs. Recent analysis by the Productivity Commission (2014) found that price inflation for infrastructure assets has closely corresponded to general price rises associated with production in the economy as a whole.\textsuperscript{118} The performance indicator for the value of lost services can be

\begin{footnotesize}
\footnotesize
\textsuperscript{117} Some commentators believe that the involvement of the private sector may speed up project completion (IPA, 2007; OIC, 2013). However, a distinction is required between private sector involvement in construction and financing, since the private sector is usually involved in project construction by way of government contracting, regardless of the financing instrument. The costs involved in project delays in the framework should only account for the delays involved in the choice of financing instrument.

\textsuperscript{118} For projects where the inflation rate for that particular type of infrastructure differs significantly from the GDP deflator, adjustments should be made accordingly.
\end{footnotesize}
determined by using the annual nominal economic rate of return (EIRR) estimates for the project being delayed. Should any bridging finance be required as a result of project delays, the cost of commercial bank loans to prime customers is adopted for bridging finance.

7.3.6 Administration and Transaction Costs

This monetary criterion includes all the costs of negotiating, contracting, administrating and managing a financial instrument imposed on society. The composition of these costs would be different depending on the financing instruments selected. For instance, bonds may involve underwriting fees and credit rating agency charges, and government contributions impose project monitoring costs, while reserve financing from development contributions often results in legal appeal costs for society. Transactional costs are generally low for government bonds because governments have high credit ratings and utilize large, trade-sized bond issues. Likewise, when bonds are issued for GTEs through Central Borrowing Authorities, even smaller-sized bond issues can benefit from reduced transaction costs by pooling of the issue. Cost savings from pooled bond issuance have been shown to amount to as much as 0.4 percentage points on average in the bond rate relative to stand-alone issues (Gilbert & Pike, 2008). For example, Robbins and Simonsen (2013) found that municipal bond issuance costs in the United States averaged about 0.92 per cent for bond amounts in excess of USD 500 million, going up to 1.29 per cent (for smaller bond issues of between USD 100 million and USD 500 million). Table 30 shows an estimation of the bond issuance costs for bonds greater than a billion dollar, based on the findings by Robbins and Simonsen (2013).119

Table 30: Bond issuance costs

<table>
<thead>
<tr>
<th>AUD</th>
<th>Bond issuance rate (percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 million</td>
<td>1.29%</td>
</tr>
<tr>
<td>500 million</td>
<td>0.92%</td>
</tr>
<tr>
<td>1 billion</td>
<td>0.66%</td>
</tr>
</tbody>
</table>

119 Robbins and Simonsen (2013) calculated the rate of decline in bond issuance costs for bond amount intervals ranging from USD100,000 to USD 500,000, up to over USD 500 million. Since bond issuance costs are largely fixed, this rate of decline was adopted in order to calculate how the issuance costs are expected to decline for megaprojects which require capital of billions of dollar.
<table>
<thead>
<tr>
<th>AUD</th>
<th>Bond issuance rate (percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 billion</td>
<td>0.0066%</td>
</tr>
</tbody>
</table>

Source: Based on Robbins and Simonsen 2013, p.8.

Obtaining reliable transaction and administration cost estimates associated with the different financing instruments is not easy. Factors that have the potential to impact on the size of society’s administrative and transaction costs associated with a specific financing instrument include the degree of complexity of the instrument, how established the instrument is in the financial markets, and government’s ability to administer the instrument in question (PC, 2014). In the light of the above considerations, total estimated lifetime administration and transaction costs to society expressed as a nominal annual percentage is suggested as the performance indicator for this criterion.

### 7.4 Intangible Criteria

In addition to the monetary criteria proposed above, there are a range of intangible attributes that are equally important in the selection of a financing approach from society’s perspective. These are discussed below.

#### 7.4.1 Effectiveness

In economics, effectiveness is defined as the extent to which an instrument or policy achieves its intended objective (Wellman & Spiller, 2012). Applied to financing instruments, this framework defines effectiveness as the ability to provide steady and reliable access to sufficient capital to construct a large public infrastructure project (ACG, 2003). When a large public infrastructure project is being financed, there may be constraints on the availability of particular financing instruments. The effectiveness of financing instruments differs. Reserve financing that is dependent on the budget appropriation process is often ineffective in raising sufficient capital to build large public infrastructure projects, as a country’s fiscal policies may constrain large capital investment when budget appropriations are employed. Infrastructure also has to compete with other uses of general government revenue, which is likely to reduce the availability of budget appropriations, as General Fund revenues are usually scarce (Vander Ploeg, 2006). Reserve financing by way of infrastructure funds (usually an accumulation of hypothecated taxes) can, however, shield and insulate the capital from various legislative and political pressures, all of which can improve the stability and continuity of finances, as opposed to budget appropriation financing from general taxes.
Reserve financing from accumulated special property charges can also place constraints on the effectiveness of financing of public infrastructure projects. Possible limitations include: restrictions on the replacement of existing infrastructure; uncertainty of finances owing to the ubiquity of legal challenge by dissatisfied developers; and a mismatch between the timing of collecting development contribution revenues and the actual development of the infrastructure (Chan et al., 2009). User charges are also often ineffective in raising sufficient reserve financing for large public infrastructure. This is because user fees are normally set too high to encourage optimal use, and too low to cover the cost of capital (ACG, 2003).

Debt is generally a more effective source of capital for large public infrastructure projects than reserves. In particular, general purpose government bonds represent a stable and reliable source of funds when a well-functioning debt management programme is in place (ACG, 2003). However, specific purpose infrastructure bonds may be ineffective in raising sufficient funds for investment in large infrastructure projects as stringent credit analysis and requirements that focus on the nature of the income sources that back the bonds is usually imposed. Such requirements typically include a debt coverage ratio of around 1.5 to 2, establishment of operating reserve funds, setting of minimum charges, and restrictions on further leverage (Chan et al., 2009). In the absence of sufficient government guarantees, the debt-carrying capacity of public infrastructure projects that involve private financing is determined by its ability to generate a positive cash flow after operating costs have been deducted (ARUP TMG, 2001). For SPVs involving private financing, the ability to raise sufficient capital via corporate bonds will likewise depend mainly on the credit rating of the corporate entity, as well as the degree of government support and guarantees, and the general state of domestic and international capital markets.

External equity is also a more effective financing instrument than reserves, since it affords the delivery vehicle access to a larger capital pool derived from a range of potential investors.

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120 When timing of realization of contributions are subsequent to development (for instance, where in-kind contributions require further development before they can provide services), government faces the task of financing the required infrastructure investment through existing reserves or borrowing.

121 This may also apply to government GTEs, or SPVs, depending on the explicit or implicit recourse of bond holders to government backing or guarantees – if these are in place the reliance on project revenue flows is diminished.

122 For example, for a period after the Global Financial Crisis (GFC), capital markets were constrained, debt became more expensive, and credit risk insurance and some traditional forms of finance were no longer readily available (Regan, 2009).
including superannuation funds and life insurance companies (ACG, 2003). However, external equity financing is usually less effective in raising sufficient capital than debt. This is because the amount of external equity available for a specific project is dependent on the project’s financial viability, and will be limited to the amount that investors estimate would ensure them a sufficient return on their investment (as discussed in Section 7.3.1d). It is also generally easier to raise more capital for unlisted infrastructure projects (or private equity) than by the stock market (in other words, public equity). The reason being that owners’ backing will normally afford the project easier and more flexible access to additional capital, should it be required, than would be the case in the stock market (Office of the National Infrastructure Coordinator [OIC], 2013).

7.4.2 Fairness
The fairness of a financing instrument requires careful consideration of many dimensions, including intragenerational and intergenerational impacts. Intragenerational equity refers to how different social groups are disproportionately affected in terms of their particular profile (which may include income distribution, gender, ethnic or cultural background, age, health, skill or location) (IER, 2005). In economic terms, the fairness (or equity) of an instrument is often applied to taxes (a funding mechanism), where it refers to the fair sharing of the tax burden between individuals who have differing abilities to pay (ACG, 2003). Vertical equity generally indicates that individuals with greater economic capacity should contribute more than those with lower capacity, while horizontal equity means that people in similar situations should be treated similarly (Musgrave, 1959; Musgrave, 1987). For example, when external equity is invested, that would normally entail an investment of surplus funds of wealthier individuals in the community. Even when superannuation funds invest in the equity of a project, higher-income individuals would contribute a higher proportionate share of financing than lower-income individuals. These individuals would also have a claim on the future revenues of the project (returns on equity), and consequently, external equity is regarded as having good vertical equity impacts. However, private sector financing that involves unrestricted markets often leads to gross inequalities with regard to society’s access to important resources and can lead to the creation of monopolies, which necessitate regulation or public subsidies to the monopoly to remedy the situation (Nelson, 2005).

Intergenerational equity requires a balance between generations benefitting from a public policy or project with those paying for it (Musgrave, 1959). The intergenerational equity of financing instruments can be demonstrated by comparing debt and reserve financing. Debt,
in general, is recognized for its ability to improve intergenerational equity, since it is repaid by both current and future generations, both of which can benefit from using the infrastructure (Jones, 2000; Freebairn & Corden, 2013; PC, 2014). Using reserves, by way of contrast, raises concerns regarding intergenerational fairness. This is because past and current society will cover all the costs of infrastructure, while future generations reap the benefits over what might be a very long infrastructure lifespan (Robinson, 2002; ACG, 2003; Vander Ploeg, 2006). Given that public infrastructure projects are often not able to fully recover all debt obligations from user fees, government subsidies are routinely required. This places a burden on future generations. Provided that the infrastructure has been appropriately selected and maintained, long-term debt assists in synchronizing the costs associated with servicing debt with the long-term benefits of long-lived public infrastructure assets (Kitchen, 2004).

It is clear, then, that the repayment term (or tenure) also plays an important role in determining the intergenerational equity impacts of a loan. Gruber (2007) added that debt financing of public infrastructure that enhances productivity and the standard of living for future generations is defensible, and that we should not consider the absolute burden of debt in isolation, but relative to the standard of living. Furthermore, Hyman (1999) compared the intergenerational equity of debt and deficit finance with a nation’s traditional heavy reliance on borrowing to finance wars, which was justified on the basis that the mitigation of a threat to national security will provide future benefits to future generations. Robinson (2002) reminded us that this is consistent with the golden rule of public finance, which states that government should only borrow to invest and not to fund current spending over the economic cycle, in contrast with a cash balance or a zero ‘public sector net borrowing’ requirement.

When it comes to the fairness of a financing instrument, an added dimension that requires consideration is society’s claim on potential future project returns. The provision of capital by society often confers (or should confer) ownership or property rights, including claim to any net project revenues (Abelson, 2011; HM Treasury, 2012). When reserve or debt financing is employed, society retains property rights, including project returns. A project that is exclusively delivered by a government department could earn society revenues from user fees. GTE and SPV delivery vehicles can earn government dividends. When a mix of financing instruments are used that involve private parties, society’s claim on project revenues is often different in proportion to the claims of private parties, and in theory should be determined by how risk is shared (refer Section 7.3.2). However, when the projects are
exclusively financed by way of external equity, society normally completely foregoes its claim to project revenues.

The size of net revenues generated by public infrastructure projects are estimated during project appraisal (refer Chapter 5). Marketable and economic infrastructure can be expected to yield higher returns than non-marketable and social infrastructure (OIC, 2013). Involvement of private sector financing may or may not alter a project’s returns (as discussed in Chapter 6, Section 6.8.3). Even if private sector financing does improve project returns, higher project returns do not imply higher returns to government and society at large. This is because private investors extract financial returns in exchange for their investment.

7.4.3 Flexibility

Flexibility of financing instruments is defined in this study as the ability of the financing instrument to allow for the specific requirements of public infrastructure projects, as well as changing financing requirements and market conditions over time. For debt instruments, flexibility may involve the ability to renegotiate repayments and restructure loan arrangements, or easing credit terms during difficult financial times (Vander Ploeg, 2006). For example, Hann and Mack (2005) suggest that infrastructure debt is becoming more flexible and allows for longer repayment periods to accommodate the financing of public infrastructure projects with slow demand ramp up. The Productivity Commission (2014) also observed that loans afford policy makers more flexibility than bonds, given that there exists the option to renegotiate and restructure loan terms. In particular, short-term loans allow for further flexibility benefits since infrastructure can be refinanced once project risk are clearer, instead of being locked into unfavourable long-term loans (PC, 2014).

A financing instrument may also allow for changing project requirements in terms of its ability to accommodate restructuring of an asset’s ownership, such as when the asset is privatized. For example, if government wants to retain flexibility to withdraw from an SPV delivered asset, a capital grant would be preferred to government loans. Another example of a financing instrument specifically engineered to allow for a shift in ownership is converting infrastructure bonds, which start off as debt, and are later converted to equity (refer Chapter 6, Section 6.7) (Mulino, 2013). The funding mechanisms and delivery vehicles employed can also affect the flexibly of a financing approach. By way of example, Vander Ploeg (2006) points out that finance that is dependent on hypothecated tax funding makes the budgetary process more rigid and can limit flexibility, as it binds decision makers to outdated priorities.
for project selection. Some jurisdictions avoid this limitation by borrowing against reserves in funds. This, however, violates the accountability rationale or principle for earmarking and can create budgetary confusion (Vander Ploeg, 2006).

7.4.4 Stakeholder Support
The various financing instruments enjoy different levels of stakeholder support. Governments in democratic nations are reluctant to pursue a choice that is not supported by the greater portion of society, or apply measures that fall predominantly upon influential stakeholders (ACG, 2003; Vander Ploeg, 2006). An example of how stakeholder support varies by financing instrument is the use of reserve financing as opposed to debt. Reserve financing is generally regarded as more fiscally prudent, since government spends only what is currently affordable (Vander Ploeg, 2006; Chan et al., 2009). Debt does not always enjoy stakeholder support. For example, if financial markets interpret increased public debt as a sign of improper fiscal management, stakeholder support can be expected to decline, carrying with it political and economic risk (ACG, 2003). An issue raised with public debt in particular is the potential crowding out of private investment by increasing the costs of financial capital. Yet counter arguments exist in the case of infrastructure, as opposed to structural and ongoing government operating budget shortfalls (Abelson, 2008; McTaggart et al., 2010). Indeed, McAuley (2002) points out that, regardless of whether infrastructure is developed with borrowing by the public or the private sector, the same amount of capital is required. Furthermore, the private sector often benefits from such government-financed public infrastructure and without it, its investments may be less productive (Hyman, 1999).

While reserve financing may, in general, be politically more popular than debt instruments, the merits of this kind of financing strategy depend on the nature of the public infrastructure. If sufficient reserves are available to finance infrastructure, stakeholders would normally prefer it to other instruments that require increasing taxation (Vander Ploeg, 2006). Reserve financing has a role to play for financing highly technological infrastructure that runs the risk of obsolescence, or smaller groups of assets that carry lower initial costs and possess shorter life spans. However, limiting finance to accumulated funds might be regarded as an unduly conservative approach in the context of supplying large public infrastructure with high up-front costs and long life spans (Vander Ploeg, 2006). Financing by the private sector (external equity) is often opposed by stakeholders. This is for a range of reasons, including reluctance to pay the full price of delivery, fear that private firms will use their market power
to overcharge, as well as other potential political issues such as union backlash (Blöndal, 2005; Hann & Mack, 2005).

Although stakeholder support requires consideration as a criterion for appraisal of financing approaches, there is the risk of making short-term political choices that are not in the long-term best interest of society. Freebairn and Corden (2013) highlight this risk, which is prevalent in the investment decision, or project selection for public infrastructure. It is not uncommon for political parties and the government of the day to select projects in response to the pressures of special interest lobby groups. In effect, decisions in the interest of short-term political goals such as re-election may come at expense of the national benefit. This dilemma may also apply to the choice of financing instruments, and can be mitigated by ensuring that a rigorous appraisal of financing instruments is performed by truly independent entities and that the details of such appraisals are made publicly available so as to allow for public scrutiny.

7.4.5 Accountability and Transparency

Accountability and transparency are closely related concepts. The accountability of an instrument is enhanced when the design and ownership of an approach or policy is clear to society (Kitchen, 2004). This means that society can pinpoint who is responsible and who should be held accountable for their actions. Accountability also refers to rigorous and transparent reporting and oversight requirements, together with well-defined and measurable performance measures (MPIR, 2004). Transparency is promoted when society has access to information and decision-making forums, and so can familiarise itself with the way in which alternatives are set and assessed (Kitchen, 2004). The Allen Consulting Group (2003) highlight that transparency is an important way of reducing uncertainty, given that it facilitates an understanding of the process and issues that require consideration. Keefer and Knack (2007) also found that transparency and accountability in financing decisions for public infrastructure is vital for protecting the public interest and to avoid issues such as rent seeking.

The way in which public infrastructure is financed has different transparency implications and is closely related to the delivery vehicle involved in financing. For example, the terms of government bonds are transparent to society, while transparency may be compromised on account of the non-disclosure of contracts for commercial-in-confidence reasons when external equity is raised (ACG, 2003). Another financing instrument credited with promoting
transparency is project-specific financing raised on the capital market, as a result of its stringent disclosure requirements. External equity, which is normally associated with PPP contracting, often involves a significant degree of complexity. This also makes it hard to understand accountability of the different parties involved (Hann & Mack, 2005).

Reserve financing which is reliant on intergovernmental transfers or grants is also open to political abuse; for instance, areas representing swing voters may receive larger grants than other groups (Milligan & Smart, 2005; Australian National Audit Office, 2007). However, accountability is improved when development contributions are used, as they often require formal development plans that meet standards of reasonableness and accountability (Chan et al., 2009). Budget appropriations are relatively transparent and accountable owing to the parliamentary scrutiny and legislative control exercised for capital spending and financing (ACG, 2003). However, the accountability and transparency may be compromised when legislative control and oversight over resources is bypassed via special appropriations. At the same time, public budgeting reforms aimed at reflecting full costs of asset acquisition and related future liabilities have improved the quality of the budgeting process (Chan et al., 2009).

7.4.6 Degree of Public Control and Ownership

The loss of control over infrastructure has the potential to expose citizens and government to enormous policy and economic risk, should private financing arrangements be structured in a way that would mean that government loses its primary tools to address future societal problems (such as congestion and promotion of economic development), as well as its ability to price assets and build new infrastructure (Hann & Mack, 2005; Snyder & Luby, 2012). When private financing of public infrastructure is selected, private objectives may override the public interest, or it may be harder for government to advance other important policy objectives. An example is provided by the Canadian telecommunications industry, which was first held in public hands given the significance of the technology to overall economic development, and was only divested to the private sector once the infrastructure was widely available (Vander Ploeg, 2006). This concept also has implications for foreign financing or investment when retaining local ownership of strategic infrastructure is regarded as critical. Financing instruments that allow government to retain public control and ownership enable it to promote society’s goals or deliver other coordination benefits. Particularly with respect

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123 This practice has been observed in Canada, France, Sweden and Australia.
to electricity and water infrastructure, public financing and delivery has often been selected to support governments’ economic goals, or improve coordination between various related infrastructure systems (Vander Ploeg, 2006). 

The commitment of its own capital affords government ownership rights, thereby ensuring that society retain ownership and control of the management of the infrastructure, which may be important for strategic public infrastructure. In addition, as long as the borrowing public sector entity meets its debt obligations, that entity also normally retains control and ownership of the infrastructure. The utilization of external equity financing means that government usually sacrifices a degree of appropriate control and ownership in the infrastructure project. It is difficult to specify a contract with the private financing partner that protects society’s interests for every possible eventuality (Jenkinson, 2003).

7.5 Appraisal Approach

The appraisal approach adopted for the thesis retains the standard BCA and MCA principles that are applied in project appraisals (refer Chapter 5), and modifies them to accord with financing approaches. The framework suggests monetary expression of all aspects where it is possible, albeit augmented by the formalized inclusion of intangible criteria. The resulting MCFA approach utilizes a BCA-based calculation of the Effective Cost of Financing (ECF) in terms of the monetary performance indicators, combined with the appraisal of intangible criteria following MCA principles.

Calculating the ECF for a financing approach entails expressing monetary performance indicators as premiums to the base estimated cost of capital for each of the financing instruments. Figure 24 illustrates how the ECF is calculated for a hypothetical financing instrument which involves all the proposed monetary cost elements of the appraisal framework.
The monetary aspect of the appraisal concludes with the calculation of an ECF per instrument. If a favourable rating in terms of the subsequent appraisal of intangible impacts is assumed, the instrument with the lowest ECF would be most desirable and should be prioritised by the public sector decision makers who are tasked with compiling a financing approach. The MCFA framework formally includes the intangible criteria identified in Section 7.4. Intangible criteria are assessed based on a modified MCA approach. It is proposed that each instrument’s performance against the intangible criteria are rated or scored against a simple Likert-type scale, as was adopted by Infrastructure Australia (2008) for appraisal of intangible project appraisal aspects (refer Chapter 5, Section 5.6.1).

The scores or ratings are then combined, based on weighted criteria, to arrive at an appraisal of intangible criteria for each potential financing approach for a particular project. Finally, by combining weighted results of the monetary and intangible appraisal components, the desirability of the various instruments can be established by comparing the resulting Net Multi-Criteria Cost of Financing (NMCCF) by instrument. In calculating the NMCCF, care is required in establishing the quantum of discount, and thus, the relative weight, allocated to intangibles in comparison with the size of the monetary aspects (the ECF). It follows that the standard MCA methods should be applied by the expert appraisal panel to arrive at the relative weight allocated to each criterion, such as applying pair-wise comparison matrices used in AHP techniques. These methods were briefly discussed in Chapter 5, Section 5.4.1.
The instrument with the highest NMCCF is the most desirable choice and if selected would optimize society’s welfare. As discussed earlier, any intangible measures that overlap with the monetary criteria would only be considered where it is not possible to monetise the concept or for triangulation purposes. Preference is given to performing monetary calculation (resulting in an ECF) for all criteria where reliable data is available. A key benefit of monetary expression of aspects is that it addresses some of the controversy associated with comparing ordinal ratings and rankings, together with the danger of the appraisal process being manipulated (Abelson, 2008). In the event that reliable data is not available for a particular monetary aspect, an appraisal panel may elect to revert to the use of a qualitative rating for such criteria. As an alternative, a qualitative appraisal may be performed for any given intangible criterion, even if it overlaps with concepts included in the monetary part of the appraisal, in order to allow for the triangulation of results. The latter may be a more appropriate route to follow when it is important to involve stakeholders in the appraisal process for whom a qualitative assessment is regarded as more suitable than a quantitative approach (Diakoulaki & Karangelis, 2007).

When the range of financing instruments is being appraised for a particular project, there may be constraints on the availability of particular financing instruments. An example is the limitations on public sector debt in Australia, as was discussed in Chapter 1, Section 1.2. It is suggested that an appraisal of each financing alternative is performed before premature elimination of instruments based on real or perceived constraints. Following this sequence will enable a more informed and transparent selection approach. Once the MCFA framework is completed for the full range of instruments, appraisers would be able to perform sensitivity analysis of how different combinations of financing instruments would ensure the optimisation of society’s interests. At this point, such scenarios may be constrained by the practical and institutional limitations mentioned above. Chapter 8, Section 8.3.4 explains how practical constrains should be addressed subsequent to appraisal of individual instruments.

Since all of the effective cost elements are expressed as a percentage, calculation of the absolute amount of savings which may be achieved by choosing the instrument with the lowest cost of financing over the most expensive instrument requires a simple multiplication

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124 Triangulation was defined earlier in Section 5.6 as the use of more than one research approach to improve the reliability of research findings.
of the percentage by the capital amount sourced using each instrument. Furthermore, the principal capital amount should not be included in the cost of financing appraisal. From a balance sheet perspective, the amount being financed is offset by the value of the asset, which may or may not show a net increase in value (depending on whether there is a net appreciation or depreciation). Whether the asset value accrues to society or the private sector should be considered in the delivery appraisal.

As a result of the sheer amount of capital required for building large public infrastructure projects, a combination of financing instruments is usually required. In Australia, the Gold Coast Rapid Transit project is one example where a financing ‘cocktail’ was employed. This consisted of a mix of bank debt, external equity, and contributions from the federal, state and local government (CEDA, 2010; E&Y, 2010; PWC, 2011). Other Australian examples include: (a) the Melbourne City Link, which was financed by way of a combination of long-term commercial bank debt, institutional debt and equity; (b) the Brisbane Airport Rail Link’s financing mix which consisted of external equity, plus institutional debt; and (c) a combination of commercial bank debt and government contributions were required to build the AirportLink Company in Sydney (ARUP TMG, 2001).

When the MCFA framework is applied, larger proportions of the instruments which achieve the lowest (NMCCF) would be preferred in the financing portfolio. However, there are practical constraints that put limitations on the amount of capital that can be raised by a particular instrument when capital is raised for a large-scale public infrastructure project. Possible limitations for raising sufficient capital from a particular instrument include limits on borrowing. For instance, an SPV’s credit rating, the project’s commercial viability, and the amount of government guarantees may reduce the entity’s ability to borrow. Commercial lenders also generally require a minimum equity contribution of twenty per cent or more for any project financing, with the average range being between twenty and forty per cent for the majority of public infrastructure projects (ARUP TMG, 2001). These aspects were briefly addressed in Section 7.4.1 (effectiveness).

A project’s capacity for external equity is also often limited, because private investors normally only invest in projects that are expected to be financially viable, which means that they require a minimum rate of return on their investment. The private sector would normally not invest more in a project than the amount on which they estimate they could make an
acceptable financial return. The private sector’s maximum equity commitment to a public infrastructure project can therefore be calculated as follows:

\[
\text{Maximum portion of project capital requirements financed by private sector equity} = \text{Total cost of project} \times \left( \frac{\text{Project FIRR}}{\text{Private sector’s expected FIRR}} \right)
\]

In sum, the MCFA framework uses the standard MCA approach for combining all monetary and intangible aspects into a single appraisal indicator by alternative being considered, even when the financing approach consists of a combination of instruments. The desirability of a financing approach consisting of a range of instruments can be determined by weighing the appraisal results of each instrument in terms of the amount of capital raised per instrument. This is consistent with a common practice adopted for calculating the WACC for public infrastructure delivery vehicles (refer Chapter 5). Chapter 8 demonstrates how the appraisal can be carried out by using the MCFA framework for the proposed Australian HSR project.

7.6 Critical Success Factors

There are a number of critical success factors for ensuring that public sector decision makers act in the best interest of society when the appraisal approach proposed for the MCFA framework is applied. An appraisal process that optimizes the impacts on society at large should be transparent and accountable and decision makers should be objective and have the skills required to perform a robust appraisal. It is also proposed that systematic and transparent MCA approaches (such as Analytic Hierarchy Process or Multi-Attribute Utility Theory, as discussed in Chapter 5) be applied to arrive at the ratings and weights allocated to the appraisal. The public sector decision makers which are tasked with selecting the financing approach for a public infrastructure project should also have access to thorough independent research. Collection of data from stakeholders who represent society is also recommended for rating intangible criteria (such as community surveys).

It is envisaged that a panel of experts would be required to assist the public sector decision makers when a financing approach is selected, given the complexity involved in large public sector projects and the significant impact that the decision will have on society. Independent experts may include academics and management consultants who are knowledgeable in capital markets and public infrastructure delivery. These experts are likely to require

125 An upper limit of one hundred per cent of the project capital requirements exist for the rare case where the project FIRR is greater than the required FIRR.
substantial research to be conducted in order to perform calculations and collect information on the monetary benchmarks required, as well as to inform the rankings and weights allocated to the intangible criteria. The research may be performed by experts within government, such as Infrastructure Australia or the Productivity Commission. Alternatively, independent economists and consultants may be appointed to collect the information and perform the analysis required.

One of the important lessons which emerged from project appraisal methods (Chapter 5, Section 5.2) was that government needs to remain responsible and in control of decisions, even when private sector and expert inputs are required. The analyses required for the appraisal of the financing approach may similarly be informed by commercial and private sector entities, such as investment bankers. That said, the appraisal and final decision and accountability should remain with the public sector. Advisory panels have been employed, or are being contemplated, to improve the quality, accountability and transparency of other infrastructure decision-making structures. Such panels usually include a mix of experts and representatives for consumers and other stakeholder groups. Examples where independent advisory panels were employed to assist decision-making processes and review projects include the National Broadband project in Australia, the HSR project in Australia, the Australian Energy Regulator; as well as the Office of the Gas and Electricity Markets (Ofgem) and the Water Services Regulation Authority (Ofwat) in the United Kingdom (PC, 2014; HSR Advisory Group, 2013).

7.7 Summary
This chapter presented the components that comprise the MCFA framework. The MCFA framework applies a set of monetary and intangible appraisal criteria to appraise financing approaches. These concepts were defined and discussed from the perspective of financing instruments, including examples of how the concepts would apply to individual financing instruments. Where possible, criteria were also operationalized by way of proposed performance indicators. This particularly applies to monetary criteria. Intangible criteria require significant deliberation by an independent expert panel in the light of a range of factors that may affect the performance of a financing approach with respect to each identified criterion. For example, Section 7.4.2 discussed that the concept of fairness has many dimensions, including vertical, horizontal and intergenerational equity. Appraisal in terms of these criteria would require judgment on a case-by-case basis when the framework
is applied to an actual project. Chapter 8 expands on the concepts introduced in this chapter, and applies the framework to the proposed Australian East Coast HSR project.
8 Framework Application

8.1 Introduction
This chapter presents a case example in which the Multi-Criteria Financing Appraisal (MCFA) framework is used to assess five instruments that could be used to finance the proposed AUD 114 billion Australian HSR project. A number of assumptions and simplifications are utilized for the case example as an illustrative application of the MCFA. Section 8.2 provides a brief overview of the proposed Australian HSR project, and is followed by an appraisal of financing instruments in Section 8.3. Appraisal benchmarks are suggested and base ratings are introduced with a view to operationalizing the monetary and intangible criteria introduced in Chapter 7. Section 8.4 concludes the chapter by summarizing chapter findings.

8.2 Background
Various proposals for a HSR system on Australia’s East Coast have been put forward since the 1980s. Initial proposals by private developers required large government subsidies or tax shields, but were rejected by government (ARUP TMG, 2001). Various government commissioned studies for a full Brisbane to Melbourne line followed, including ARUP TMG (2001); CRC (2010); AECOM (2011; 2013). The latest HSR study by AECOM (2013) indicated that the preferred network would comprise a dedicated network of approximately 1,748 kilometres, with the preferred alignment costing around AUD 114 billion (in 2012 terms). AECOM (2013) demonstrated that the entire network could achieve an Economic Benefit-Cost Ratio (ECBR) of around 2.3. Expected economic benefits include environmental and emissions advantages, capacity relief for airports, economic stimulus and employment opportunities. The AECOM report estimated an overall Economic Internal Rate of Return (EIRR) of 7.6 per cent (excluding wider economic benefits – such as regional accessibility advances), with a Financial Internal Rate of Return (FIRR) of 0.8 per cent (AECOM, 2013). The report suggested that most of the economic benefits would accrue to users of the system, and that externality benefits would be relatively small. AECOM (2011; 2013) also expected the HSR line to be self-funding once operational, but that it would require government investment to finance the massive construction costs.

The ARUP TMG (2001), CRC (2010) and AECOM (2011; 2013) studies considered which delivery models are best suited for the project, and financing considerations. However, none
of them performed an appraisal of the range of possible financing instruments. Instead, it was assumed that private sector investment should be maximized, while government financing should be limited to filling the commercial financing gap. This approach is reflective of the prevailing fiscal policy, whereby government maintains balanced or surplus cash budgets, a shift towards reliance on private sector financing for public infrastructure and removing financing obligations from government’s balance sheet (discussed in Chapter 1, Section 1.3). The proposed approach may nevertheless not be an optimal choice, and other approaches may be more beneficial for society. As a result, the framework application below appraises a range of financing approaches and does not take the AECOM (2013) financing approach as a given. Chapter 1 indicated that debate about optimising the financing of public infrastructure is receiving significant attention in Australia, with innovative financing instruments being proposed, such as converting infrastructure bonds (Mulino, 2013), all of which may result in a different financing approach than the one proposed by AECOM (2013). When the complexities involved, and the importance of providing public infrastructure to keep up with the growing Australian population are taken into account, the financing of public infrastructure is expected to remain on the agenda for some time to come.

8.3 Illustrative Appraisal

An illustrative appraisal of financing via reserves, general purpose bonds, specific purpose bond, loans and external equity was performed for the proposed Australian HSR project. It was assumed that government reserves are accumulated over a period of ten years. The specific purpose bonds are assumed to be similar to the model implemented in the United States, whereby bond holders do not have recourse to government guarantees or liquidation of assets, bond rates are reliant on project revenue flows, and interest earned is tax exempt. Loans were assumed to be derived from government borrowing from commercial banks. The last alternative involves the raising of equity from private sector investors. These private sector parties were assumed to be mainly international companies that intend to transfer project returns offshore. It is not uncommon for established international suppliers of HSR technology, such as the Japan Railway Construction, Transport and Technology Agency (JRTT) to invest in offshore HSR projects (Thompson & Tanaka, 2011). For the sake of simplicity, it is also assumed that the project development is not phased (which would not likely be the case), but that the entire project is developed and requires a total of 114 billion Australians dollar to be available at the start of the project. In order to avoid unnecessary
complication, the focus of the appraisal is on comparing the annual cost of financing rather than on aggregate financing over the project life.

Debate continues regarding the justification for building an Australian East Coast HSR project. On the one hand, proponents of the HSR project cite a range of environmental and emissions credentials, its ability to provide capacity relief for airports, as well as economic stimulus, agglomeration and employment benefits (Australian Logistics Council, 2011; Rail Express, 2012; The Tipping Point Institute, 2012; Coombs, 2014; Hensher et al., 2014). On the other hand, critical commentators question the ability of project benefits to outweigh the massive capital investment required (Saulwick, 2010; Henn et al., 2012; Laird, 2014). This high-level application assumes that the project appraisal was favourable, that government has decided to proceed with the project, and wants to select a financing approach that maximizes society’s welfare. This section discusses the monetary appraisal, followed by an appraisal of the intangible aspects. The two components are then combined to arrive at an overall appraisal by instrument. Thereafter, the application illustrates how an appraisal of financing approaches which combine instruments would be appraised (Section 8.3.4).

8.3.1 Monetary Appraisal
Table 31 presents a list of the monetary criteria which were adopted in the MCFA framework, as well as the proposed performance indicators as was discussed in Chapter 7.
Table 31: Monetary performance indicators (annual nominal percentage)

<table>
<thead>
<tr>
<th>Cost Elements</th>
<th>Performance Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of capital</td>
<td>- General purpose bonds: 10 year government bond rate</td>
</tr>
<tr>
<td></td>
<td>- Specific purpose infrastructure bonds: 10 year government bond rate upwardly adjusted to account for increased credit risk.</td>
</tr>
<tr>
<td>Bonds</td>
<td>- Commercial bank loans: Prime rate charged by commercial banks</td>
</tr>
<tr>
<td>Loans</td>
<td>- Economic Internal Rate of Return (EIRR) of project(s) not being pursued.</td>
</tr>
<tr>
<td>Reserves</td>
<td>- Private sector required rate of return.</td>
</tr>
<tr>
<td>External equity</td>
<td>- Risk premium for systematic risk. When external equity financing is involved, the portion of systematic risk remaining with public sector needs to be estimated.</td>
</tr>
<tr>
<td>Contingent liabilities</td>
<td>- Cost of capital premium associated with any credit rating downgrade anticipated given the use of a particular financing approach</td>
</tr>
<tr>
<td>Credit rating impact</td>
<td>- Marginal corporate tax rate multiplied by the bond rate.</td>
</tr>
<tr>
<td>Taxes forgone</td>
<td>- Composite indicator, accounting for estimated increases in construction cost, prime lending rate (should any bridging finance be used); and EIRR of the project.</td>
</tr>
<tr>
<td>Cost of delay</td>
<td>- Total estimated administration and transaction costs to taxpayers expressed as a percentage.</td>
</tr>
</tbody>
</table>

This section presents an overview of the illustrative appraisal of monetary aspects of the costs of financing the HSR project. Appropriate benchmarks are proposed for each of the performance indicators by financing instrument, and indicative figures are adopted for the HSR illustration. Figures adopted in the HSR illustration were informed by the AECOM (2013) report. Where specific figures were not provided by that report, indicative figures were adopted within the benchmark ranges proposed.

a. Cost of Capital for Reserves
The development of a large public infrastructure project may require the cancellation or deferment of other public projects. This can be expected to be the case should Australia develop a HSR project from internal government reserves, given ongoing fiscal constraints. Therefore, the cost of capital is derived from the opportunity costs of projects not pursued.

126 When an actual appraisal is performed for a project, this would require significant data analysis, which may involve the commissioning of various reports.
Meaney and Hope (2012) found that the returns127 for the vast majority of economic infrastructure projects studied (consisting of water, electricity, gas and transport projects in 21 countries) fell between the economic growth rate and returns on general public equity (stock) of that country. If the benchmark range suggested by Meaney and Hope (2012) is applied, the Australian benchmark spans between 3 per cent (Australia’s average Annual GDP Growth Rate between 2004 and 2014 [ABS, 2015]) and 8.9 per cent (gross stock market returns for the ten years to December 2012 [Australian Securities Exchange, 2013]).

Dividend returns on public infrastructure projects also informed the benchmark adopted for the application. The OIC (2013) suggested that dividend returns on public infrastructure projects averaged 3.7 per cent over a five-year period for thirty Australian economic infrastructure projects such as public transport, ports, electricity, and water.128 This number, however, needs to be adjusted upwards to calculate project Economic Internal Rate of Return (EIRR), since it does not account for capital gain or externality benefits. Historical data on the average realized (ex-post) returns for Australian public infrastructure projects could not be located. The benchmark for society’s cost of capital for reserve financing adopted for this study therefore ranges between about 3.5 and 9 per cent in real terms for Australia. For the illustrative HSR case, the opportunity cost of reserve financing is taken to be 6 per cent in real terms, which translates to 8.88 per cent in nominal terms.129 This is based on an assumption that the average EIRR of projects being displaced exceeds the investor’s internal cost of capital (Espinoza, 2014), which is 4 per cent for government bonds, but is lower than the EIRR of the HSR project being financed (Hyman, 1999), which is estimated at 10.48 per cent nominal (7.6 per cent real) (AECOM, 2013).

**b. Cost of Capital for Bonds**

Government bond rates in OECD countries are low and, for a country like Australia, it’s Commonwealth and state government bonds are regarded as being free of default risk, since they are backed by full faith of government (Kidwell et al., 2011). In Australia, Central Borrowing Authorities (CBAs) source finance for sub-national governments at a very fine margin over the relevant Commonwealth government bonds, and automatically assume the relevant state’s credit rating (Chan et al., 2009). Government bond rates in OECD countries

127 Appears to indicate financial returns.
128 Appears to be in real terms.
129 Applying the same GDP deflator used in cost of delay, amounting to 2.88 per cent (20 year average to 2013) (World Bank, 2015).
have shown a declining trend since 2006/07. For example, according to the OECD, the average ten year general government bond rate for Australia averaged 3.7 per cent in 2013, compared to 4.88 per cent in 2011 (OECD, 2015). The decreasing rates can be partially explained by the declining trend in inflation over the same period in Australia, down from over six per cent in the 1990s to under two per cent in 2014 (Reserve Bank of Australia, 2015; World Bank, 2015).

In Australia, a ten-year term to maturity is the standard benchmark used in public infrastructure project appraisals (SFG Consulting, 2013). For the HSR illustration, the benchmark cost of capital for general purpose bonds is taken as the ten-year Commonwealth bond rate, which averaged around four per cent over the past three years (OECD, 2015). Figure 25 shows interest rates for a range of bond types issued for financing infrastructure within a PPP delivery environment. The various forms of bonds have different finance servicing costs, because their risk profiles are dissimilar. Specific purpose infrastructure bonds expose investors to increased risk, since investors do not have recourse to government’s general taxation funds, or the liquidation of the assets financed. Vander Ploeg (2006) suggested that government-issued specific purpose infrastructure bonds, such as Tax Increment Financing (TIF) bonds, typically involve interest costs of around 1 to 3 per cent higher than a comparable government general obligation bond. Therefore, specific purpose bonds are benchmarked at 6 per cent for the HSR application, when the midpoint in the range suggested by Vander Ploeg (2006) is applied (2 per cent).
Figure 25: Rates by bond type (nominal percentage above prime rate)

Source: Hann and Mack 2005, p.316.

c. Cost of Capital for Loans

The Central Intelligence Agency World Fact Book (CIA, 2015) estimated Australia’s average annualized commercial bank prime lending rate\(^\text{130}\) at 6.2 per cent in 2013 and 6 per cent in 2014. Abelson (2011) suggested a 4 to 5 per cent differential between public and private sector borrowing, while the Australia Institute (Richardson, 2014) more recently applied differentials of between 1 and 3 per cent. Following the suggestion of the Australia Institute and adopting the midpoint, a benchmark discount of 2 per cent is adopted here. This results in a cost of capital for loans of 4.1 per cent for the HSR case. This is comparable with the average ten-year Commonwealth bond rate, which averaged four per cent in recent years (refer Section b).

d. Cost of Capital for External Equity

Equity investment is regarded as an investor’s riskiest form of investment and is therefore the most expensive of the financing instruments being considered in this study. Benchmark required returns on equity investment in public infrastructure projects in developed countries averaged at around 15.8 per cent in 2010 (Inderst, 2010), and totalled between fifteen and

\(^{130}\) Defined as “average of annualized interest rates commercial banks charge on new loans, denominated in the national currency, to their most credit-worthy customers” (CIA, 2015).
twenty per cent in 2012 in the USA (Han, 2013). In the United Kingdom, Bhattacharya et al. (2012) applied a required return on equity of fifteen per cent for infrastructure projects. Benchmarks in Australia have ranged between 10 and 14.4 per cent in recent years, demonstrating a declining trend. For instance, in 2001, ARUP TMG applied a required rate of return of fifteen per cent to the Australian HSR study, while ACG (2003) based its MMRF model calculation on a commercial rate of return of ten per cent real (12.7 per cent nominal). More recently, Bhattacharya et al. (2012) suggested a target rate of return of between 11 and 13.5 per cent for public infrastructure projects with demand risk, while the Australian Office of the Infrastructure Coordinator (OIC, 2014) estimated that the equity rate of return range for public infrastructure projects is between 10 per cent and 14.4 per cent, and arrived at an average of 12 per cent (nominal) in its submission to the Productivity Commission’s enquiry into public infrastructure financing.

Bhattacharya et al. (2012) estimated an industry standard benchmark for private sector equity premium\(^{131}\) that ranges between six and nine per cent for public infrastructure projects with demand risk, such as public transport projects. Vecchi et al. (2013) used an estimate of 9.3 per cent above the Weighted Average Cost of Capital (WACC) for privatized hospitals, while SFG Consulting (2013) reported a six per cent margin above contemporaneous government bond yield for a large sample of infrastructure entities, of which utilities form a large component. Benchmark equity premiums for public infrastructure projects in other developed countries averaged seven per cent above bond rates at the time (Ben-Haim, 2012). The cost of equity applied for the Australian HSR case is taken at fifteen per cent, as suggested for the HSR project by AECOM (2013). When this is compared to the bond rate benchmark of four per cent for general purpose bonds (which are regarded as practically ‘risk free’ in developed nations), this reflects a substantial equity premium of eleven per cent.

\(e.\) **Contingent Liabilities**

The appropriate benchmark to adopt for the systematic risk remaining with society associated with financing any given project is a contentious issue. The benchmark is developed by reference to the private sector risk premium (refer Section d). Chan et al. (2009) (bearing in mind the Markowitz and Tobin principle discussed earlier) estimated that

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\(^{131}\) Defined as “the excess return that an individual stock, or the overall stock market, provides over a risk-free rate” (Chan et al., 2009, p.9).
the average private sector risk premium should be no more than one per cent. Spackman (2001) suggested that, although the premium is usually estimated at over five per cent based on a perfect capital market view, other approaches calculated a risk premium of around two to three per cent. The Dutch government also generally applies a benchmark risk premium of three per cent (Hunsucker, 2012). Spackman (2001) established that systematic risk associated with publicly financed projects could be as low as a fraction of one per cent. This reflects government’s ability to control and influence some of the systematic risks, as well as its significant ability to diversify risks, in view of its considerable size relative to private sector companies (Snyder & Luby, 2012; Eriksen & Jensen, 2010; Leviäkangas, 2007).

A benchmark of 1.5 per cent is adopted for society’s contingent liabilities for reserves, general purpose bonds and loans.\(^{132}\) This represents the midpoint for benchmarks suggested in the literature as discussed above. A reduced benchmark of 0.5 per cent is applied for external equity financing of the HSR project, if it is assumed that society’ component of contingent liabilities are shared with the private sector investors. Specific purpose bonds allow for some risk transfer to investors, since returns are usually linked to the financial performance of the project. It is furthermore assumed that the risk transfer for external equity financing of the HSR project exceeds the risk transferred to specific purpose infrastructure bonds. As a result, an indicative benchmark of 0.8 per cent, which falls between the benchmarks for general purpose bonds and external equity, is applied to the HSR case for specific purpose bonds.

\(f.\) **Credit Rating Impact**

In Australia, Commonwealth debt levels are regarded as low by international standards. The Australian Government has substantial borrowing capacity and the ability to retain its AAA credit rating (Sheehan & Gregory, 2013). However, the states, with their limited revenue raising powers, which necessarily restrict their borrowing capacity, find it harder to retain their AAA or near AAA credit ratings (Sheehan & Gregory 2013). Whenever some of the states suffered rating downgrades, it was found that they retained access to capital markets, but at increased finance servicing costs (IFWG, 2012). When Australian GTEs, for example,

\(^{132}\) The most recent AECOM (2013) analysis of the HSR project calculated an absolute risk estimate of AUD 15 billion (in 2012 terms). This represents thirteen per cent of full construction costs. This amount appears to represent both diversifiable and undiversifiable risk, and therefore far exceeds the systematic risks considered in calculating the risk premium to be applied to the cost of financing.
borrow funds, any implicit government guarantees usually affect the relevant agency’s credit rating, but not the overall government’s credit rating (PC, 2014).

For illustrative purposes, the credit rating was assumed to be downgraded from by one level from AAA to AA+, thus resulting in a fifty basis point increase in the cost of capital for general purpose bond and loan financing of the HSR project. This benchmark is based on the Infrastructure Finance Working Group’s estimation that a one-level credit rating downgrade from AAA to AA+ would result in an increased cost of borrowing of up to 50 basis points in Australia (IFWG, 2012). On average, the benchmarks are also broadly comparable with international benchmarks for developed countries, including those of Snyder and Luby (2012), who calculated a 16 to 20 basis point differential between AA and A rated bonds in the United States, and Huang and Huang (2002), who found an average 27 basis point increase in bond rates for a ratings downgrade from AAA to AA in the United States. Lastly, a reduced impact of fifteen basis points is applied to the use of specific purpose bonds. Revenue bonds were found not to have a significant impact on governments credit ratings, since the debt and the related risks are shifted to the project entity, as was discussed in Chapter 6, Section 6.6 (Brittain, 2002).

g. **Taxes Forgone**

For the HSR illustration, society’s loss of tax revenues when government issues specific purpose bonds was estimated at 2.4 per cent. This benchmark was calculated by applying the GAO (2002) approach mentioned in Chapter 7, whereby the marginal corporate tax rate is applied to the bond rate. The marginal corporate tax rate in Australia averaged 30 per cent during the past decade (KPMG, 2014); while the bond rate was benchmarked earlier at 6 per cent (refer Section b). It was assumed that none of the other financing instruments would involve any tax credits or rebates for the HSR project illustration.

h. **Cost of Project Delay**

As discussed earlier, the benchmark for the cost of delay associated with using a particular financing instrument comprises three elements: estimated annual increase in construction cost (GDP deflator), the annual interest rate on any bridging finance used, and the value of lost services (refer Chapter 7, Section 7.3.5). An annual inflation benchmark of 2.88 per cent is adopted for annual construction cost escalations, which is the average annual Australian GDP deflator over the twenty years ending 2013 (World Bank, 2015). The value of lost services (annual economic returns) will differ by project, as was discussed earlier. A
benchmark of 10.48 per cent nominal (7.6 per cent real) was adopted for the value of lost services (equal to the estimated EIRR for the HSR project, as was discussed in Section 8.2). For the HSR project, it is assumed that a delay in initiating and financing the project would not necessitate any bridging finance for government, and as a result the cost of bridging finance is not included in the calculation.

Calculation of a composite annual cost of project delay associated with choosing a particular financing instrument requires the benchmarks discussed above to be expressed in terms of the period of delay per instrument compared to the project life. The European Commission (Hunsucker, 2012) guidelines for public infrastructure project time horizons included 25 years for road projects and 30 years for railways. The Australian HSR project life is benchmarked at fifty years (AECOM, 2013). A delay of ten years is assumed for accumulating sufficient reserves for the HSR project, and the average eighteen month delay for efficient bidding processes (Wyman, 2014) is adopted for the raising of external equity. No significant delay is estimated for raising bond capital or loans. The resulting composite benchmark calculation is reflected in Table 32. This simplified calculation results in an illustrative annualized percentage cost of project delay for reserve financing of 2.1 per cent and 0.3 per cent for external equity, while the three debt instruments are taken to have no significant delay costs.

Table 32: Calculation of project delay cost benchmark

<table>
<thead>
<tr>
<th></th>
<th>Annual</th>
<th>Reserves</th>
<th>External Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased construction cost (GDP deflator)</td>
<td>2.88%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lost project benefits (EIRR)</td>
<td>10.48%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composite Indicator (CI)</td>
<td>13.36%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project period in years (Tp)</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delay period in years (Td)</td>
<td>10</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Composite delay %: CI*(Td/Tp)</td>
<td>2.1%</td>
<td>0.3%</td>
<td></td>
</tr>
</tbody>
</table>

133 Consistent with the ATC National Guidelines (ATC, 2006).
i. Administration and Transaction Costs

Let us assume that reserve financing of the HSR project involves a budget appropriation from government’s General Fund (for example, consisting of accumulated infrastructure levies) over a period of ten years. The annualized administrative and transactional cost for budget appropriations would be negligible compared to the large capital outlay of such a public infrastructure megaproject. The reason is that reserve financing from the government’s General Fund amounts to a one-off transfer and does not involve significant costs.

Debt usually also has low transaction costs (ACG, 2003). The administrative and transactional cost premium for raising specific purpose bonds and commercial bank loans were both assumed to amount to 0.01 per cent for financing of the HSR project, thus resulting in an annual amount of AUD 11.4 million. Specific purpose bonds and commercial bank loans involves higher administration costs, given that they are specifically established and administered on an ongoing basis (and in the case of commercial bank loans, also negotiated) for each individual project (Chan et al., 2009; Vander Ploeg, 2006). The financing of a project from general government bonds requires a transfer of total bond funds to the project. As a result, the administrative and transaction costs of general government bonds would be negligible and has been left out of the calculation of the Effective Cost of Financing (ECF). The cost premium for external equity was assumed to be higher than the other instruments in view of comments about the considerable transactional costs associated with raising external equity (Refer Chapter 7). The benchmark adopted for external equity was informed by Abelson’s (2011) estimation of the total administration and transaction fees involved in the privatization of public infrastructure, which amounted to two to five per cent of the revenue raised. If one assumes the lower end of the spectrum (two per cent), when this one-off amount is annualized (using a project life of fifty years), this results in a benchmark of 0.04 per cent. Table 33 presents a summary of the annual administration and transaction costs which result from applying the benchmarks adopted.
Table 33: Calculation of annual administration and transaction costs

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Benchmark adopted (Annual percentage)</th>
<th>Amount (AUD, million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reserves</td>
<td>0.00%</td>
<td>0</td>
</tr>
<tr>
<td>Specific purpose bond</td>
<td>0.01%</td>
<td>11.40</td>
</tr>
<tr>
<td>Commercial bank loans</td>
<td>0.01%</td>
<td>11.40</td>
</tr>
<tr>
<td>External equity</td>
<td>0.04%</td>
<td>45.60</td>
</tr>
</tbody>
</table>

j. Summary Appraisal of Monetary Criteria

The ECF per instrument is shown to differ by financing instrument. Figure 26 demonstrates the cost components involved in calculating the ECF for five financing approaches for the proposed Australian HSR project.

Figure 26: Effective Cost of Financing (ECF) by instrument

Source: Informed by Henn et al. forthcoming.

The ECF by instrument differs significantly. The ECF is largest for external equity, followed by reserve financing, then specific purpose infrastructure bonds, commercial bank loans and, lastly, general purpose bonds. The results indicated above will, however, differ depending
on the nature of the project. For example, the differential between the effective cost of external equity financing and the other alternatives would be even larger for a project where there is a greater mismatch between the market’s estimation of project risks and that which government estimates. The ECF elements and their proportions would also differ significantly if the project being financed was social infrastructure (refer Chapter 2, Section 2) with higher economic benefits (EIRR) than the HSR project (which is regarded as economic infrastructure). Projects with higher economic benefits are also less likely to be delayed and should be prioritised in government’s infrastructure planning.

8.3.2 Appraisal of Intangible Benefits

The illustrative appraisal of the six financing instruments for the Australian HSR project considered the following six intangible criteria that were not addressed in the monetary appraisal:

- Effectiveness
- Fairness (equity or equality)
- Flexibility
- Stakeholder support
- Accountability & transparency
- Degree of public control/ownership

A five-point scale was applied to the rating of instruments, with higher scores indicating better performance of an instrument. The scale was based on the five-point scale used by Infrastructure Australia (2008) for the appraisal of intangible aspects of project appraisals (refer Chapter 5, Section 5.6.1). Table 34 shows the suggested scale.

Table 34: Intangible Benefits appraisal scale

<table>
<thead>
<tr>
<th>Rating</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Financing instrument is extremely effective in satisfying the requirements of the criterion</td>
</tr>
<tr>
<td>4</td>
<td>Financing instrument is effective in satisfying the requirements of the criterion</td>
</tr>
<tr>
<td>3</td>
<td>Financing instrument just satisfies the requirements of the criterion</td>
</tr>
<tr>
<td>2</td>
<td>Financing instrument is ineffective in satisfying the requirements of the criterion</td>
</tr>
<tr>
<td>1</td>
<td>Financing instrument is extremely ineffective in satisfying the requirements of the criterion</td>
</tr>
</tbody>
</table>
a. Effectiveness

The three debt instruments for the HSR project all scored high with regard to effectiveness. Debt would be a reliable and certain source of financing for the HSR illustration, because the Australian Government should be able to raise large amounts of debt in a relatively short time frame. General purpose government bonds were allocated a score of five, since they are a stable and reliable source of funds in Australia. Specific purpose bonds may be ineffective in raising sufficient funds for investment in infrastructure megaprojects. This is because stringent credit analysis and requirements that focus on the nature of the income sources that back the bonds are usually required, as was discussed in Chapter 7.

If the HSR project public sector decision makers were to place a high emphasis on borrowing mostly from Australian banks, the capacity of commercial banks in Australia to lend the full amount of AUD 114 billion is also questionable. This was assumed to be the case for the HSR illustration, thus resulting in a low score. Specific purpose bonds and loans were allocated a score of two out of five. A decision to limit borrowing to Australia may be motivated by the desire to support the local economy and to limit exchange rate risks. Instead of relying on further loans from offshore banks, it is assumed that government would prefer to utilize other local borrowing instruments, such as government bonds. The ability of external equity financing to raise sufficient capital is also substantially limited by the HSR project’s commercial viability, thus resulting in a low score of one out of five for effectiveness. If it is assumed that the reserve financing used for the HSR project is dependent on the budget appropriation process, reserve financing was allocated a low score of one out of five. Governments’ General Fund revenues are usually scarce. HSR is generally regarded as economic infrastructure (discussed in Section 2.2) that largely delivers user benefits and relatively small externality benefits (AECOM, 2013). When such economic infrastructure projects with low externality benefits have to compete with other uses of general government revenue which has higher public benefits, it is likely that little reserve financing would be available for the project with low externality benefits. The rating may be improved should reserves be accumulated over time by way of hypothecated taxes and infrastructure levies, or if capital recycling is able to raise sufficient funds. Alternatively,

\[134\] However, in light of its high credit ratings, the Australian Government should have no trouble raising sufficient loans from the wider international banking sector.
should a phased development approach for the HSR project be adopted, user charges from initial phases of the project could be accumulated for subsequent phases.

b. Fairness

The financing instruments for the HSR project illustration vary significantly in terms of their fairness. Financing of the project through the three debt instruments scored the highest with a rating of 5. These instruments have high intergenerational equity benefits, and society also retains its claim on project returns when government employs debt instruments. External equity scored lowest in terms of fairness. Since it was assumed that equity investors for the HSR illustration are international and intend to shift any project returns offshore, its fairness in terms of its distributional impacts on the Australian society is undermined. There may also be other concerns around the fairness of private sector financing if a monopoly situation occurs when the private sector is involved, which could result in inequalities with regard to society’s access to the infrastructure (discussed in Chapter 7). Reserves also scored low on fairness in view of intergenerational equity concerns, whereby past and current generations pay for an asset that is expected have a project life of at least fifty years. Since society retains its claim on project returns when investing its own funds, reserves scored higher on fairness than external equity investment.

c. Flexibility

The Australian HSR project is expected to involve demand risk and uncertainty regarding its ramp-up period until it is able to operate on a commercial basis (AECOM, 2013). The ability of a financing instrument to adjust to changing project requirements and market conditions over time, as well as how well an instrument can be customised for the specific requirements of the project, is important. Reserves and general purpose bonds scored the lowest in terms of their flexibility for the HSR project illustration. Both of these instruments are fixed and rigid in terms of their design. For instance, general purpose government bond rates are fixed, or may be inflation indexed, but do not allow for customisation according to the project requirements. Reserves imply a commitment of accumulated funds, which does not afford government a significant degree of flexibility to adjust to changing project requirements and market conditions over time.135 Specific purpose bonds are more flexible, and it was assumed that interest payments fluctuate according to the project’s ability to raise

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135 Can only be restructured by way of re-financing and/or privatization – in whole or in part, for instance through leasing.
revenues over the term of the bond. Loans scored high on flexibility. Loans from commercial banks can be customized and restructured according to the project needs over time, and can be refinanced once project performance risks have reduced. External equity raised from corporate investors may have a degree of flexibility and allow for some customization of financing aspects, thereby resulting in a higher score than bonds. However, if private investor’s returns are guaranteed (for example, through availability payments), which may be the case for the Australian HSR project, financing costs are largely fixed for the term of the PPP agreement.

d. Stakeholder Support

General purpose bonds and loans were allocated an indicative score of two out of five. This is because the use of public debt is politically highly unpopular in Australia (Kee & Forrer, 2002; Edwards, 2006) in view of the aforementioned ‘surplus fetish’ (Stiglitz, 2010). Project revenue-linked specific purpose bonds are expected to be more acceptable to stakeholders. This is because investors assume some risk. The use of federal reserves scored the highest on stakeholder support, because their use is generally regarded as the most fiscally prudent approach. Since the reserve financing in question for the Australian HSR project would not be funded by HSR fares, it may not enjoy full stakeholder support, for people will not see a direct link between the service and the price. As a result, the use of reserves was allocated an indicative score of four out of five. When the private sector invests its equity in public infrastructure, it normally translates into partial or full ownership of the assets by the private sector. External equity was given a score of three out of five, because private ownership of public infrastructure is often opposed by stakeholders in view of concerns about private firms using their market power to overcharge, as well as other potential political issues, such as union backlash.

e. Accountability and Transparency

Locating detailed information about the financing of the international HSR case studies was difficult. Access to information is an important aspect of accountability and transparency. Reserve financing was given a rating of three out of five. On the positive side, the budget appropriation process that would normally be required is regarded as enhancing accountability and transparency. However, the use of any special appropriations may

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136 Refer Chapter 5, Section 5.5.
compromise accountability and transparency if legislative control and oversight over resources are bypassed. The terms of government bonds are easy to understand and transparent to society, thus giving them a rating of five out of five. Commercial bank loans was assigned a rating of three four out of five, since it is likely to be more complex and not reported in an easily accessible manner. Private sector equity financing is also often criticised for compromising accountability and transparency in view of complex contract terms, or non-disclosure of contracts for commercial-in-confidence reasons. Some equity investment by private parties involved in the delivery of a project would normally improve accountability, since these private partners would carry some of the risks involved in delivery of the project (or ‘skin in the game’). However, for the HSR project, AECOM (2013) suggested that there should not be any significant risk transfer to the private sector. This decision would not assist in promoting the accountability performance of private sector equity investment in the HSR project. When these factors are taken into account, external equity financing was allocated an indicative rating of two out of five.

f. Degree of Public Control and Ownership
Reserve financing, as well as both general and specific purpose government bonds and loans, would afford government full control and ownership of the HSR, so that government are free to promote society’s goals or deliver other coordination benefits, as was discussed in Chapter 7, Section 7.4.6). This results in a rating of five out of five for reserves. However, when external equity is employed, government may sacrifice a degree of control and ownership of the infrastructure project. External equity financing may also have foreign ownership implications, which may not be desirable for the HSR project if society wants to retain local ownership. As a result, external equity financing was allocated a rating of two out of five.

g. Summary of Intangible Appraisal
Scores or ratings for each of the intangible appraisal results were weighed and combined to arrive at an appraisal for each financing instrument, as was discussed in Chapter 7, Section 7.5. The weights assigned indicate the importance of the respective criteria, while ratings show the relative performance of each instrument in terms of the criteria. These intangible criteria weights were illustrative. Ratings by instrument are indicative of the performance of each financing instrument against these criteria in terms of the considerations which were raised in Chapter 7. Table 35 shows the HSR illustration results discussed above.
Table 35: Appraisal of intangible criteria by financing instrument

<table>
<thead>
<tr>
<th>Intangible criteria</th>
<th>Weight</th>
<th>Reserves</th>
<th>General Purpose Bonds</th>
<th>Specific Purpose Bonds</th>
<th>Loans</th>
<th>External Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness</td>
<td>25</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Fairness</td>
<td>40</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Flexibility</td>
<td>15</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Stakeholder support</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Accountability &amp; transparency</td>
<td>10</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Degree of control/ownership</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Total weighted intangible rating</td>
<td>100</td>
<td>2.35</td>
<td>4.25</td>
<td>4.05</td>
<td>4.00</td>
<td>1.90</td>
</tr>
</tbody>
</table>

The weights and ratings in Table 35 are reflective of the normative judgments of the author as outlined in Sections 1.3 and 3.4.2. It is acknowledged, however, that appraisers with a different conception of the good of society would arrive at a different set of weights per criterion and ratings by instrument. Most importantly, the MCFA framework requires that these judgements to be formalized and made transparent by the clear allocation of criteria ratings and weights. Section 7.6 furthermore discussed the critical success factors for ensuring that public sector decision makers act in the best interest of society when the appraisal approach proposed for the MCFA framework is applied. These critical success factors include that the appraisal be performed by an independent, skilled and objective body, supported by rigorous analysis and application of established MCA approaches (such as Analytic Hierarchy Process or Multi-Attribute Utility Theory), to assist decision-makers in formulating judgments about which financing approaches are in the best interest of society.

8.3.3 Calculation of the Net Multi-Criteria Cost of Financing

The monetary and intangible appraisal results are combined in one appraisal measure, the Net Multi-Criteria Cost of Financing (NMCCF), per instrument. The NMCCF is calculated by offsetting intangible benefits from monetary cost. As explained in Chapter 7, this was achieved by way of combining weighed results following an MCA procedure. Consideration
was given to the maximum quantum of discount allocated to intangibles in comparison with the size of the ECF by instrument. Using an illustrative weight of twenty per cent of the effective cost of capital for intangible benefits would result in a maximum possible discount by instrument of one per cent for the intangible benefits. A discount of 1 per cent on the average effective cost of capital for the four instruments, which amounts to 9.97 per cent for this illustration, was regarded as reasonable. However, as explained in Chapter 7, Section 7.5 the relative weights assigned per criterion should be determined by the appraisal panel and by applying standard MCA techniques, such as AHP pairwise comparison matrices.

Table 36 shows the final results of the financing appraisal, which combines the performance of each instrument in terms of both its monetary and intangible criteria, to arrive at a Net Multi-Criteria Cost of Financing (NMCCF) per instrument. The results of Table 36 show that loans are most desirable, with the lowest NMCCF, followed by general purpose bonds, specific purpose bonds, reserves and lastly, external equity.

Table 36: Calculation of Net Multi-Criteria Cost of Financing (NMCCF)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Weight</th>
<th>Reserves</th>
<th>General Purpose Bonds</th>
<th>Specific Purpose Bonds</th>
<th>Loans</th>
<th>External Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective Cost of Financing (ECF)</td>
<td>80%</td>
<td>10.44%</td>
<td>4.80%</td>
<td>7.01%</td>
<td>4.89%</td>
<td>12.75%</td>
</tr>
<tr>
<td>Discount associated with intangible benefits</td>
<td>20%</td>
<td>0.47%</td>
<td>0.85%</td>
<td>0.81%</td>
<td>0.80%</td>
<td>0.38%</td>
</tr>
<tr>
<td>Net Multi-Criteria Cost of Financing (NMCCF)</td>
<td>9.97%</td>
<td>3.95%</td>
<td>6.20%</td>
<td>4.09%</td>
<td></td>
<td>12.37%</td>
</tr>
</tbody>
</table>

8.3.4 Combining Instruments

A proposal for a HSR project between Sydney and Canberra (the Speedrail bid) in the 1990s proposed a combination of instruments for the private sector to raise external equity. This consisted of AUD 750 million in equity investment and a further AUD 2 billion in bank debt (ARUP TMG, 2001). A combination of financing instruments may be required for the Australian HSR project, given the large amount of capital required. As explained in Chapter 7, when the MCFA framework is applied, the financing approach is optimized by pursuing the maximum amount available of the most desirable instrument, in terms of the lowest Net
Multi-Criteria Cost of Financing (NMCCF), first followed by the instrument with the second lowest NMCCF, and so forth, until the full capital requirements are met.

To demonstrate the impact of the composition of the financing approach selected on society, the MCFA framework was applied to appraise three scenarios. The base case (named the AECOM scenario) is a simplified version of what the Australian Government may select in the absence of a systematic and comprehensive appraisal of financing instruments, based on the limited financing comments in the AECOM (2013) project appraisal. The AECOM scenario assumes an approach whereby the maximum amount of private financing is pursued, with government’s contribution limited to financing the remainder of the project. AECOM (2013) estimated that government would not be able to raise more than AUD 16.3 billion (in 2012 terms) in private sector equity. This is applied to the base case. It is furthermore assumed that public sector decision makers are constrained in terms of their ability to borrow in view of government’s debt limits (described in Chapter 1, Section 1.3). A debt limit of AUD 30 billion is assumed, which amount is split equally between general purpose bonds, specific purpose bonds and loans. In view of the limited private financing estimated by AECOM (2013), this would mean that government would have to accumulate sufficient reserves to finance the remainder of the project, which would result in a significant delay in commencing construction.

The second scenario applies the MCFA framework in order to establish an optimized financing approach, but assumes that there are certain constraints on the availability of financing instruments (named the Constrained Optimized scenario). The Constrained Optimized scenario assumes that general purpose bonds and loans are limited to a maximum amount of AUD ten billion each, while total debt is limited to AUD 40 billion. Since external equity has a higher NMCCF, under these constraints, an optimized capital structure will source the remainder of financing from reserves, and use no external equity for this scenario. The last scenario, named the Unconstrained Optimized scenario, allows for the full capital amount to be financed by way of the financing instrument that was regarded as most desirable, given its low NMCCF (general purpose bonds). Table 37 shows how each of these scenarios is structured.
Table 37: Composition of three financing scenarios

<table>
<thead>
<tr>
<th>Financing Instrument</th>
<th>Composition of Financing Scenario (AUD, billion)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AECOM</td>
</tr>
<tr>
<td>Reserves</td>
<td>67.70</td>
</tr>
<tr>
<td>General purpose bonds</td>
<td>10.00</td>
</tr>
<tr>
<td>Specific purpose bonds</td>
<td>10.00</td>
</tr>
<tr>
<td>Commercial bank loans</td>
<td>10.00</td>
</tr>
<tr>
<td>External equity</td>
<td>16.30</td>
</tr>
<tr>
<td>Total</td>
<td>114.00</td>
</tr>
</tbody>
</table>

For illustrative purposes, the results of the three scenarios for raising a portfolio of financing instruments are contained in Table 38. For simplicity, the Effective Cost of Financing (ECF) and Net Multi-Criteria Cost of Financing (NMCCF) per instrument calculated in Sections 8.3.1 to 8.3.2 was retained. However, these figures may change marginally when a financing approach consisting of a combination of instruments are used, such as the cost of delay (can be expected to reduce for a smaller amount of reserves), or a reduced credit rating impact for smaller debt commitments. As explained in Chapter 7, the resulting ECF and NMCCF per financing approach is calculated by weighing these two appraisal measures in terms of the relative contribution of each financing instrument to the total financing amount. Table 38 shows that the AECOM scenario imposes the highest total weighed ECF and weighed NMCCF, followed by the Constrained Optimized scenario approach, while the Unconstrained Optimized scenario delivers the best results. The results show that an application of the MCFA framework in order to appraise instruments and compile a financing structure significantly reduces both the total monetary cost of financing, or Effective Cost of Financing (ECF), and Net Multi-Criteria Cost of Financing (NMCCF) – which includes the intangible benefits on society. Application of the MCFA framework within different circumstances would have resulted in a different outcome. For example, if a phased approach is applied to the HSR project, effectiveness scores are likely to change for some of the financial instruments. This is because it may be easier, for example, to secure reserve financing for the smaller amounts required per phase. Section 8.4 discusses the main
findings which emerged from the illustrative HSR application of the MCFA framework in more detail.
Table 38: Appraisal results for three HSR financing scenarios

<table>
<thead>
<tr>
<th>Instruments</th>
<th>ECF</th>
<th>NMCCF</th>
<th>Weight (%)</th>
<th>Weighted ECF (%)</th>
<th>Weighted NMCCF (%)</th>
<th>Weight (%)</th>
<th>Weighted ECF (%)</th>
<th>Weighted NMCCF (%)</th>
<th>Weight (%)</th>
<th>Weighted ECF (%)</th>
<th>Weighted NMCCF (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reserves</td>
<td>13.05%</td>
<td>9.97%</td>
<td>59%</td>
<td>7.75%</td>
<td>5.92%</td>
<td>65%</td>
<td>8.47%</td>
<td>6.47%</td>
<td>0%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>General purpose bonds</td>
<td>6.00%</td>
<td>3.95%</td>
<td>9%</td>
<td>0.53%</td>
<td>0.35%</td>
<td>9%</td>
<td>0.53%</td>
<td>0.35%</td>
<td>100%</td>
<td>6.00%</td>
<td>3.95%</td>
</tr>
<tr>
<td>Specific purpose bonds</td>
<td>8.76%</td>
<td>6.20%</td>
<td>9%</td>
<td>0.77%</td>
<td>0.54%</td>
<td>18%</td>
<td>1.54%</td>
<td>1.09%</td>
<td>0%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Commercial bank loans</td>
<td>6.11%</td>
<td>4.09%</td>
<td>9%</td>
<td>0.54%</td>
<td>0.36%</td>
<td>9%</td>
<td>0.54%</td>
<td>0.36%</td>
<td>0%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>External equity</td>
<td>15.94%</td>
<td>12.37%</td>
<td>14%</td>
<td>2.28%</td>
<td>1.77%</td>
<td>0%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>11.86%</td>
<td>8.94%</td>
<td>100%</td>
<td>11.07%</td>
<td>8.27%</td>
<td>100%</td>
<td>6.00%</td>
<td>3.95%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
8.4 Summary

Section 8.3 demonstrated how the MCFA framework is applied to in order to determine the desirability of financing approaches from a societal perspective. The appraisal was applied to five individual financing instruments, as well as three financing approaches which involved a combination of instruments. Appraisal results showed that there are significant financial and intangible differences between the various financing instruments and approaches. For example, at 3.95 per cent the Total Net Multi-Criteria Cost of Financing (NMCCF) of general purpose bonds is more than 2 per cent lower than should specific purpose bonds be employed for financing the HSR project (NMCCF of 6.2 per cent).

Section 8.3 also showed that none of the instruments has perfect scores on all of the criteria and that trade-offs are required when each instrument is appraised. Trade-offs are evident both within the monetary and intangible dimensions of each financing instrument, as well as across different instruments, or approaches which consist of a combination of instruments. An example of trade-off that exist within an instruments in terms of its relative monetary strengths and weaknesses, include the benefits associated with reduced contingent liabilities when external equity is selected (benchmarked at 0.5 per cent compared to 1.5 per cent for reserve and debt financing), versus the large equity premium of 11 per cent annually. Another example of trade-offs within the monetary dimension of an instrument include commercial bank loans, which has a relatively low cost of capital (4.1 per cent), but results in society retaining the full contingent liability (1.5 per cent). Furthermore, when intangible aspects are considered, there are also trade-offs by instrument. For example, reserves were judged to be ineffective in terms of raising sufficient capital in a timely manner for the HSR project, but do secure public ownership and full control of the assets, as well as the ability for society to retain project returns (refer Table 31).

The HSR illustration also demonstrated the trade-offs between different instruments in terms of its Effective Cost of Financing (ECF). For example, the costs involved in a credit rating downgrade for using excessive debt (0.5 per cent) are far outweighed by other costs associated with using alternative instruments, such as reserves (an opportunity costs of capital of 8.88 per cent and 2.67 per cent project delay costs) or external equity (the 11 per cent equity premium). These trade-offs are also clear across the monetary and intangible spheres to compare the full societal impacts. For instance, the HSR example demonstrated that, although specific purpose bonds fared much better than general purpose bonds in terms
of fairness, flexibility, and stakeholder support, the monetary costs associated with their cost of capital and taxes foregone outweigh the intangible benefits. Table 39 contains an extract of the HSR appraisal application performed in Section 8.3 to show these differences.

Table 39: Comparison of bond types

<table>
<thead>
<tr>
<th></th>
<th>General Purpose Bonds</th>
<th>Specific Purpose Bonds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective Cost of Financing (ECF)</td>
<td>6.00%</td>
<td>8.76%</td>
</tr>
<tr>
<td>Effectiveness</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Fairness</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Flexibility</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Stakeholder support</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Accountability &amp; transparency</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Degree of control/ownership</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

The differences between alternate financing approaches can be expressed in terms of absolute numbers by applying the ECF and NMCCF to the amount of capital being raised, as shown in Table 40 and Table 41.

Table 40 shows the financial impact of the choice of financing instrument by comparing the annual Effective Cost of Financing (ECF) of general purpose bonds with the annual ECF of external equity for the HSR application, whereby AUD 114 billion in financing is raised. These savings apply over the life of the project.

Table 40: Absolute amount difference between most and least expensive instruments

<table>
<thead>
<tr>
<th>Cost Measure</th>
<th>General Purpose Bonds</th>
<th>External Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective Cost of Financing (annual ECF %)</td>
<td>6.00%</td>
<td>15.94%</td>
</tr>
<tr>
<td>Effective Cost of Financing (annual ECF; AUD billion)</td>
<td>6.84</td>
<td>18.17</td>
</tr>
</tbody>
</table>
Table 41: Absolute amount cost of financing by financing scenarios

<table>
<thead>
<tr>
<th>Cost Measure</th>
<th>Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AECOM</td>
</tr>
<tr>
<td>Total Effective Cost of Financing (AUD, billion)</td>
<td>13.52</td>
</tr>
<tr>
<td>Total Net Multi-Criteria Cost of Financing (AUD, billion)</td>
<td>10.19</td>
</tr>
</tbody>
</table>

Table 41 shows the annual savings that can be achieved by optimizing financing approaches involving a combination of instruments to raise the estimated AUD 114 billion to finance the Australian HSR project. These savings similarly apply over the course of the project life. For example, moving from the AECOM scenario to the Constrained Optimized scenario would equate to an annual saving to broader society of over nearly AUD 1 billion (in EFC terms), and over AUD 6 billion when an Unconstrained Optimized scenario is selected. In sum, the HSR illustration demonstrated that the choice of financing approach has significantly different ongoing financial and intangible implications for society, as was foreshadowed in previous chapters.
9 Conclusion

9.1 Introduction
This chapter concludes this study. Section 9.2 summarizes the key thesis findings, Section 9.3 reflects on the research contribution and how the framework developed addressed the gaps in the current knowledge base and practices. Section 9.3 also considers how the application of the MCFA framework addresses the core research objectives, including the need for a transparent, systematic and comprehensive appraisal process that takes into account societal impacts. Section 9.4 discusses the transferability of the framework and thesis findings, and Section 9.5 closes with the constraints and limitations of the research and proposes possible future research.

9.2 Summary Findings
The financing of public infrastructure has emerged as an increasingly topical issue. The financing approach was defined as the way that capital is raised. This study was motivated by early research that indicated that the way in which public sector decision makers currently select financing instruments for public infrastructure projects appeared to be inadequate, often reactive and sometimes ideologically driven. Economists and other independent commentators have raised concerns about the financing decision-making process and have signalled the need for a trade-off appraisal of financing approaches. Yet no documented evidence could be found of a formal, consistent and proactive financing appraisal process whereby a range of instruments can be systematically appraised by public sector decision makers in order to select an approach that is in the best interest of society, despite the fact that such appraisals are customarily performed to appraise projects.

It was also found that the financing decision and concepts were inconsistently addressed in the literature, since the literature mainly focused on the funding and delivery aspects. A review of the literature also showed that project appraisal methods were much more mature and established than the way that financing decisions were made. The foundational principle adopted is that different financing instruments have different impacts on society. This is because there is a range of capital market failures, such as different knowledge, expectations, and ability to bear risk. As a result, the monetized Effective Cost of Financing (ECF), as well as intangible aspects such as fairness, differ by financing approach. Of particular importance is that a failure to recognize these aspects is likely to result in sub-optimal decisions. Public
sector decision makers are accountable to society and, as custodians of a nation’s assets, are expected to make decisions which are in the best interest of society. The objective of this thesis was to develop an appraisal mechanism for public sector decision makers tasked with selecting a financing approach for a public infrastructure project. These aspects were introduced in Chapters 1 and 2. An interpretive research paradigm was adopted in the formulation of the framework and involved exploratory and synthesizing research methods (refer Chapter 3). Exploratory research methods were applied to identify the various aspects involved in selecting a financing approach, and the MCFA framework was mainly developed by synthesizing separate elements already developed in prior studies.

A review of international HSR case studies confirmed the lack of a formally documented financing appraisal policy or process, but that the appraisal of the projects are well documented (see Chapter 4). A number of public infrastructure financing themes and trends also emerged, in particular that:

- A variety of financing instruments were employed for these public infrastructure megaprojects, ranging from government grants and budget allocations, to loans from government, development bank loans and commercial banks, public and private bonds, and reserves. Also, there does not appear to be one clear financing approach that fits all HSR system developments.
- PPP financing models are becoming more popular on account of a shift to off balance sheet financing.
- Government financing remains inevitable for the construction of HSR lines, even when PPP arrangements are selected.
- The choice of financing approach had important ramifications for society, such as debt servicing costs and project delays. For example, there were cases where the involvement of many role players in the financing of HSR significantly delayed projects.

The proposed MCFA framework for financing instruments is a modification on the standard MCA approach typically used for project appraisals, and which includes concepts used in a BCA calculation. A review of public infrastructure project appraisals, as presented in Chapter 5, showed that there is a trend to combine quantitative and qualitative, as well as monetary and intangible elements in project appraisals and that a combination of BCA and MCA can lead to better-informed decisions. It is clear that BCA methods are well established...
in the appraisal of large public infrastructure projects and are recognized for their rigour and objectivity in appraising aspects that can be monetized. MCA methods are becoming increasingly popular for decision making in the public infrastructure arena, in view of their ability to formally include intangible aspects that are equally important to society, and allow for societal inputs as well as trade-offs to be incorporated. The review of project appraisal approaches also demonstrated a clear distinction between the investment, delivery and financing concepts, but did not provide much guidance on the financing decision. It was also found that project appraisal methods include a number of transferable definitions, best practices, critical success factors and lessons which could inform formulation of a financing appraisal framework, given that the project appraisal decision and financing decision have a lot in common. Important contributions to the development of the MCFA framework included that:

- Policy documents aimed to provide guidelines and principles, were amenable to new and improved calculation and modelling methods, and also allowed for geographical or jurisdictional differentials as long as the rigour of the appraisal are not compromised. However, policies often included clear processes, performance indicators and metrics for monetized criteria to ensure that the guidance is practical and implementable.
- While new methods, such as wider economic benefits and general equilibrium modelling may have be considered in project appraisals, these were often not formally included in BCA, given concerns about the rigour and maturity of these methods. As a result, policies mainly restricted the BCA to first-order impacts.
- Only systematic risk should be monetized, that the incidence of asymmetric information and optimism bias should be critically appraised, and to avoid any form of double counting.
- Intangible criteria should be monetized as far as possible, but where monetization is impossible, intangible criteria should be formally appraised by following an MCA approach.
- There are practical examples of how to perform qualitative ratings, such as simple Likert-type scales.
- Overreliance on one appraisal tool should be avoided and triangulation of results from more than one tool is beneficial.
Public-sector decision makers need to have access to sufficient expert input and knowledge to perform appraisals, but government should remain in control and responsible for the process to ensure the promotion of societal welfare.

Appraisals are required for large projects, for example, in Australia detailed project appraisal reviews are performed for public infrastructure projects over AUD 100 million.

A set of five Mutually Exclusive and Collectively Exhaustive (MECE) financing instrument categories were developed, these being: reserves; public equity; bonds; loans and external equity (refer Chapter 6). A range of aspects were included that considered monetary and intangible impacts. The proposed appraisal approach incorporates a set of six monetary and six intangible considerations, as shown in Table 42 below (refer Chapter 7).

Table 42: Appraisal criteria

<table>
<thead>
<tr>
<th>Intangible</th>
<th>Monetary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness</td>
<td>Cost of capital</td>
</tr>
<tr>
<td>Fairness</td>
<td>Contingent liabilities</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Cost of project delay</td>
</tr>
<tr>
<td>Accountability &amp; transparency</td>
<td>Credit rating impact</td>
</tr>
<tr>
<td>Stakeholder support</td>
<td>Taxes forgone</td>
</tr>
<tr>
<td>Degree of public control/ownership</td>
<td>Administration &amp; transaction costs</td>
</tr>
</tbody>
</table>

Source: Adapted from Henn et al. 2014, pp.12–15.

Formulation of the criteria was informed by the literature on public infrastructure projects. The literature also contributed theories and conceptual frameworks that informed the development of the MCFA framework. Inputs from the literature were, however, synthesized and adapted to address the focus of the study, being the appraisal of the financing approach.

Lastly, in Chapter 8, a simplified application of the MCFA framework to the proposed Australian East Coast HSR project demonstrated that the framework can be a practical tool if decision-makers adopt the critical success factors proposed in Section 7.6, in particular, agrees to appoint an independent, skilled and objective body to perform the appraisal. The proposed MCFA appraisal approach does not involve a decision-making process of a political nature. It is proposed that decision-makers and politicians appoint an independent panel or body such Infrastructure Australia, the Productivity Commission or independent economists and consultants to obtain the information required and perform the appraisal. A similar approach is already adopted by decision-makers when performing economic
appraisal of public infrastructure projects (refer Chapter 5). As discussed in Chapter 5, it is normally a government policy requirement that an economic appraisal of the project merits be performed by an independent body, in order to assist final decision-makers in arriving at an informed resolution. Nonetheless, in industrialized countries like Australia which is based on the Westminster system, the final decision to proceed with the project requires political acceptance and endorsement. This thesis calls for a similar rigorous, formalised and transparent appraisal approach of the financing decision.

The application in Chapter 8 furthermore indicated that none of the instruments had perfect scores on all of the criteria and that trade-offs are required when instruments are appraised. Such trade-offs were evident both within the monetary and intangible dimensions of each financing instrument, as well as across different financing approaches. Finally, the hypothetical Australian East Coast HSR application showed that there are indeed significant financial and intangible differences between the various financing approaches, which may amount to billions of dollars annually for megaprojects.

9.3 Research Contribution

The research aimed to develop an appraisal framework in view of the gaps in financing appraisal practice and theory which was identified. A standard comprehensive literature search revealed that there is a lack of guidance from economic and capital market theory with regard to how to decide on a financing approach that is in the overall best interest of society. In the absence of theoretical guidance for public sector decision makers, their decisions may be ad hoc and not lead to optimal results for the wider community. The foundational theoretical principle adopted in developing the MCFA framework was that different financing approaches impose different costs and benefits on society. This notion is consistent with the theory and empirical evidence on financial market imperfections, which results in different impacts across financing instruments. Application of the MCFA framework can lead to better outcomes for society in terms of significant financial savings and important intangible aspects, such as fairness, effectiveness, flexibility and stakeholder support. The MCFA framework can help to identify savings which may amount to billions of dollars every year (as much as AUD 4 billion for the HSR project illustration).

The MCFA framework was also designed to fill the gap in the current knowledge base for a practical approach that can be applied by public sector decision makers. For this reason, the criteria put forward in this study were operationalized by way of performance indicators and
benchmarks, and an illustrative application of the framework for financing of the proposed Australian HSR project was performed. Decision makers can compare one financing instrument or approach with another on an equal basis, which is its Net Multi-Criteria Cost of Financing (NMCCF). The NMCCF combines all the monetary and intangible impacts into one relatively simple measure, and expresses a range of intricate notions in a tangible and transparent form.

Decision makers can also systematically compare different instruments and the range of trade-offs that exist by applying the MCFA framework. Examples of trade-offs accounted for in the framework include credit rating impacts, should the amount of debt pursued be regarded as excessive, versus project delays, if fiscal constraints imply that reserve financing could take years to accumulate. The MCFA framework also helps public sector decision makers to trade-off possible compromises of ownership and control of the asset, with the potential benefits of private sector equity contributions, such as reduced contingent liabilities. Both of these aspects are addressed in the monetary criteria and performance indicators. In sum, the framework consolidates all of these complex considerations by expressing results in comparable annual monetary terms. Certain fiscal, institutional and other practical constraints may imply that a combination of instruments is often required to assemble sufficient capital for building a large public infrastructure project. The MCFA framework allows public sector decision makers to perform an appraisal despite these practical constraints, because the framework allows for the composition and appraisal of an optimized constrained financing approach which consists of a combination of instruments.

The appraisal framework was also developed to address the lack of a fair, transparent and accountable finance selection process. Public sector decision makers tasked with selecting a financing approach for a particular public infrastructure project would not be able to ignore intangible aspects that which are important to society, such as fairness. In the absence of an MCA approach, intangible aspects are usually considered in an ad-hoc and informal way by public sector decision makers. Such an ad-hoc approach compromises the transparency and accountability of the appraisal process. The tailored MCA approach adopted in the MCFA framework includes BCA elements, and leads public sector decision makers to document the appraisal of intangible aspects explicitly and in a way which is comparable to the monetary aspects. The MCFA framework also requires these decision makers to clearly document how important each of these intangible aspects are when trade-offs are performed, by allocating weights to criteria. The quantification of intangible aspects, and relating them directly to the
monetary results, would make it clear how public sector decision makers weigh and rank criteria. When values are assigned to these aspects, economic and social analysts can scrutinise results and are able to comment and propose alternative calculations. In addition, the MCFA approach allows for transparent and systematic inclusion of societal inputs for appraising intangibles by way of discussion groups and surveys, all of which allows for statistical analysis and interpretation in order to inform weights and rankings.

Lastly, application of the MCFA framework calls for the involvement of an independent, skilled and objective body to appraise financing proposals. The appraisal body should also have access to experts in financial markets, public infrastructure and project appraisal. Other critical success factors of the MCFA framework include that the ultimate decision should remain the responsibility of government, with the expectation that they would represent the best interest of society. Together with the other qualities of the MCFA framework discussed above, these requirements are expected to deliver a practical, fair, transparent, and accountable financing appraisal process that addresses the current gaps in financing appraisal practices and theory.

9.4 Transferability

While the HSR application was simplified for illustrative purposes, the MCFA framework possesses all the elements to allow for transferability to more complex cases. For example, the HSR application was simplified in terms of the instruments appraised; which did not include innovations and complex hybrid instruments. Furthermore, the HSR application did not venture into the possible complications associated with federal versus state or local contributions. These aspects are discussed in more detail in Section 9.5 below. However, the MCFA framework can be applied to more complex scenarios, such as including appraisal of the cost and availability of state versus federal and local finance, and the relative impacts on their respective credit ratings. Furthermore, while an ex-ante approach was adopted in the HSR illustration, the MCFA framework could be applied successfully ex post in an evaluation context. The only change required would be to use the realized or actual indicators and metrics. The HSR application was also from the perspective of economic infrastructure, but the framework could be applied with equal success to social infrastructure, such as schools and hospitals. In addition, the MCFA framework could be employed in a developing country from a conceptual perspective, but would require some adjustment to the instrument categories, criteria and performance indicators. Instrument categories and criteria would
require some adjustment since not all the instruments discussed may be available in developing nations. The criteria may also need to be adjusted to reflect the priorities of developing countries, since financing decisions are often driven by the need for economic and social development and could involve donor financing.

9.5 Limitations and Future Research
The focus of the study was on establishing all the elements, concepts and approach involved in a financing appraisal framework. The application of the MCFA framework to the HSR project furthermore assisted in contextualizing the framework elements, including its performance indicators and benchmarks, and considerations in order to perform an appraisal. The logical next step would be an application of the MCFA framework by an independent panel of experts with access to in-depth analysis by a range of analysts and consultants.

More expansive data collection is required to refine the benchmarks and weights allocated to the proposed MCFA framework criteria, as well as to formulate a standard data collection process. The research encountered difficulty in locating comprehensive ex-post data for each of the monetary criteria benchmarks, such as the economic and financial performance of existing public infrastructure projects in terms of historical EIRR and FIRR. It would be worthwhile to collect benchmark data in a comparable format and develop a database that distinguishes between different types of public infrastructure categories, such as transport, health and education. Further research and primary data collection that could inform the weights allocated to the different intangible criteria is also suggested. For example, clarification of society’s views and current understanding of the intangible aspects raised in this study by way of customer surveys and focus groups. This would also be helpful in formulating a data collection approach and pro forma survey formats for application to any particular project.

The MCFA framework approach is to give preference to the monetization of criteria. However, a number of important intangible criteria remained. More research is proposed to determine the best ways to express the remaining intangible criteria in monetary terms. The MCFA framework also limited the appraisal to first-order impacts of the choice of financing approach. At the same time, second-order financing impacts are often important to society, such as the wider economic impact of a credit rating downgrade. Another example of second-order impacts may be the ripple effect on the broader society of delaying a project. For example, the delay of a major economic infrastructure megaproject may result in the delay
of other socially or economically useful projects. There is growing interest and some adoption of second-order impact analyses in the public infrastructure project appraisal arena. For example, general equilibrium analyses and wider economic benefits for some HSR projects, in addition to airports, often use economic impact analyses (see Section 4.2.2). A field of research exists on the how to quantify and consider second-order impacts in project appraisals (as discussed in Section 5.3). These developments should be monitored and the financing appraisal framework should be refined to account for any such developments.

Further research that allows for the application of the MCFA framework to more complex case studies is also recommended. The HSR illustration was also simplified to maintain the focus on key concepts and principles, and therefore a number of limitations and assumptions were introduced. It is proposed that further pilots of the framework should relax these assumptions. Notable assumptions of the HSR application warranting further analysis include the adoption of a set of five existing, uncomplicated financing instruments. Future research is recommended for applying the framework to a wider set of more complex proposed hybrid financing innovations which may address the potential limitations of existing instruments. The international HSR case studies also identified the growing decentralization of government financing, and that regional authorities and local governments can contribute significantly to the financing of a large public infrastructure project. Since the HSR application did not involve the complexities of federal versus state or local contributions, this may be a worthwhile area of further research. Furthermore, the HSR illustration was simplified by assuming that the entire project is financed upfront. Future research into the impacts of a phased financing approach would be a helpful refinement of the MCFA framework.

Other decisions made to keep the HSR illustration straightforward included a comparison of the annual cost of financing rather than on aggregate financing over the project life, and adopting the Effective Cost of Financing (ECF) and Net Multi-Criteria Cost of Financing (NMCCF) per individual instrument calculated earlier (for example, in Sections 8.3.1 to 8.3.2) to the financing scenarios, which consisted of a combination of those instruments. It is suggested that research be conducted into how to perform more in-depth studies of how the ECF and NMCCF would change for different proportions of financing instruments. The performance of financing approaches consisting of a combination of instruments (and thus, smaller quantities of each instrument) may result in slightly different ratings in terms of credit rating impacts of debt components, and the time required to collect smaller quantities
of reserve financing (reduced cost of delay). Similarly, stakeholder support for external equity may improve should the amount of equity and resulting ownership and control of the private sector fall below a certain threshold.

In sum, the suggested research discussed above amounts to further refinement, identifying supporting data and allowing for expansion of the MCFA framework. The framework categories, criteria and performance indicators, together with the proposed multi-criteria appraisal approach and principles, provide all the essential elements required to perform such additional research. The framework in its current form allows for refinements, and further research is not expected to alter the fundamentals of the framework, but would rather provide enhanced nuance to its application that would enable even more effective decision making. The categories, criteria and combined MCA and BCA approach would remain essentially the same when additional complexities are incorporated into the assessment framework presented herein. These key elements would continue to be important to ensure a practical, fair, transparent and accountable appraisal process that is in the best interest of society. As long as the key success factors and established framework principles are met, more complex and advanced framework application and further data should not compromise the key benefits of objectivity, robustness, transparency and accountability of the MCFA framework.
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