

Last updated: 05/05/22  
Version no. 1.0  
Version author: Adrian Bridge

May 2022

# Procurement Decision Tool

Draft User Guide



## **Online**

ISBN: 978-1-925352-46-7

Ownership of intellectual property rights in this publication

Unless otherwise noted, copyright (and any other intellectual property rights, if any) in this publication is owned by the Commonwealth of Australia (referred to below as Infrastructure Australia).

© Infrastructure Australia 2022

## **Disclaimer**

The material contained in this publication is made available on the understanding that the Commonwealth is not providing professional advice, and that users exercise their own skill and care with respect to its use, and seek independent advice if necessary.

The Commonwealth makes no representations or warranties as to the contents or accuracy of the information contained in this publication. To the extent permitted by law, the Commonwealth disclaims liability to any person or organisation in respect of anything done, or omitted to be done, in reliance upon information contained in this publication.

## **Creative Commons licence**

With the exception of the Coat of Arms, the copyright in this publication is licensed under a Creative Commons Attribution 3.0 Australia Licence.

Creative Commons Attribution 3.0 Australia Licence is a standard form licence agreement that allows you to copy, communicate and adapt this publication provided that you attribute the work to the Commonwealth and abide by the other licence terms.

A summary of the licence terms is available from <http://creativecommons.org/licenses/by/3.0/au/deed.en>

The full licence terms are available from <http://creativecommons.org/licenses/by/3.0/au/legalcode>

This publication should be attributed in the following way: © Infrastructure Australia 2022.

This report was developed in collaboration by Infrastructure Australia and Queensland University of Technology (QUT).

Infrastructure Australia is an independent statutory body that is the key source of research and advice for governments, industry and the community on nationally significant infrastructure needs.

It leads reform on key issues including means of financing, delivering and operating infrastructure and how to better plan and utilise infrastructure networks.

Infrastructure Australia has responsibility to strategically audit Australia's nationally significant infrastructure, and develop 15-year rolling infrastructure plans that specify national and state level priorities.

QUT is a major Australian university with a truly global outlook. Home to nearly 50,000 students, QUT provides real-world infrastructure, learning and teaching, and graduate skills to the next generation of change-makers.

# Contents

Executive Summary	5
Acknowledgements	6
Section 1 Introduction	7
Section 2 Overview of the Tool	14
Section 3 Application Projects	31
Section 4 Procedures and Examples	39
Section 5 Mobilising	76
Section 6 Practical Implications	78
Findings and Recommendations	83
Appendix A Shortlists of Activities in GCUH	85
Appendix B Theoretical Exposition	99
Appendix C Development and Empirical Testing	108
References	110

# Executive Summary

The Procurement Decision Tool (the Tool) identifies the best value for money approach to two key infrastructure procurement decisions. These are contract packaging (the size and number of contracts) and their contract terms (using competitive and/or collaborative contracting). To achieve this, the Tool employs state-of-the-art microeconomic theory that was developed to address these two procurement decisions specifically and systematically. The Tool was successfully trialled on Australian major public sector road and health projects as part of an Australian Research Council grant and in collaboration with Infrastructure Australia. The Tool was also successfully piloted internationally on major public sector road projects in collaboration with the OECD.

The Tool can be applied in three different modes. First, it can be used to guide contract packaging and contract terms in projects whose procurement decision is yet to be made i.e., preview mode. Second, it can be applied to evaluate existing procurement decisions i.e., in current mode (in projects whose design has commenced but whose main construction and/or installation works are yet to start). Third, it can be applied in review mode (in projects whose main construction and/or installation works are complete).

It is expected that the Tool will deliver significant time and/or whole-life cost savings – in contrast to contract packaging and contract terms established using current procurement decision-making practice. The Tool will also enhance the objectivity, transparency, accountability, reliability, and consistency of infrastructure procurement decision-making. Beyond these microeconomic benefits, the Tool will improve the planning of portfolios of projects, including improving the planning and pipelines of projects, to nurture and deepen markets and to advance productivity.

This user guide introduces and illustrates application of the Tool on a major road project and a major health project. Both infrastructure projects had been constructed prior to application of the Tool. This means the Tool was applied in its review mode. The two projects were selected to demonstrate the flexibility of the Tool applied to linear infrastructure (i.e., a road) and vertical infrastructure (i.e., a hospital). The Tool's recommended procurement strategy substantially matched the actual procurement of the road but substantially mismatched the actual procurement of the hospital. These outcomes were validated and show the potential of the Tool to add significant value in the delivery of mega and major projects.

# Acknowledgements

This user guide was prepared by Associate Professor Dr Adrian Bridge, the Queensland University of Technology (QUT). Associate Professor Bridge would like to acknowledge the important contributions made by the following persons, teams, and organisations:

- Emeritus Professor Clem Tisdell, School of Economics, The University of Queensland, Australia provided significant support and guidance to Associate Professor Bridge during his PhD in which the approach to integrating various state-of-the-art microeconomic theories in Step 3 and in Step 5 of the Tool was developed and empirically tested.<sup>1</sup>
- Australian Research Council (Linkage Projects grant ID: LP0989743) funded the PhD study by Dr Pauline Teo in which all the steps in the Tool were developed and tested. Assistance provided by Stephen Hogan in developing the Tool in this PhD study is gratefully acknowledged.<sup>2</sup>
- Austroads funded the trial of the Tool on Toowoomba Second Range Crossing (TSRC) and have kindly given their permission for content from the report arising from the trial application of the Tool on TSRC to be used in this user guide.<sup>3</sup> The leadership and foresight shown by Ross Guppy (Transport Infrastructure Program Manager at Austroads) in facilitating Austroads supporting the application of the Tool on TSRC is greatly appreciated.
- Infrastructure Australia (IA) funded the trial of the Tool on the Gold Coast University Hospital and the production of this user guide. The key role played by Peter Colacino is recognised. Beyond IA, the following persons also provided valuable assistance in completing this trial application and user guide: Jason Wishart (Queensland Treasury); Don Glynn (Queensland Health); Robert Phillips (retired, formerly Queensland Department of Project Services); Tony Asvec; Steven Evans; Dr Dejan Makovsek; Klaus Grewe; Dr Linda Carroli; Nora Kinnunen and Tracy Small.
- OECD funded the involvement of Associate Professor Bridge and QUT in the OECD's piloting of the Tool on major roads in Norway. This OECD project was led by Dr Dejan Makovsek. This project helped strengthen the Tool and led to formation of OECD's version of the Tool i.e., "STEPS" (Support Tool for Effective Procurement Strategy). Assistance given to Associate Professor Bridge, in his involvement in OECD's application of the Tool, by Associate Professor Dr Tim Rose, Dr Farshad Rezvani, Gerald (Mango) Murphy PSM and Dr Linda Carroli is also gratefully acknowledged.<sup>4</sup>

---

1 Associate Professor Bridge's PhD Thesis is available at: <https://eprints.qut.edu.au/17214/>

2 Dr Teo's PhD Thesis is available at: <https://eprints.qut.edu.au/72914/>

3 The report of the application of Tool on TSRC and a webinar on this application are available at: <https://austroads.com.au/publications/project-delivery/web-r624-20>

4 The report on the application of STEPS on the Norwegian roads, along with a webinar on this application and a brochure on STEPS are available at: [https://www.oecd.org/publications/procurement-strategy-in-major-infrastructure-projects-38996343-en.htm#:~:text=The%20OECD%20has%20tried%20a%20new%20evidence-based,effectiveness%20of%20public%20procurement%20of%20infrastructure%20and%20beyond](https://www.oecd.org/publications/procurement-strategy-in-major-infrastructure-projects-38996343-en.htm#:~:text=The%20OECD%20has%20tried%20a%20new%20evidence-based,effectiveness%20of%20public%20procurement%20of%20infrastructure%20and%20beyond;); and <https://www.youtube.com/watch?v=G8lucvC7DE>; and <https://www.oecd.org/gov/public-procurement/STEPS-brochure-april-22.pdf>

# Introduction

## 1.1 Improving Current Procurement Decision-Making Practice

### 1.1.1 Evidence of sub-optimal decision-making

The question of procurement is challenging because of a lack of cost and performance data across the whole-life of infrastructure facilities. This lack of knowledge is due largely to the intractability of data, including the difficulty of isolating the effect of the facility from other important factors on front-line outcomes. Suitability drives, or criteria, used in Procurement Option Analysis (POA), also known in academic literature as Multiple Attribute Utility Approach, is the key tool used in current practice to determine procurement. The suitability criteria are vague indicators, or filters. As our knowledge of the relative merits of procurement is largely restricted to capital costs only to the end of construction/start of operations, it is not surprising that POA amounts to matching some perceived feature/s of a stereotypical procurement model to some outcome desired at the end of construction/start of operations. This process of going from required outcome at the end of construction/start of operations (read effect) to selection of the procurement model (read cause) is tautological and non-scientific. This is because cause and effect are expressed in the same terms.

An important practical flaw arising from POA's non-science manifests when this current practice overlooks the fundamental assessment of microeconomic risks associated with market failure. More specifically, POA is ill-equipped to identify the likelihood of high prices arising from a lack of competition (pre-contract market failure) and the likelihood of costly variations (post-contract market failure). The application of POA becomes susceptible to non-economic forces and in the public sector this often equates to a focus on seeing cost and/or time minimisation or certainty at the end of construction/start of operations. Those procurement models that are thought to deliver these features are favoured. This is a short-term approach and runs counter to the minimisation of whole-life costs.

Another practical flaw flowing from POA is seen when the favoured procurement model tends to be used to deliver the entire project or substantial part of the project. This promotes the emergence of unduly large contracts that undermine competition. It also encourages the use of the same contract terms across all the activities in the contract when the activities in the contract may exhibit appreciable differences in their predictability. Using the same terms across these different activities crystallises costly variations when changes occur in those unpredictable activities and suppliers proceed to appropriate super profits on variations (i.e., *hold-up*) by leveraging post-contract bargaining power associated with high costs faced by buyers to switch to alternative suppliers. In turn, this causes major cost and time blow-outs. This unwanted aspect of public sector procurement has received much attention in many countries including Australia. Again, these additional pre-contract and post-contract costs run counter to the minimisation of whole-life costs.

Box 1.1 presents a summary of the survey on the procurement of major road and health projects that was part of an Australian Research Council (ARC) project in which the Tool was developed and tested (Bridge and Bianchi, 2014). This survey indicates a short-term tendency in the public road and health sector in Australia promoted by current procurement decision-making practice. For example, only five projects out of the 87 major projects surveyed include operations and/or maintenance with construction as part of the contract. An adverse effect of current procurement decision-making practice on the size of contracts and corresponding lack of competition is apparent in the patterns in Box 1 that also undermine the minimisation of whole-life costs, that is:

- A low number of higher value projects account for an appreciably higher proportion of the overall value
- The majority of road and health projects are delivered as single contracts
- Larger value projects (over \$100m) are dominated by Design and Construct, Alliancing, Early Contractor Involvement, and Managing Contractor approaches, which exclude operations and/or maintenance as part of the contract
- The budget established in collaboration with the contractor (including a pain share/gain share regime) in the majority of health projects, and
- The majority (57 percent) of projects in the sample have Expressions of Interest (EoI) that lie below 5 or above 8 EoI. The significance of EoI as an indicator of high prices and costly variations will be explained at the end of this introductory section.



## Box 1.1 Survey of major road and health projects (Source: Bridge and Bianchi, 2014 and Teo, 2014)

### Project size/value

The total value of the 87 projects is AUD 32.297 billion (comprising AUD 22.143 billion road projects and AUD 10.154 billion health projects) and across these projects **a low number of higher value projects account for an appreciably higher proportion of the overall value:**

- That is, in roads, 40 of the submitted road projects (66 percent) comprise the two lower value/most frequently occurring categories (between AUD 50 to 100 million and AUD 100 to 250 million). These account for AUD 4.164 billion (19 percent) of the total value of the submitted road projects. At the same time, 10 of the submitted road projects (16 percent) fall in the two higher value categories (between AUD 500 million to AUD 1 billion, and more than AUD 1 billion). These account for AUD 13.847 billion (63 percent) of the total value of the submitted road projects.
- In terms of health projects, 17 of submitted health projects (65 percent) comprise the two lower value/most frequently occurring categories (between AUD 50 to 100 million and AUD 100 to 250 million). These account for AUD 2.024 billion (20 percent) of the total value of the submitted health projects. At the same time, five of the health projects (19 percent) fall in the two higher value categories (between AUD 500 million to \$1 billion, and more than \$1 billion). These account for AUD 6.593 billion (65 percent) of the total value of the submitted health projects.
- **The majority of road and health projects (62 projects, or 71 percent of the submitted projects representing AUD 19.406 billion, or 60 percent of the value of submitted projects) are delivered as a single contract.** In terms of projects delivered as multiple contracts, these tend to comprise the two lower value categories and below AUD 250 million.

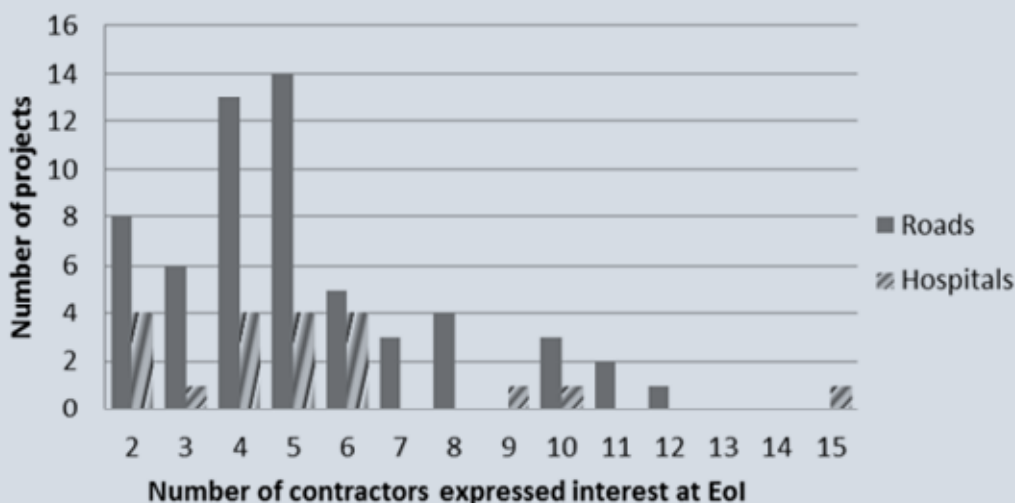
### Bundling

The 61 road projects lower value projects (\$50-100m) are dominated by Construct Only (24 projects). The **larger value projects over \$100m are dominated by Design and Construct (in 15 projects), Alliancing (in 14 projects), and Early Contractor Involvement (in 6 projects)**. Only two projects comprise Design, Construct; Operations and Maintenance (including a PPP):

- **Managing Contractor in 13 projects (and of these projects eight were greater than AUD 100 million) dominated the health projects** submitted. Again, only a small number of projects comprise Design, Construct; Operations and Maintenance (namely three PPPs).

### Expressions of Interest (EoI)

The following histogram shows that **57% projects in the sample of 87 projects (or 45 projects out of 79 projects, with missing data on 8 projects) have EoI that lie below 5 or above 8.**



## 1.1.2 Public inquiries and recommendations

In its inquiry into public infrastructure, Australia's Productivity Commission cited a paper on the Tool as well as the entire ARC project in which the Tool was developed and tested (Productivity Commission, 2014; 461). The Productivity Commission developed a wide range of far-reaching recommendations to improve public procurement practice. The most pertinent of these recommendations, in terms of addressing high prices and costly variations, are shown in in Box 1.2.

### Box 1.2 Key recommendations by Productivity Commission to improve current procurement practice (Source: Productivity Commission, 2014; Author's emphasis)

#### Recommendation 7.1

All governments should put in place best practice institutional and governance arrangements for the provision of public infrastructure. This includes use of transparent, innovative, and **competitive processes** for the selection of private sector partners for the design, financing, construction, maintenance and/or operation of public infrastructure; and ensuring **efficient allocation and subsequent monitoring of project risks** between government and the private sector.

#### Recommendation 12.1

All governments should **invest more time and resources in the initial concept design specifications** to help reduce bid costs, but in doing so, provide opportunities in the tender process for tenderers to contest the specifications of the design.

#### Recommendation 12.8

For larger and more complex projects, government clients should pre-test the market to gain insights into possible **savings from packaging the project into smaller components**, reducing the level of risk borne by any one contractor, and promoting greater competition from relatively smaller construction companies.

#### Recommendation 12.9

Government clients should **invest more time and money in understanding the site risks** for infrastructure projects and update the information provided to tenderers during the request for tender stage in consultation with potential contractors.

Clearly, the common denominator across the Productivity Commission's recommendations in Box 1.2 is government needs to avoid rushing to market and to develop a more strategic approach to procurement.

Unfortunately, a review of the submissions to the House of Representatives Standing Committee on Infrastructure, Transport and Cities inquiry into government procurement in Australia demonstrates that there has been no discernible improvement to procurement practice since the Productivity Commission issued its recommendations. If anything, the situation has worsened over eight years. This is reflected in the recommendations made arising from the inquiry by the House of Representatives Standing Committee inquiry. Box 1.3 highlights four of the eight recommendations that are highly relevant to the context and the rationale for the Tool.

### **Box 1.3 Key recommendations by House of Representatives Standing Committee on Infrastructure, Transport and Cities to improve current procurement practice (Source: House of Representatives Standing Committee on Infrastructure, Transport and Cities, 2022)**

#### **Recommendation 1**

The committee recommends, with a view to addressing Australia's historically piecemeal approach to infrastructure planning and project delivery, the Australian Government investigate, in consultation with state, territory and local governments, and relevant industry bodies and stakeholders, how to facilitate better planning and coordination of the infrastructure pipeline. As part of this work, consideration should be given to:

- the effectiveness of planning, and stakeholder and industry engagement prior to project commitments being made;
- avenues for enhancing cooperation with existing bodies, and/or bolstering independent expertise, to support more integrated and holistic infrastructure planning;
- extending governments' approach to long-term infrastructure planning from a decade to a strategic outlook of 20 to 50 years, as applicable;
- periodic reporting on priorities and progress on the *2021 Australian Infrastructure Plan* items for which the Australian Government has been identified as the proposed lead agency.

#### **Recommendation 2**

Given the crucial role that procurement plays in planning, the tendering process and delivery of infrastructure projects, the committee recommends that the Australian Government review the practical application of the Commonwealth Procurement Rules, with a particular focus on the extent to which factors other than price are assessed in practice. As part of this work, the Australian Government should explore ways to support the training of government procurement officials in procurement best practice approaches to support sophisticated assessments of value for money, and ways to maximise Australian local industry engagement.

#### **Recommendation 5**

To improve planning, procurement and delivery efficiencies for infrastructure projects, the committee recommends the Australian Government, in consultation with state, territory and local governments, explores opportunities for standardisation on like projects.

#### **Recommendation 6**

The committee sees increasing the access of tier two and three companies, and related Australian small and medium enterprises, to projects in the Australian infrastructure pipeline as key to enhancing Australia's sovereign industry capacity. Accordingly, the committee recommends that the Australian Government examine ways to maximise developing Australia's sovereign capacity in infrastructure delivery. As part of this work, consideration should be given to:

- providing opportunities in procurement and contracting to engage local industry and utilise local content;
- ways to break up projects into packages of less than \$500 million to increase competitiveness by tier two and three companies;
- making as a condition of Australian Government funding for major infrastructure projects over \$500 million industry sustainability criteria within the early stages of procurement design that encourage tier one contractors to partner/joint venture with a non-tier one company in the head contract;
- education and training for government officials to support these objectives;
- reviewing market conditions for infrastructure insurances and the impact on small and medium enterprises.

The more encouraging news is that the House of Representatives Standing Committee's Recommendation 1 mentions periodic reporting on priorities and progress on Infrastructure Australia's (IA) 2021 Australian Infrastructure Plan. In this infrastructure plan, IA take a significant step forward in recognising that a *new* procurement decision-making tool is required to replace current procurement decision-making practice (Infrastructure Australia, 2021). Such a tool would substantially address the four recommendations by House of Representatives Standing Committee in Box 1.3. Indeed, the House of Representatives Standing Committee specifically refer to IA's Recommendation 3.2b.1 that mentions a new procurement-decision making tool (see Box 1.4 which includes IA's Recommendation 3.2b.1 and the other key recommendations by IA concerning the Tool).

#### **Box 1.4 Key recommendations by Infrastructure Australia to improve current procurement practice (Source: Infrastructure Australia, 2021; Author's emphasis)**

3.2a.1 Reduce risk, improve competition, lower bid costs and improve project outcomes by consistently applying ***due diligence activities to the front-end*** of all infrastructure projects.

- Uplift quality of infrastructure decision-making through the development and delivery of ***training for key decision-makers on due diligence and de-risk***, construction innovation, timing of project announcements, commercial and legal, and project governance.
- Improve value for money and reduce risk by prioritising resources and time to develop business cases, create reference designs and ***undertake comprehensive due diligence processes***.
- Ensure a strategic view of risk is appropriately translated to project procurement by developing and applying ***mature risk allocation processes*** that comprehensively assess and validate risk and uncertainty and fairly apportion them to the parties best-placed to manage them.

3.2a.2 Improve infrastructure value for money by ***applying whole-of-life cost***, scheduling and risk management best practices, processes and systems.

- Ensure a consistent focus on value for money by developing in-house capabilities, in areas such as cost management systems and processes, scheduling, ***risk management***, estimating and project controls.

3.2b.1 Reduce risk and improve value for money by using common and best practice commercial arrangements, standard contract forms and delivery approaches to infrastructure.

- Unlock market equality and lower risk by utilising ***more collaborative commercial models*** that facilitate value for money ***and smaller engagements directly with contractors and consultants***.
- Apply appropriate consistency and improve certainty in procurement by ***developing a procurement decision-making tool*** to more effectively understand and allocate scope in line with project fundamentals.
- Improve consistency, certainty and value for money by developing and implementing a new ***nationally consistent contract suite to support a spectrum of procurement models***.
- ***Increase competition in the industry by*** developing guidelines and training programs on market engagement best practices that are accessible to all project practitioners. Cover topics such as multistage bidding, fair risk appropriation processes, bidding requirements at each gate, receiving industry feedback, ***using nationally consistent contract forms and the supporting procurement decision-making tool***.

3.2b.2 Create a culture of genuine innovation by clarifying the desired ***project outcome innovation*** criteria in bid requirements, including outcomes, value for money, risk and embedding successful innovation in future projects.

- Normalise risk appetite and use of innovation by ***aligning innovation criteria in bid assessment with project and organisational needs***, including tangible measurable outcomes that are owned by a project leader

## 1.2 Purpose of the Tool

The Tool identifies the best value for money approach to two key infrastructure procurement decisions. These are contract packaging (the size and number of contracts) and their contract terms (using competitive and/or collaborative contracting). To achieve this, the Tool employs state-of-the-art microeconomic theory that has been developed to address these two procurement decisions specifically and systematically. The Tool was successfully trialled on Australian major public sector road and health projects, as part of an Australian Research Council grant and in collaboration with Infrastructure Australia. The Tool is also successfully piloted internationally on major public sector road projects in collaboration with the OECD.

The Tool can be applied in three different modes, either:

1. To guide contract packaging and contract terms in projects whose procurement decision has yet to be made i.e., preview mode, or
2. To evaluate an existing procurement decision i.e., in current mode (in projects whose design has commenced but whose main construction and/or installation works are yet to start), or
3. To review mode (in projects whose main construction and/or installation works are complete).

The Tool is ready to replace current procurement decision-making practice and to significantly advance value for money in the delivery of new infrastructure assets.

## 1.3 Purpose and Structure of User Guide

This user guide introduces and illustrates the application of the Tool on a major road project and a major hospital project. Both infrastructure projects were constructed prior to application of the Tool and so the Tool was applied in its review mode. The two projects were selected to demonstrate the flexibility of the Tool applied to linear infrastructure (i.e., a road) and to vertical infrastructure (i.e., a hospital). The Tool's recommended procurement strategy substantially matched the actual procurement of the road but substantially mismatched the actual procurement of the hospital. These outcomes were validated and show the potential of the Tool to add significant value in the delivery of major projects.

To illustrate these applications, first, an overview of the Tool is given including an outline of its procedural steps. Next the key features of the two projects are summarised. Worked examples of the steps in the Tool follow and with advice on mobilising resources to apply the Tool. Finally, the practical implications of using the Tool are highlighted, along with key findings and recommendations.

# Overview of the Tool

## 2.1 Client’s Procurement Priorities and Applying the Tool

In its development of a recommended procurement strategy, the Tool starts by promoting the prioritisation of key attributes of project performance in such a way to allow finance, design, construction, operation, and maintenance decision making to minimise whole-life costs and enhance the operation of the asset by front-line users. In doing so, the Tool improves value for money in contrast to procurement arising from current procurement decision-making practice.

The operation of the steps in the Tool reflects the prioritisation and ranking of the eight key attributes of project performance as shown in Table 2.1.

**Table 2.1: Ranking of project performance attributes**

Project performance attributes	Ranking
<b>SET A.</b> Whole-Life Cost (lowest)	1
<b>SET A.</b> Quality (highest)	1
<b>SET B.</b> Construction Time Compliance (certainty)	2
<b>SET B.</b> Capital Cost Compliance (certainty)	2
<b>SET B.</b> Quality Compliance (certainty)	2
<b>SET C.</b> Time Construction Start/Finish (quickest)	3
<b>SET C.</b> Capital Cost (lowest regardless of lifecycle cost)	3
<b>SET C.</b> Quality (lowest regardless of lifecycle cost)	3

- 1 = Greatest priority
- 2 = Middle priority
- 3 = Least priority

Before applying the Tool in any of its three modes (preview, current or review mode), the Client clearly states the priority of the eight performance attributes in terms of ranking (1 to 3) each of the three sets of project performance attributes.

The Client explains and justifies this ranking of project performance attributes in terms of:

1. Articulating their level of commitment to de-risking the project prior to signing contract/s (including substantial construction works)
2. Resolving and clarifying their own requirements, including service levels, prior to signing contract/s (including the substantial construction works contract), and
3. Minimising other potentially unpredictable activities in the project, particularly those activities whose risks include expected third party involvement and those activities that include the risk of triggering third party involvement.

With regards to articulating their level of commitment to de-risking the project prior to signing contract/s (including substantial construction works), the Client details how much and in what way they:

- will seek to de-risk (preview mode), or
- have sought to de-risk in design to date and will seek to de-risk in any remaining design (current mode), or
- had sought to de-risk (review mode).

In terms of resolving and clarifying their own requirements, including service levels, prior to signing contract/s (including the substantial construction works contract), the Client details how much and in what way they:

- will seek to resolve and clarify their own requirements (preview mode), or
- have sought to resolve and clarify their own requirements in design to date and will seek to resolve and clarify their own requirements in any remaining design (current mode), or
- had sought to resolve and clarify their own requirements (review mode).

The optimal level of design for the Client to complete prior to signing construction contract/s is a design that is sufficiently robust such that it is unlikely to change and clearly imparts the Client's requirements. This Optimal Design Level is, therefore, not universal, it will depend on the Client's circumstances. Clients procuring simple structures perhaps a simple carriageway or an industrial building may find a functional specification and schematic sufficient. Whereas, a client procuring a complex and high-profile facility such as a headquarter building may need to progress the design to some point between developed design and full working drawings – though not reaching full working drawings. The important point is that the design progresses right up to but, ideally, not a single detail further than what is required to achieve the Optimal Design Level.

Regarding minimising other potentially unpredictable activities in the project, particularly activities whose risks include expected third party involvement and those activities that include the risk of triggering third party involvement, the Client details how much and in what way they:

- will seek to minimise other potentially unpredictable activities, especially associated with third parties (preview mode), or
- have sought to minimise other potentially unpredictable activities, especially associated with third parties (current mode), or
- had sought to minimise other potentially unpredictable activities, especially associated with third parties (review mode).

In summary, the resultant justification statement reflects the level of the Client's commitment to effective planning and accurate documentation and is associated with the timeline to seeking EoI.<sup>5</sup>

The Client's ranking of the project performance attributes and accompanying justification statement and associated EoI timeline is recorded and forms an important input to identifying risks in Step 3 of the Tool and also in the validation of the Tool's recommended procurement strategy.

The Tool develops different procurement strategy in relation to different rankings of project performance attributes because in Step 3 the Tool is sensitive to assessing and treating those risks associated with changes to the Client's requirements and risks associated with third party involvement that remain active at the signing of substantial construction works contract. Hence, the Tool is sensitive to different rankings of project performance attributes because this ranking has a material effect on the level of residual risks at the signing of contract/s (including substantial construction works contract).

---

<sup>5</sup> Kennedy *et al.* (2018) provides a useful guide and checklist to promoting effective planning and accurate documentation.

In turn, the Tool develops a unique response to the Client’s particular ranking of project performance attributes. This is because the output of Step 3 directs the configuration of bundling (and contract packaging) in Step 4 and the output of Step 3 also directs nature of the exchange relationship (competitive and/or collaborative contracting) in Step 5.

If the Client’s ranking of project performance attributes is, or was, different than that shown in Table 2.1, then the Tool would still develop the most efficient procurement strategy vis-à-vis this ranking of project performance attributes by the Client and a procurement strategy to deliver superior value for money in contrast to current procurement decision-making practice. However, the procurement strategy recommended by the Tool when the Client’s ranking of project performance attributes is, or was, different than that shown in Table 2.1 would deliver inferior value for money in contrast to a procurement strategy the Tool would recommend in response to a ranking of performance attributes that is closer to the profile in Table 2.1.

In each of the three modes of applying the Tool there are two alternative approaches that create a total of up to six ways to apply the Tool as shown in Table 2.2.

**Table 2.2: Ways to apply the Tool**

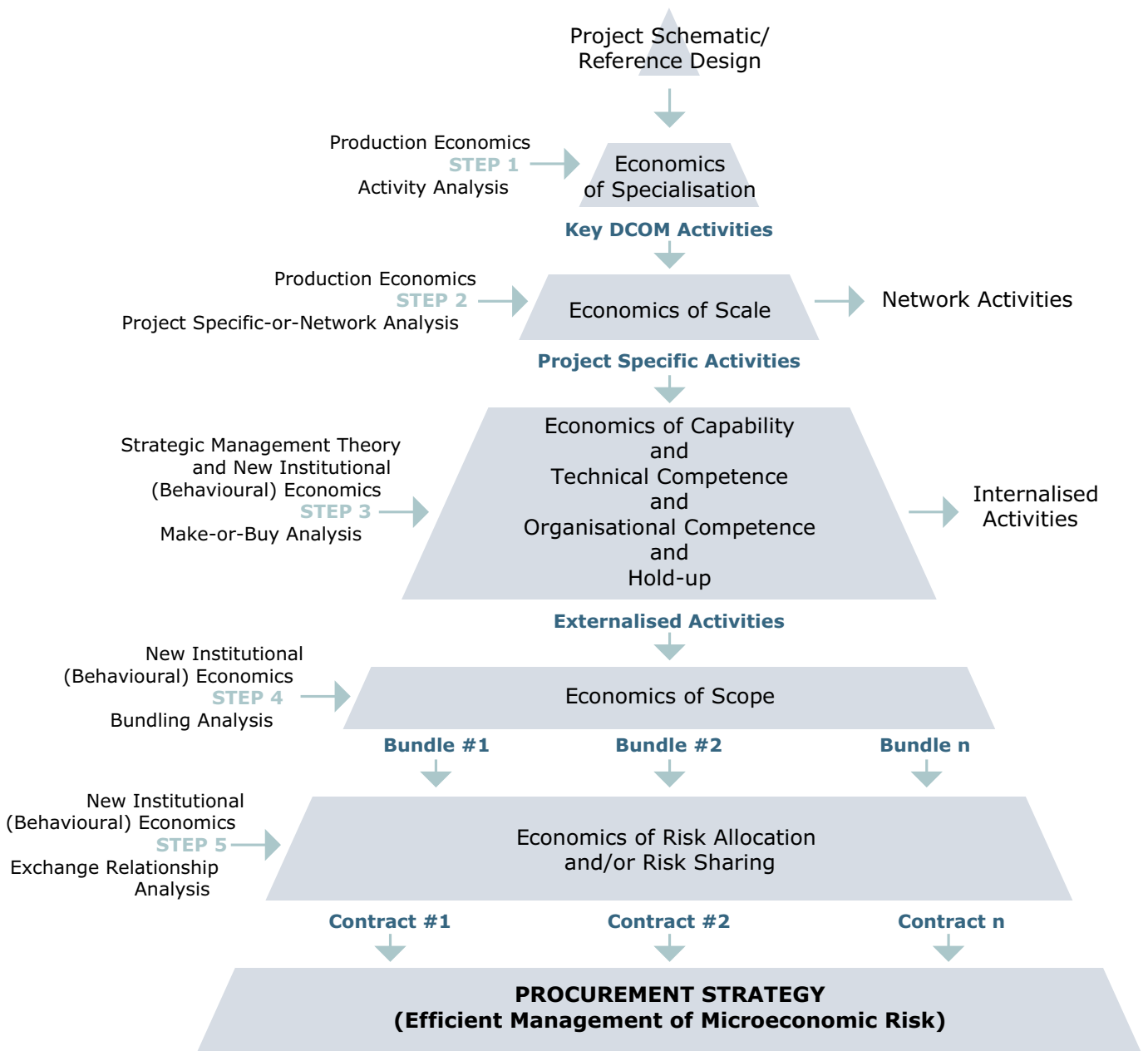
Application Modes	Client’s ranking of project performance attributes	Table 2.1 ranking of project performance attributes
<b>1. Preview Mode</b>	<b>Application 1A.</b> <b>Guide</b> a <b>future</b> procurement decision using the Client’s ranking of project performance attributes	<b>Application 1B.</b> <b>Guide</b> a <b>future</b> procurement decision using Table 2.1 ranking of project performance attributes
<b>2. Current Mode</b>	<b>Application 2A.</b> <b>Evaluate</b> an <b>existing</b> procurement decision using the Client’s ranking of project performance attributes	<b>Application 2B.</b> <b>Evaluate</b> an <b>existing</b> procurement decision using Table 2.1 ranking of project performance attributes
<b>3. Review Mode</b>	<b>Application 3A.</b> <b>Evaluate</b> a <b>past</b> procurement decision using the Client’s ranking of project performance attributes	<b>Application 3B.</b> <b>Evaluate</b> a <b>past</b> procurement decision using Table 2.1 ranking of project performance attributes

Even before applying the tool in one or more of the six ways shown in Table 2.2., the process of articulating the ranking of the project performance attributes with reference to Table 2.1 begins to encourage decision-making to improve value for money outcomes. First, explaining and justifying a different ranking of project performance attributes than the ideal ranking in Table 2.1 can influence a change in the Client’s priorities to align more closely to the ranking in Table 2.1. Second, within each of the three modes, there is the opportunity to apply the Tool both using the Client’s initial ranking of project performance attributes and using Table 2.1’s ranking of project performance attributes. This creates the basis to assess the difference in procurement recommended by the Tool in relation to the different ranking of project performance attributes. This forms the basis upon which to assess the potential to improve value for money. This would also incentivise the Client to change their ranking of project performance attributes closer to Table 2.1.



## 2.2 State-of-the-Art Microeconomics

The Tool employs state-of-the-art microeconomic theory that has been integrated and empirically tested to identify the most efficient size and number of contracts within a project and the most efficient use of competitive and/or collaborative terms across each of these contract/s. This microeconomic theory is highlighted in the Figure 1.



**Figure 2.1: Microeconomics in the Tool**

As indicated in Figure 2.1 the Tool combines various schools of economic thought to develop the most efficient procurement strategy for the project vis-à-vis the Client’s ranking of project performance attributes. This procurement strategy amounts to the efficient management of microeconomic risk in the externalisation of key design, construction, operations and maintenance (DCOM) activities arising from the project schematic, or reference design. More details on the body of microeconomic work mobilised by the Tool and the development of the Tool, along with its empirical testing and trials are given in Appendix B and C. In the next section, the steps in the Tool are outlined.

## 2.3 Steps

### 2.3.1 Step 1. Activity Analysis

The Tool begins by guiding the user to identify key production activities in the DCOM of an infrastructure project. The project is broken down into its key activities, using production and transaction costs logic. According to Transaction Cost Economics (TCE), a transaction cost occurs when goods or services are transferred across a technologically separable interface with distinct technology and distinct knowledge or skill sets (Williamson, 1985). This creates a natural division of labour, and how much a division of labour occurs is explained by classical theory of production; where the extent of the market demand is that which generates scale economies, including the accumulation of knowledge and/or learning curve economies. This justifies investments in special purpose technology. Deploying this logic, an infrastructure project can be broken down into activities that correspond with the highest level of market specialisation. If market firms exist that specialise in an activity within the boundaries of the project, then an activity has been identified.

Having found an activity, this activity is then located across the scope of the project and initially grouped together. If the size of this grouped activity is non-trivial (relative to the cost of the entire project) then this grouped activity is identified as an initial activity to form part of the analysis in the next step.

In the process of identifying key activities, it is important to note that the distinguishing features of various key activities lie in their discrete technological boundaries i.e., their distinct knowledge base or skill sets. These distinct knowledge and skills associated with key activities are the source by which specialist firms develop technology to add value in the design of construction, operations, and maintenance and in the implementation of construction, operations and maintenance. These value adding technologies are distinct from the following – which are not considered a key activity within the Tool: a milestone in a program; an entire schematic design (covering many design disciplines); a multi-trade building element; an organisational and/or management activity (including planning or programming); and trade packages using a work breakdown structure.

### 2.3.2 Step 2. Project Specific-or-Network Analysis

Key activities can be either one-off capital works or recurrent works, and each of these kinds of key activities may create the potential to deliver efficiency gains through *economies of scope*. Economies of scope is usually defined in terms of the relative total cost of producing a variety of goods and services (or a variety of activities) together in one firm or contract versus separately in two or more firms or contracts (Besanko *et al.*, 2010). Government can promote economies of scope, via bundling design and/or construction and/or operation and/or maintenance activities, when these new project activities are appreciably different than recurrent activities (found in an existing network) and when these new project activities exhibit potential synergy (or complementarity).

Design and construction activities tend to be inherently different than recurrent activities in an existing network. This is because of the one-off nature of design and construction and because of their unique location and associated resource immobility. Recurrent operation and maintenance activities arising from a new project can still be appreciably different than recurrent operation and maintenance activities in an existing network, because of differences associated with knowledge and skills and/or in the manner knowledge and skills are to be applied including peculiar constraints associated with the focal asset. Potential complementarity is likely to be more pronounced when the cost of operation and maintenance is sizable relative to the cost of design and construction. In the Tool, those new project activities that are appreciably different to recurrent activities in an existing network are termed *project specific activities* and create the potential to deliver efficiency gains through economies of scope.

The new project may also generate recurrent activities that are like recurrent activities in an existing network. In contrast to project specific activities, these *network activities* create the potential to deliver efficiency gains through *economies of scale*. Economies of scale are usually defined in terms of the relative declining average total cost function (in a single activity). Where a new project generates one or more activities that are like recurrent activities in an existing network, then government can more readily achieve efficiency gains. This can be achieved via economies of scale by procuring these new project activities that are like recurrent activities in an existing network along with these existing recurrent activities.

In the subsequent steps, the Tool focuses on the analysis of the procurement of project specific activities, on the basis that the network activities are procured separately.

### 2.3.3 Step 3. Risk (Make-or-Buy) Analysis

In this step, the Tool identifies those project specific activities that are more efficiently internalised (Risk Patterns 1 to 4) and those project specific activities that are more efficiently externalised (Risk Patterns 5 to 8). Internalisation, or the *make* decision, is a mode of operation in which government can exert direct control over resources within the activity and is either wholly responsible or majority responsible for the activity. This definition would include a contract of employment, a government agency, or a majority government-owned subsidiary. On the other hand, externalisation, or the *buy* decision, comprises all other modes of operation.

The Tool also identifies microeconomic risks associated with externalised project specific activities. The Tool identifies those activities that could lead to a lack of competition and high to very high prices (Risk Patterns 7 and 8) as well as high switching costs that could lead to hold-up and costly variations (Risk Patterns 5a and 5b) as shown in Table 2.3.

**Table 2.3: Microeconomic risks of high prices and costly variations: Risk patterns**

Market Structure → High Prices			Switching Costs → Costly Variations			Activity	
Complementarity	Rarity	Costly to Imitate	Sunk Costs and/or Timeliness	Unpredictability	Frequency → Risk Pattern	→	Internalise or Externalise
High	High	High	Low or High	Low or High	High	1	Internalise
High	High	Low	Low or High	Low or High	High	2	Internalise
High	Low	Low	Low or High	Low or High	High	3	Internalise
Moderate	Low	Low	High	High	High	4	Internalise
Moderate	Low	Low	High	High	Moderate or Low	5a	Externalise: Treat risks of very costly variations
Low	Low	Low	High	High	Low	5b	Externalise: Treat risks of costly variations
Low	Low	Low	Low or High	Low	Low	6	Externalise: Low risks of costly variations and low risks of high prices
Low	High	Low	Low or High	Low or High	Low	7	Externalise: Treat risks of high prices
Low	High	High	Low or High	Low or High	Low	8	Externalise: Treat risks of very high prices

Questions are provided for each of the three columns (or dimensions) of high prices and for each of the three

dimensions of costly variations. Each of these questions has a clear answer/response format (mostly “Yes or No”) that creates an unambiguous assessment (i.e., High or Low) for each of the dimensions. The questions may be adapted and customised to suit the characteristics and circumstances of the project and the way (or mode) by which the Tool is being applied. However, any changes to the questions are restricted, to ensure the integrity of each question is maintained.

By answering the questions, a risk pattern for each project specific activity is generated that is matched with the closest risk pattern in Table 2.3. This indicates whether the activity should be internalised or externalised. Regarding the externalised risk patterns, Table 2.3 also identifies which activities carry economic risks that need to be treated (in the next two steps of the Tool) i.e., Risk Pattern 7 and 8 activities need to be treated to avoid risks of high prices and Risk Pattern 5a and 5b activities need to be treated to avoid risks of costly variations. Risks of high prices and costly variations are low in Pattern 6 activities and so Low-Risk Pattern 6 activities do not require any treatment, they can be bundled and efficiently transferred to suppliers using standard contracting terms.

As a check on the accuracy of matching the project specific activity pattern with one of the patterns in Table 2.3, only one of nine rows in Table 2.3/one of the nine patterns will appear as fully ticked/shaded. Also, a brief secondary data review is undertaken of the market structure surrounding each activity assigned to one of the five externalisation contracting patterns (i.e., Risk Patterns 5a; 5b; 6; 7; and 8). These externalisation patterns correspond with market structures, tending towards perfect competition with a high level of price competition (Risk Patterns 5a; 5b and 6), to oligopoly to monopoly market structures with much less price competition (Risk Patterns 7 and 8).

Since those activities that are assigned a Risk Pattern 1 through Risk Pattern 4 are more efficiently internalised, the Tool proceeds to focus only on the procurement of those project specific activities assigned one of the five externalisation patterns i.e., Risk Patterns 5a; 5b, 6, 7 or 8.

## 2.3.4 Step 4. Contract Packaging (Bundling) Analysis

### 2.3.4.1 Benefits of bundling

There are two key benefits delivered by bundling and fewer contracts. First, more bundling and fewer contracts promotes value for money by incentivising positive investments of time and other resources into decision-making in those upstream activities in a bundle i.e., design and/or construction activities to reduce the cost of downstream activities i.e., maintenance and operations activities in the same bundle and, in turn, reduce whole-life costs. These positive investments lead to innovations in the quality of design and construction that, while targeting reducing costs of maintenance and operations, can enhance the function and performance of the asset from the front-line users’ perspective. For example, the use of better quality and more robust materials and components with lower life cycle costs may enhance users’ perception of the asset and reduce interruptions in the use of the asset due to fewer repairs and replacements. Furthermore, the design of the geometry and line of the asset in linear infrastructure or the design spaces associated with the asset’s hard maintenance and soft maintenance in vertical infrastructure e.g., location of outbuildings housing equipment for maintaining external spaces and the location of cleaning stations for maintaining internal spaces will also reduce interruptions in the use of the asset and enhance its function and performance. Additionally, designing for buildability during initial construction and subsequent rehabilitation in linear infrastructure or refurbishment in vertical infrastructure, as well as designing for ease of future maintenance will again reduce interruptions in the use of the asset and enhance its function and performance.

Second, more bundling and fewer contracts lead to more single-point responsibility that reduces poor visibility across many interfaces and reduces compliance costs in terms of quality. In turn, this reduces time and/or cost variations.

As shown in Tables 2.4 to 2.6, the Tool leverages these two key benefits of bundling in pursuance of advancing value for money in accordance with the ranking of project performance attributes in Table 2.1.

**Table 2.4: Key benefits of bundling: Targeting *Priority #1***

Project performance attributes	Benefits of Bundling Design (D) With Construction (C)	Benefits of Bundling Design and Construction (D&C) With Operations and/or Maintenance (O&/orM)
Whole-Life Cost (Lowest)		<p>Potential for improvements in whole-life costs including innovations where strong relationship from D&amp;C to O&amp;/orM activities, likely where:</p> <ul style="list-style-type: none"> <li>• Size/cost of O&amp;/orM significant relative to size/cost of D&amp;C; and</li> <li>• Frequency and scale of O&amp;/orM (beyond repairs and replacement) strongly affected by D&amp;C</li> </ul>
Quality (Highest)		<p>Potential for improvements to quality including innovations where strong relationship from D&amp;C to O&amp;/orM activities, likely where:</p> <ul style="list-style-type: none"> <li>• Size/cost of O&amp;/orM significant relative to size/cost of D&amp;C; and</li> <li>• The user and/or direct operators very sensitive to the functionality of design</li> </ul>

**Table 2.5: Key benefits of bundling: Targeting *Priority #2***

Project performance attributes	Benefits of Bundling Design (D) With Construction (C)	Benefits of Bundling Design and Construction (D&C) With Operations and/or Maintenance (O&/orM)
Time Compliance (Certainty)	<p>More time required for the Client to develop their performance requirements gives more time to resolve some of the unpredictability creating any pattern 5 activities. This improves time compliance.</p> <p>Risks associated with time among pattern 6 D&amp;C and O&amp;/orM activities, can be efficiently transferred leading to superior efficiency vis-à-vis time is achieved with more bundling and less contracts (relative to procurement modes that incorporate less bundling and more contracts e.g., Management Contracting or Engineering Procurement and Construction Management or Design-Bid-Build)</p>	Same as benefits of bundling D&C
Cost Compliance (Certainty)	Same as benefits of bundling D&C vis-à-vis time compliance but this time improves cost compliance.	Same as benefits of bundling D&C
Quality Compliance (Certainty)		Provides incentives to avoid quality shading ('cutting corners') during construction, including avoiding shirking requirements in terms of workmanship, the use of plant and equipment and the sourcing of materials.

**Table 2.6: Key benefits of bundling: Targeting *Priority #3***

Project performance attributes	Benefits of Bundling Design (D) With Construction (C)	Benefits of Bundling Design and Construction (D&C) With Operations and/or Maintenance (O&/orM)
Capital Cost (Lowest regardless of lifecycle cost)	Strong incentive to seek capital cost savings by developing more buildable solutions both in design and construction method and planning including avoiding gold-plating to minimise capital costs.	Same as benefits of bundling D&C
Lifecycle Cost (Lowest regardless of capital cost)		Strong incentive to seek lifecycle cost savings by developing more operable and maintainable solutions including avoiding gold-plating to minimise lifecycle costs.
Time Construction Start/Finish (Quickest)	Bundling D&C with O&/orM does not represent the quickest approach to starting/finishing construction works. This is because time will be required to fully develop at least the client’s performance requirements. Time will also be needed for proponents to develop their outline design to submit their fixed price tender before construction can commence. Less bundling and more contracts could be signed as soon as design for the relevant construction is completed to achieve a quicker start and finish construction times e.g., Management Contracting or the Engineering Procurement and Construction Management approach. However, bundling is quicker than having one substantial contract for design and separating all design from construction, e.g., Design-Bid-Build	Same as benefits of bundling D&C

### 2.3.4.2 Costs of bundling

Bundling can also create significant costs in terms of encouraging high prices and costly variations. When the contract becomes so large that it restricts the number of firms that are capable and willing to express an interest in bidding for the project, then bundling associated with this contract is inefficient. Activities in a contract that are unpredictable create a potential source of disturbance during the delivery of the project. Contract activities can be unpredictable when:

- the Client’s requirements have not been clearly specified and are likely to change, and/or
- the external environment is laden with exogenous risk including the undue involvement of third parties.

With a lack of competition and/or unpredictably, less bundling and more contracts are likely to deliver better value for money. In terms of reducing unpredictability, less bundling and more contracts increase the time before the signing of contracts that allow more time and opportunity to resolve unpredictability in contracts before signing. This may also increase the attractiveness of the project from the market's perspective and resultant competition.

Some of the benefits of bundling in Tables 2.5 and 2.6 in terms of D&C (without any O&/orM) can be a double-edged sword. Without an O&/orM component, D&C provides incentives to quality shade ('cut corners') during construction, including shirking requirements in terms of workmanship, the use of plant and equipment and the sourcing of materials. Quality shading can be avoided using site-based supervisors working as the client's agent in monitoring the quality of the construction e.g., Clerk of Works, and/or by mobilising the credible threat of future work by monitoring contracts post construction/in operations to assess the performance of these contracts in terms of those operations and maintenance activities affected by design and construction. This performance assessment can be published as an incentive not to shirk quality in design and/or construction and this performance assessment can also be used in the formulation of tendering lists for future contracts (for example, the new Value Rating Tool – see section 2.3.6).

And while there is a strong incentive in D&C to seek capital cost savings by developing more buildable solutions (both in design and construction method and planning including avoiding gold-plating) this incentive can turn negative when these cost savings increase the whole-life cost of the asset and/or reduce the functionality of the asset. These kinds of negative cost savings can be avoided by more prescription in Client requirements in relation to those aspects of the project that are sensitive to lifecycle costs and functionality.

#### 2.3.4.3 Maximising the benefits of bundling and minimising the costs of bundling

The Tool maximises the benefits of bundling and minimises the costs of bundling, in pursuance of advancing value for money in accordance with the ranking of project performance attributes in Table 2.1. The Tool achieves this by using separate contract/s for those activities that can create high prices (High-Risk Patterns 7 and 8) and separate contract/s for those activities that are likely to lead to costly variations (High-Risk Patterns 5a and 5b), and then bundling mostly only those activities that have low risk of high prices and low risk of costly variations (Low-Risk Pattern 6).

Before assigning a separate contract for each of the High-Risk Pattern 7 and 8 activities, these are reviewed to assess how many High-Risk Pattern 7 and High-Risk Pattern 8 activities have occurred due to the project size (because of the activity's initial grouping across the scope of the project in Step 1). Consideration is given to de-bundling each High-Risk Pattern 7 activity and each High-Risk 8 activity to see whether a smaller version of the activity would suit the next lower/smaller tier of suppliers. This would increase the pool of likely bidders and convert an initial High-Risk Pattern 7 or 8 activity into a new Low-Risk Pattern 6 activity.

However, it may not always be practical to separate High-Risk Pattern 5a, 5b, 7 and 8 activities from Low-Risk Pattern 6 activities because of a proximity issue/s. For example, some of the High-Risk Pattern 5a, 5b, 7 and 8 activities may be physically contiguous with some of the Low-Risk Pattern 6 activities. This example includes a layer/s of road assessed as either High-Risk Pattern 5a, 5b, 7 or 8 and when the remaining layer/s of the road are assessed as Low-Risk Pattern 6 activities. In these situations, High-Risk Pattern 5a, 5b, 7 or 8 activities are included in an otherwise bundle of Low-Risk Pattern 6 activities, but the contracting terms (collaborative and competitive contracting) used for the High-Risk Pattern 5a, 5b, 7 or 8 activities are different than the contracting terms used for otherwise Low-Risk Pattern 6 activities (competitive contracting only) in this bundle. This is explained further in the next section.

Having bundled-up activities, each bundle is re-assessed, in terms of the market firm at the head of bundle, to generate a Risk Pattern, this time for each bundle (as opposed to individual activities). This re-assessment includes those bundle/s comprising initially assigned Low-Risk Pattern 6 activities (including any High-Risk Pattern 5a, 5b, 7 or 8 activities that can't be practically separated from pattern 6 activities) to check that a new High-Risk Pattern 7 or new High-Risk Pattern 8 bundle has not arisen because of the size of this bundle. If a new High-Risk Pattern 7 or a new High-Risk Pattern 8 bundle has arisen, then this can be disaggregated along the lines of splitting the bundle into two or more bundles of the same scope of activities but with each bundle reduced in size to suit lower tiers of suppliers. Alternatively, the bundle can be divided along the lines of the activities, for example, the design activities separated from the construction activities.

Where a bundle of mostly Low-Risk Pattern 6 D&C and O&/orM activities, with a strong potential for efficiencies in whole-life costs and/or strong potential for quality (functionality) innovations is identified, then this bundle can be market sounded for private finance because this presents the opportunity for the cost of private finance (beyond the cost of government finance) to be outweighed by strong efficiency gains. Again though, care is needed to ensure that this private finance approach does not create a new High-Risk Pattern 7 or High-Risk Pattern 8 bundle. To help prevent this, the Client can consider mechanisms like upfront capital contributions to reduce the amount of private finance to perhaps increase the pool of capable consortium willing to express their interest. However, if a new High-Risk Pattern 7 or 8 bundle is still being created because of a lack of appetite from private finance providers, then this bundle/s of mostly Low-Risk Pattern 6 D&C and O&/orM activities is procured using government finance.

The next section gives more details and an overview on identifying the best value approach to the contractual exchange.

### 2.3.5 Step 5. Collaborative-or-Competitive Contracting Terms (Exchange Relationship) Analysis

Each contract used to procure each bundle of activities requires the Client to identify the most efficient exchange relationship with the market firm/supplier at the head of the supply chain of each bundle of activities. The exchange relationship is a continuum from relational exchange (collaborative contracting) to arm's length or discrete exchange (competitive contracting) as depicted in Table 2.7.

**Table 2.7: Exchange relationship continuum**

Market Structure → High Prices		Switching Costs → Costly Variations				Bundle	
Complementarity	Rarity	Costly to Imitate	Sunk Costs and/or Timeliness	Unpredictability	Frequency → Risk	→ Exchange Relationship	Pattern
Moderate	Low	Low	High	High	Moderate or Low	5a	Collaborative Contracting
						(Very High Risk)	
Low	Low	Low	High	High	Low	5b	Collaborative Contracting
						(High Risk)	
Low	Low	Low	Low or High	Low	Low	6	Standard Competitive Contracting
						(Low Risk)	
Low	High	Low	Low or High	Low or High	Low	7	Bespoke Competitive Contracting
						(High Risk)	
Low	High	High	Low or High	Low or High	Low	8	Bespoke Competitive Contracting
						(Very High Risk)	



At one extreme of the exchange relationship continuum, collaborative contracting includes credible commitments, e.g., sharing contractual pains and gains associated with a negotiated budget, which represents a contractual adaptive mechanism. This adaptive mechanism is designed to pre-empt suppliers leveraging their balance of power post-contract and behaving negatively on the occurrence of a change in the works post-contract, arising from unpredictability among the activities in their contract bundle. This kind of collaborative contracting is efficient for contracts associated with High-Risk Pattern 5a and 5b bundles of activities.

On the other hand, standard competitive contracting incorporates much less reliance on credible commitments. It also places less emphasis on credible threats (other than those safeguarding mechanisms in standard contracts e.g., liquidated, and ascertained damages and recourse to third party dispute resolution). Instead, standard competitive contracting relies much more on the clear allocation of risk and responsibility among the parties to the contract, and contractual precedent associated with well-established standard contracts. Therefore, standard competitive contracting is suited to those bundles for activities which are substantially predictable i.e., Low-Risk Pattern 6 bundles of activities.

Competitive contracting becomes more extreme (and further away from collaborative contracting) when it includes bespoke contracts and/or costly-to-write credible threats concerning performance (e.g., a substantial performance bond). Credible threats are also designed to pre-empt a strong balance of power held by suppliers in thin markets. This power imbalance manifests most acutely when suppliers can mobilise their pre-contract and ongoing market power to behave in a negative way on the occurrence of a change in the works post-contract (arising from unpredictability among the activities in their contract bundle). Regardless of the level of unpredictability this kind of bespoke competitive contracting is efficient for contracts associated with High-Risk Pattern 7 and 8 bundles of activities.

In both standard and bespoke competitive contracting risks are clearly allocated. Consequently, the use of a payment mechanism based on a fixed-priced established in a low-price auction is efficient.

Looking into the exchange relationship continuum further, there are those bundles that comprise activities that are Low-Risk Pattern 6 activities and/or High-Risk Pattern 7 activities and/or High-Risk Pattern 8 activities, whose overall scope and method of work is predictable, but which include a significant component of unpredictability. For example, labor and amount of plant/equipment involved in an activity can be predictable in proportion to the quantity of materials used, but the quantity of materials to be used can be unpredictable. In this case, standard competitive contracting is still efficient when it incorporates an adapting mechanism such as a schedule of rates in relation to work where final in-place quantity is re-measured on completion. Such that the suppliers are allocated risks associated with labor, plant/equipment and the unit cost of materials, and the Client is allocated the risks of the number of units of the material concerned.

Another example of this concerns building inflation. This time, the quantities of labor, plant/equipment and materials are predictable, but prices are unpredictable with rising inflation. Again, standard competitive contracting is still efficient when it incorporates an adapting mechanism such as rise and fall provisions. Here, suppliers are allocated risks associated with the amount of labor, plant/equipment, and materials, along with the base price of units of work and the Client is allocated the risk of building inflation. These kinds of overall Low-Risk Pattern 6 bundles remain closer to standard competitive contracting than collaborative contracting, as risks continue to be allocated in conjunction with an adaptive mechanism/s (e.g., scheduled of rates and/or rise and fall provisions) which fall short of a risk sharing mechanism. As such, this kind of overall Low-Risk Pattern 6 bundle is still procured using a payment mechanism in which risks are clearly allocated and based on unit prices established in a low-price auction.

As mentioned, it may not always be practical to separate High-Risk Pattern 5a, 5b, 7 and 8 activities from Low-Risk Pattern 6 activities because of proximity issue/s. Where High-Risk Pattern 5a and 5b activities cannot be practically separated from an otherwise Low-Risk Pattern 6 bundle of activities, then collaborative contracting terms are used for the High-Risk Pattern 5a and/or 5b activities within

this otherwise Low-Risk Pattern 6 bundle of activities and when standard competitive contracting is used for the High-Risk Pattern 6 activities, creating a mixed contracting approach within the same bundle. Where High-Risk Pattern 7 and 8 activities cannot be practically separated from an otherwise Low-Risk Pattern 6 bundle of activities, then each of these High-Risk Pattern 7 and 8 activities are procured as a nominated supplier using a trilateral contract between the Client, the supplier at the head of the contract bundle and the nominated supplier of the High-Risk Pattern 8 activity. Again, a mixed contracting approach is created when standard competitive contracting is used for the Low-Risk Pattern 6 activities and bespoke competitive contracting used for the High-Risk Pattern 7 and 8 activities in the same bundle.

This best value for money approach to contracting including the use of mixed contracting where efficient, directly supports the ranking of the project performance attributes in Table 2.1. In doing so, the Tool ensures the Client avoids mistakenly pursuing a collaborative contract or mistakenly seeking a competitive contract. For example, a mistaken collaborative contact can include the Client and their supplier agreeing to a risk sharing regime associated with a budget when the Client may suffer from lack of information associated with its inferior capabilities and competences concerning the delivery of the activities of the contract. This means that the Client is not able to effectively collaborate and exercise the adaptive mechanisms in this contract, should a change of works occur. Consequently, the Client remains vulnerable to costly variations. This situation is worsened when the supplier is in a thin market. That is, the government's sensitivity and vulnerability to hold-up, created by virtue of its sunk investment in the project, is exacerbated by high switching costs when there are only a few alternative potential suppliers. A mistaken competitive contract can include the supplier being remunerated on a fixed-price basis, in which the supplier is responsible for those risks to which it has been allocated. In such a contract, the Client may suffer from a lack of an adaptive mechanism to address changes in the works when it could have effectively collaborated in mitigating potential additional costs. Here, the Client can also suffer a high price levied by the supplier in respect of those risks that the supplier cannot effectively control. For example, risks associated with third parties, when the Client and their supplier could more effectively work together to resolve.

### 2.3.6 Validation and Value for Money

In order to validate the procurement strategy recommended by the Tool (based on Table 2.1 ranking of project performance attributes) – when this matches the actual procurement approach (where a Client ranking of project performance attributes similar to Table 2.1) and when this mismatches the actual procurement approach (where a Client ranking of project performance attributes is dissimilar to Table 2.1), an assessment of value for money achieved/achievable by the actual approach versus the approach recommended by the Tool is required.

The Public Sector Comparator (PSC) used to assess Public-Private Partnership (PPP) bids is an example of the problems of attempting to directly estimate value for money. There is substantial controversy surrounding the veracity of the PSC and its attempts to directly estimate the Net Present Value (NPV) of a project delivered via traditional government finance (based on a reference design) to compare it to the NPV of the PPP bids (Winch and Schmidt, 2016).

Ideally, a direct assessment of value for money achieved/achievable by the actual approach versus the approach recommended by the Tool is made by using actual procurement related whole-life costs and benefits (i.e., only those costs and benefits affected by finance, design, construction operations decisions). This will require a database of these whole-life costs and benefits. In turn, this requires the application of a comprehensive post-completion review tool of the kind recommended by Infrastructure Australia in their 2021 Infrastructure Plan i.e., a "Value Rating Tool". At the time of writing, Associate Professor Bridge is leading the development of a Value Rating Tool that will deliver the depth and breadth of data needed to assess value for money achieved/achievable effectively directly by the actual approach versus the approach recommended by the Procurement Decision Tool (Kinnunen et al., 2022). However, this Value Rating Tool has only been applied to a sample of PPP schools and non-PPP schools, and so the Value Rating Tool is in its infancy. One of the reasons that effective post-completion tools are not common is due to the intractability of data, particularly with respect to surfacing and measuring costs and benefits in the operations and maintenance stage

of built infrastructure. This is because costs are whole-life and include both internal and external transaction costs that are much less observable than production costs (comprising finance, design, construction, operations and maintenance costs). Meanwhile, benefits relate largely to the effects of the built infrastructure on the core activity, and this can be difficult to objectively isolate and evaluate (KPMG and University College London, 2010; National Audit Office, 2011). Such tools take time to develop and it has taken Associate Professor Bridge and his team over five years to develop and test the Value Rating Tool in one sector only.

In the absence of the ability to directly assess value for money achieved/achievable from the actual approach versus the approach recommended by the Tool by using actual procurement related whole-life costs and benefits, an indirect approach is a valid alternative approach and *indicator* of value for money – provided the indirect approach meets the following criteria:

1. Is established at early stage and close to the point in time just after the procurement decision has been made (*timing criterion*)
2. Avoids any charge of tautology (when cause and effect are measured in same terms) i.e., the value for money indicator (read effect) needs to be distinctly different to the key parameters in the Tool, which comprise the patterns in Step 3 of the Tool (read cause) (*non-tautology criterion*), and
3. Captures the potential for high bid prices and the potential for costly variations (*market failure criterion*).

Teo and Bridge (2017) identify Expressions of Interest (EoI), as meeting all three criteria, and because EoI are the equivalent of open tender bids, EoI reflect the extent to which the market is attracted by the project while not affected by any subjective filtering by government including the process of shortlisting bidding firms. Regarding the timing criterion, EoI are established at an early stage and, critically, very close to the point in time following the procurement decision. Consequently, EoI are not affected by any sub-optimal microeconomic decision-making post the procurement decision. In terms of the non-tautological criterion, EoI avoids a charge of tautology. That is, EoI are distinctly different to any of the parameters in the Tool, and EoI are established externally to these parameters i.e. independent of any interference by the Tool's user in developing the patterns in Step 3 of the Tool. Regarding the market failure criterion, high EoI (over 8 EOI) has been empirically shown in extensive studies in both the civil and building sectors to yield little production improvement in terms of lower prices and inferred incentives for design innovations (Gupta, 2002; Skitmore, 2002). At the same time, high EoI can indicate the prospect of costly variations, with the market signalling that it is seeing potential to make gains from variations by behaving in a negative opportunistic way (Williamson, 1985). On the other hand, low EoI (4 or less) is not sufficient to avoid oligopoly pricing constraints, which results in ineffective competition and high prices (Beattie, Goodacre, and Fearnley, 2003; Selten, 1973). For these reasons, 5-8 (inclusive) EoI is derived as optimal competition and both a reliable and valid indicator of value for money.

Teo and Bridge (2017) also develop a hypothesis, using EoI, to test and validate the outcomes of the Tool, where these match or mismatch the actual procurement approach, as follows:

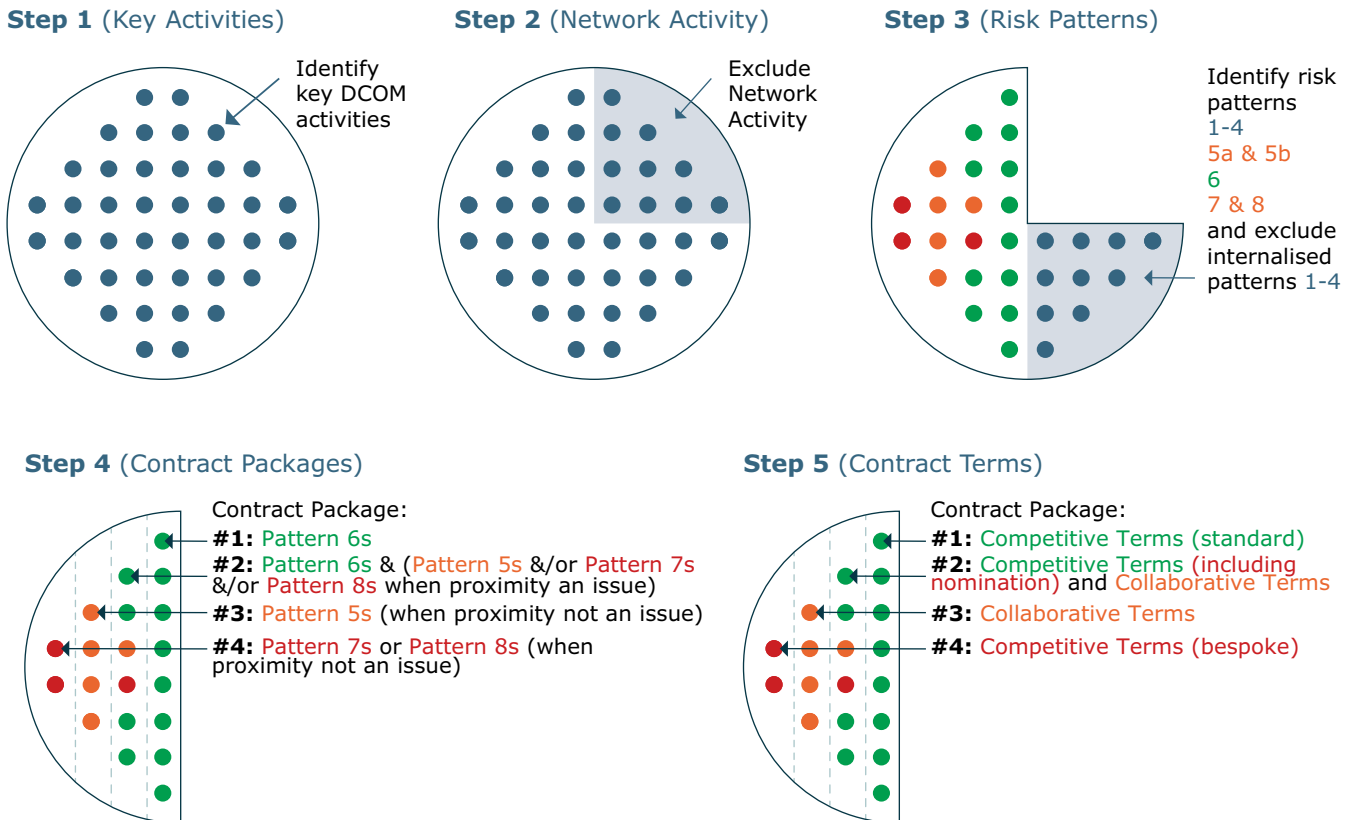
Actual competition is expected to be within the optimum range of competition, i.e., 5 to 8 EoI inclusive, in cases where actual procurement substantially matches the procurement strategy recommended by the Tool; and actual competition is expected to be outside the optimum range of competition i.e., 4 or less EoI, or 9 or more EoI, in cases where actual procurement substantially mismatches the procurement strategy recommended by the Tool.

Actual EoI known at time applying the Tool are used when applying the Tool in review mode, while actual EoI established after applying the Tool are used in either current or preview mode.

Additionally, the EoI validation approach can be corroborated by using the Client's ranking of the project performance attributes and accompanying justification statement (detailed in Section 2.1).

## 2.3.7 Summary

While efficient collaborative and/or competitive contracting terms (Step 5) and efficient contract packaging (Step 4) is central to the efficient management of microeconomic risk, these steps rely on the partition of those activities that are more efficiently internalised and those activities that are more efficiently externalised, as well as the identification of different kinds (or categories) of risks associated with externalised activities (Step 3). The risk analysis in Step 3 depends on focusing on project-specific activity and excluding from the analysis those network activities in the new project that are both recurring and like already occurring activities in an existing network of infrastructure operated by the client (Step 2). Meanwhile, Step 2 can only effectively commence once key DCOM activities have been identified (Step 1). The Tool’s sequential decision-making procedure across its five steps is summarised in Figure 2.2.



**Figure 2.2: Sequential Decision-Making Procedure**

The effectiveness of the decision at each step of the Tool is dependent on the effectiveness of the prior decisions. This process is analogous to a steeplechase in which runners need to successfully clear each hurdle to reach the finish line. In the case of procurement decision-making, we can add to this analogy by envisioning the hurdles decreasing in height and difficulty as runners proceed. In other words, the ineffective application of the initial steps in the Tool will have a bigger negative effect on efficiency and value for money than the ineffective application of the latter steps. This is pertinent to appreciating the potential of the Tool to deliver superior value for money in comparison to current procurement decision-making practice because much of the content in the first three steps in the Tool is missing in current procurement decision-making practice.

## 2.4 Assumptions and Delimitations

By definition, any assumption (within any theory, model or tool) represents an inherent weakness i.e. when the conditions associated with the assumption do not hold, then the explanatory or guiding power of the theory, model or tool, equally does not hold. Beyond assumptions, other weaknesses manifest when deliberate limitations (or delimitations) are selected. For example, delimitations may be associated with the scope of the decision to which the theory, model, or tool target.

The various microeconomic theories upon which the Tool (as noted in Section 2.2) relies incorporate assumptions. One of their key assumptions is that decision-makers will seek to maximise outcomes within the limits of imperfect information. In the context of procurement selection, the Tool sees decision-makers seeking the most efficient outcomes from procurement selection across the whole-life of the asset and given the circumstances and information prevailing at the point of time the procurement decision is made. In so doing, decision-makers focus on each project substantially in isolation and develop a procurement strategy specific to the focal project only (as opposed to a program of projects).

This key assumption generates two possible weaknesses within the Tool.

First, the Tool may deliver outcomes that are unwelcome when non-economic factors are uppermost in the decision-maker's mind, e.g., when political and/or financing factors are prioritised. These factors may be associated with the following:

- The likelihood of significant third-party interference either pre-contract or post-contract, and/or
- An appreciable imbalance of power, either pre-contract or post-contract, arising from an appreciable imbalance of dependence between the buyer and the supplier.

Consequently, the Tool's focus is on private ordering, in which at least one of the two counterparties is a 'for-profit' private sector organisation. This focus envisages that the counterparties meet their contractual responsibilities and only defer to third parties in terms of disputes that the counterparties find they alone cannot resolve. Furthermore, the Tool envisages that contractual safeguards (e.g., performance bonds) can be used to address any power/dependency imbalances, and to reduce the need to involve third parties to resolve disputes. Outside of the private ordering conditions envisaged by the Tool, it would still provide a service in delivering the basis of an economic and Value-for-Money baseline. This is based on what is achievable using the procurement strategy recommended by the Tool and upon which users can more accurately assess the costs of deviating from this procurement strategy.

Second, although the Tool assesses the prevailing conditions, and uses as much information as is available, it does this in a static way. The Tool would need to be re-run if there is a delay in the period taken to act on the recommendations of the Tool and when, during this delay, there has been an appreciable change to the capabilities of government and/or the structure of the market. That said, the Tool is designed to be completed in a very short time and with modest resources, and so re-running the Tool should not present a significant impost.

Beyond the key assumption concerning decision-making and its possible two weaknesses, there are three delimitations associated with the scope of the Tool.

First, the Tool only applies to those projects with the following features:

- A bespoke design (and not goods and services that can be 'bought off the shelf'), and
- Has a non-trivial capital commitment (and not projects that are trivial in terms of capital spending). From a practical perspective, the Tool targets mega projects (over \$1 billion) and major projects over \$50 million.

Second, the Tool is designed to start on or after a project schematic has been established (to identify DCOM activities) and extend downstream to the point in time at which EoI are established. In doing so, the Tool assesses only those costs and benefits affected by the procurement of DCOM activities and those costs and benefits affected by the approach to financing the project. That is, wider social, environmental, and economic costs and benefits, associated with the upstream investment decision, are excluded. Also, the Tool does not contain guiding apparatus to assist with any decisions beyond EoI. For example, it does not speak to downstream decisions concerning governance, tendering or contract administration.

Third, the Tool is restricted to analysing the procurement of project specific activities only and is silent on the procurement of any new network activities arising from the project that are recurrent and similar to activities in an existing network owned and operated by the decision-maker.

# Application Projects

## 3.1 Toowoomba Second Range Crossing

### 3.1.1 Client's procurement priorities

The EoI document advised that the objectives of the TSRC project include achieving value for money for the State of Queensland, including procuring the project in a way that encourages private sector innovation on technical and commercial aspects of the project, and securing timely delivery of the project (Projects Queensland, 2014). This indicates the Client (Queensland Department of Transport and Main Roads/QDTMR) ranked the project performance priorities in a way that matches the ideal ranking in Table 2.1, as shown in Table 3.1.

**Table 3.1: Client's ranking of project performance attributes in TSRC**

Project performance attributes	Ideal Client's ranking	Assumed Actual Client's ranking in TSRC
<b>SET A.</b> Whole-Life Cost (lowest)	<b>1</b>	<b>1</b> Bundling DC with O&M associated with improvements in whole-life cost is seemingly sought
<b>SET A.</b> Quality Innovations (highest)	<b>1</b>	<b>1</b> Innovations explicit in the EoI document
<b>SET B.</b> Construction Time Compliance (certainty)	<b>2</b>	<b>2</b> Timely delivery/ <i>de facto</i> time certainty explicit in the EoI document
<b>SET B.</b> Capital Cost Compliance (certainty)	<b>2</b>	<b>2</b> Cost certainty associated with time certainty
<b>SET B.</b> Quality Compliance (certainty)	<b>2</b>	<b>2</b> Quality certainty associated with bundling DC with O&M
<b>SET C.</b> Time Construction Start/Finish (quickest)	<b>3</b>	<b>3</b> Private sector finance sought, when this is associated with a long period of time needed to reach financial close
<b>SET C.</b> Capital Cost (lowest regardless of lifecycle cost)	<b>3</b>	<b>3</b> Improvements to whole-life costs associated with bundling DC with O&M sought and therefore minimum capital costs not sought
<b>SET C.</b> Quality (lowest regardless of lifecycle cost)	<b>3</b>	<b>3</b> Improvements to quality (beyond meeting only Client's requirements) associated with bundling DC with O&M sought and therefore minimum quality not sought

### 3.1.2 Scope, timeline and budget of project procured

Extracts from the EoI document overviewing the scope of the project to be procured are given in Box 3.1.

With regards to the timeline, the EoI document envisaged receipt of Request for Proposals in the first Quarter 2015 and financial close by mid-2015. The actual date for financial close was 25 August 2015 and the road was formally opened 8 September 2019.

The design and construction were budgeted at approximate \$1.606 billion with the Federal Government committing 80% at \$1.285 billion and Queensland Government committing 20% at \$321 million (Emerson, 2014).

The EoI document advised:

“The Commonwealth government has committed to fund 80% of the construction cost of the Project ... Subject to final value for money analysis and consistent with recent PPPs in Queensland, it is likely that the funding structure for the Project will be underpinned by a significant capital contribution paid by the State, utilising a component of the overall State and Commonwealth Governments funding commitments to the Project. The quantum, timing and commercial parameters around the Government Contribution will be set out in the Project documentation to be provided to shortlisted Proponents during the RFP stage. However, it is likely that the Government contribution will be in the range of 50-60% of the initial funding requirement for the Project.” (Projects Queensland, 2014: 8)

Given this, government contribution targeted the bulk or all the PPP Co's upfront design and construction costs, this leaves the PPP Co to focus on the financing operations and maintenance.



### Box 3.1 Scope of project to be procured (Source: Projects Queensland, (2014))

#### Overview of the Project and Opportunity

"The Toowoomba Second Range Crossing (TSRC) is a proposed bypass route to the north of Toowoomba, approximately 41 km in length. The TSRC will connect the Warrego Highway from Helidon in the east, to Charlton (west of Toowoomba), and to the Gore Highway at Athol in the west."

#### Reference Design

"The reference design forming the basis of the statutory planning and environmental approval process features: five intersections/interchanges ...: Gore Highway intersection, Cecil Plains Road intersection, Warrego Highway West intersection, Mort Street intersection, and Warrego Highway East intersection; two lane carriageway between the Gore Highway and Warrego Highway West (including through the Cecil Plains Road intersection) for a posted speed of 100kph; three lane divided carriageway from Warrego Highway West to Mort Street for a posted speed of 90kph; four lane divided carriageway from Mort Street to Warrego Highway East including dual two lane tunnels (approximately 700 metres in length) for a posted speed of 100kph; maximum gradient of 6.5%; and service roads and auxiliary lanes."

#### Key Considerations

"It is expected that the TSRC will be tolled. The technical scope of the Project may include some minor works to facilitate toll collection infrastructure. However, at this stage, the Project scope will not include the provision of toll collection systems or associated toll collection services as this is intended to be procured separately."

#### Pilot Tunnel

"A pilot tunnel was constructed between August and December 2007 using drill and blast methods. The pilot tunnel was excavated from the western portal, heading eastwards for approximately 625 metres (of the ultimate circa 700 metres of mainline tunnel). The pilot tunnel was not day-lighted at the eastern end. The pilot tunnel project enabled the collection of geological data, sampling of rock mechanics and cuttability tests, estimation of ground water inflows, insitu stress and convergence measurements, monitoring and measurement of drill and blast induced vibration levels."

### 3.1.3 Actual procurement

The procurement proceeded on the basis that the project is delivered by way of an availability-based Public Private Partnership (PPP), with the road being tolled, and the State retaining toll revenue risk.

The PPP structure assumed that the TSRC will be handed back to the State at the end of the Project term, in the specified condition and with no further payment being made at that time. This PPP also proceeded based on one contractual package comprising design, construct, finance and operate and maintain, with the O&M for a period of 25 years following successful commissioning of the project.

Given the substantial government contribution targeted up-front costs, this effectively created a hybrid procurement approach comprising at least a substantial part of the Design and Construction of the works procured via Design and Construction using government finance and the remainder of the works including Operations and Maintenance procured using private finance.

As shown in Table 3.1 (based on the EoI document) the Client's procurement priorities revolve around SET A project performance attributes and SET B project performance attributes, and ahead of SET C project performance attributes. The assumed ranking by the Client of project performance attributes matches the ideal ranking of project performance attributes in Table 2.1. We should anticipate the Tool's recommended procurement strategy to lean towards matching, rather than mismatching, the actual procurement approach, when applying the Tool in review mode (i.e., Application Mode #3B).

The Tool’s recommended procurement strategy for TSRC did substantially match the actual procurement and this outcome is validated. While there was a substantial match, there was an important difference between the actual procurement approach and the Tool’s recommended procurement strategy that again shows the potential of the Tool to add significant value in the delivery of major projects.

The outcome from applying the Tool (Steps 1 to 5) on TSRC is presented in Section 4.

## 3.2 Gold Coast University Hospital

### 3.2.1 Client’s procurement priorities

The Queensland Audit Office reported on three major hospitals in Queensland including GCUH (QAO 2014). This QAO report points to the Client (Queensland Health/QH) having ranked the project performance attributes in a way that mismatches the ideal ranking in Table 2.1 (as shown in Table 3.2 and Boxes 3.2-3.9).

In brief, QAO consider the Client selected its preferred procurement delivery model: Managing Contractor with a guaranteed construction sum, ahead of the business case and not in accordance with the government’s value for money/project assurance framework, because of QH’s decision to focus on achieving project timeframes within budget (QAO, 2014: 28).

**Table 3.2: Client’s ranking of project performance attributes in GCUH**

Project performance attributes	Ideal Client’s ranking	Assumed Actual Client’s ranking in GCUH
<b>SET A.</b> Whole-Life Cost (lowest)	1	<b>3 (see Box 3.1)</b>
<b>SET A.</b> Quality (highest)	1	<b>3 (see Box 3.2)</b>
<b>SET B.</b> Construction Time Compliance (certainty)	2	<b>2 (see Box 3.3)</b>
<b>SET B.</b> Capital Cost Compliance (certainty)	2	<b>2 (see Box 3.4)</b>
<b>SET B.</b> Quality Compliance (certainty)	2	<b>2 (see Box 3.5)</b>
<b>SET C.</b> Time: Construction Start/Finish (quickest)	3	<b>1 (see Box 3.6)</b>
<b>SET C.</b> Capital Cost (lowest regardless of lifecycle cost)	3	<b>1 (see Box 3.7)</b>
<b>SET C.</b> Quality (lowest regardless of lifecycle cost)	3	<b>1 (see Box 3.8)</b>

#### **Box 3.2 Ranking of project performance attributes in GCUH – SET A. Whole-Life Cost: Lowest (Source: QAO, 2014)**

- “The financial and economic analysis in the business case was not based on the full expected life of the new hospital, as the analysis only extends to 2015-2016”. (p.48)
- “The financial and economic assessment contained in the GCUH (and LCUH) business cases did not provide sufficient justification for the expected capital and operating cost of the new hospitals.” (p.28)

### **Box 3.3 Ranking of project performance attributes in GCUH – SET A. Quality: Highest (Source: QAO, 2014)**

- “The GCUH business case defined project objectives across areas...No benefits or key performance indicators are assigned to these objectives to measure baseline data and benefits delivered by the project.” (p.49)
- “None of the three projects could demonstrate that realisation of benefits was a significant driver in project delivery” (p.4)
- “None of the business cases included explicit measures of project success from the users’ perspectives – neither public nor clinicians.” (p.27)

### **Box 3.4 Ranking of project performance attributes in GCUH – SET B. Time Compliance: Certainty (Source: QAO, 2014)**

- “The business cases do not comply with the government’s project assurance framework because they do not: define the criteria to measure project success beyond delivering the projects on time and budget...” (p.21)

### **Box 3.5 Ranking of project performance attributes in GCUH – SET B. Cost Compliance: Certainty (Source: QAO, 2014)**

- “The business cases do not comply with the government’s project assurance framework because they do not: define the criteria to measure project success beyond delivering the projects on time and budget...” (p.21)

### **Box 3.6 Ranking of project performance attributes in GCUH – SET B. Quality Compliance: Certainty**

- Quality compliance enhanced by on-site location of Client’s representative (QLD Project Services).

### **Box 3.7 Ranking of project performance attributes in GCUH – SET C. Time Construction: Quickest start/finish (Source: QAO, 2014)**

- “The decision to build the new hospitals before QH had completed the health service plans, before a preliminary evaluation of options and before business cases were developed, put the whole planning process for these infrastructure projects out of step with the Project Assurance Framework (the Queensland Government’s policy for projects over \$100 million” (p.3)
- “As the planning process was out of sequence, and the solutions announced before options had been evaluated and analysed, QH was constrained to specific projects scopes and timeframes for delivery; and/or to specific sites.” (p.4)
- “QH did not assess the Gold Coast University Hospital...against the government’s value for money framework because of the risk of delaying completion...” (p.21)
- “The business cases do not comply with the government’s project assurance framework because they do not: define the criteria to measure project success beyond delivering the projects on time and budget...” (p.21)
- “A single project option...was submitted to government in August 2006. Procurement delivery options were not assessed.” (p.23)
- “When health service planning is left too late, interim solutions are needed to address immediate health service needs while new infrastructure is built.” (p.25)
- “QH’s submission to government in August 2006 contained a single option for the project, driven by QH managing the risk of not delivering the project according to the government’s time frames.” (p.27)
- “in the GCUH project, QH was concerned that the time required to prepare a business case under the VFM framework would put project time frames at risk.” (p.28)
- “QH did not detail the expected additional time required to prepare and deliver the GCUH (and LCCH) projects under a PPP option, nor did it complete an options analysis to assess the merits of a traditional delivery method against delivery as a PPP project.” (p.28)
- “QH did not assess the option of extending the time frame of the Gold Coast interim demand management strategy to consider alternative procurement models. This would have enabled more detailed planning and analysis to test if an alternative outcome could deliver a least cost solution, or greater service capacity for similar overall cost.” (p.28)

### **Box 3.8 Ranking of project performance attributes in GCUH – SET C. Capital Cost: Lowest regardless of lifecycle cost**

- Improvements associated with whole-life costs associated with bundling DC with O and/or M seemingly not sought and therefore minimum capital costs associated with meeting only Client’s requirements likely.

### **Box 3.9 Ranking of project performance attributes in GCUH – SET C. Quality: Lowest regardless of lifecycle cost**

- Quality improvements associated with bundling DC with O and/or M seemingly not sought and therefore minimum improvements to quality – beyond meeting only Client’s requirements likely.

### 3.2.2 Scope, timeline and budget of project procured

An overview of the scope of the project to be procured is given in Box 3.10.

#### **Box 3.10 Scope of project to be procured**

A new tertiary hospital. The largest public health infrastructure project undertaken in Queensland (at the time) and the first hospital in Australia to have 80% single patient bedrooms. A world-class clinical teaching and research facility hospital with 750 beds. Buildings with a floor space around 175m<sup>2</sup> (excluding car parks) comprising Clinical Services Building (9 storey topped with helicopter landing site on top); In-Patient Units (West and South buildings); Mental Health Building; Central Energy Plant; Engineering Workshops; Design to achieve a 4 Star Green Star rating. Located on a 20-hectare greenfield site. Car parking to suit requirements of the hospital.

A timeline of key procurement related events and budget is shown in Box 3.11.

#### **Box 3.11 Timeline and budget of project to be procured (Source: Based on QAO, 2014)**

- August 2006: The incumbent government announced a pre-election commitment to develop a new Gold Coast tertiary 750-bed hospital by end of 2012 and approved an indicative budget of \$1.230 billion.
- September 2006: The incumbent government returned for fourth consequent term in office.
- 1<sup>st</sup> Quarter 2007: General registration of interest by contractors.
- April 2007: Expressions of Interest by contractors for both the Building Consultant and Managing Contractor. The successful contractor performs the role of the Building Consultant in the first schematic stage of the Managing Contractor model that involves working with the other members of the project team and includes developing the terms for tendering and appointment of the Managing Contractor. The subsequent winning Managing Contractor continues to work with the other members of the project team in the procurement model's second stage to develop the design stage and Managing Contractor proposal including timeline, trade packages and guaranteed construction sum. Assuming the Client is satisfied with the outcomes of the second stage, the Managing Contractor continues into the third and final stage including appointing designers, developing full project documentation, and completing construction.
- 2008: Health Services Plan updated.
- September 2008: Business Case completed.
- November 2008: Business Case approved including schematic, budget \$1.549 billion for completion December 2012.
- December 2008: Construction commenced.
- January-July 2013: Construction completed in stages.
- September 2013: Opened to public and then officially opened.
- October 2013: Officially opened at cost of \$1.762 billion.

### 3.2.3 Actual procurement

At the time of the procurement decision, QH had mostly delivered hospital projects using the Managing Contractor model. In this model, the Managing Contractor engages consultants and subcontractors to deliver the works and is responsible for managing the design, documentation and construction of the project; and is also responsible for delivering the project on time and within the agreed guaranteed construction sum (QAO, 2014).

The reputed advantages of the Managing Contractor model include:

- An underdeveloped Client brief that can benefit from early contractor involvement, and
- Early start to construction and subsequent overlapping design and construction to deliver an earlier end of completion and earlier opening date.

Additionally, the Managing Contractor model can be augmented in several ways. For example, its speed of delivery can be increased by awarding early works contract/s that is separate, at least initially, to the Managing Contractor appointment and work. Also, certainty concerning the budget can be obtained via a guaranteed construction sum. Both these augmentations were used in GCUH. A separate early works contract was let. This early works contract included demolition works and bulk earthworks that was later added into the Managing Contractor's contract. The guaranteed construction sum was established at the end of stage 2 in the Managing Contractor model.

The Managing Contractor model designed and selected by the Client suited very well the ranking of project performance attributes in Table 3.2 in which minimum time to end of construction/opening date and capital cost certainty feature strongly as priorities. As shown in Tables 3.2 and Boxes 3.2-3.9, these Client's procurement priorities revolve around SET C project performance attributes and SET B project performance attributes, and ahead of SET A project performance attributes. The assumed ranking by the Client of project performance attributes mismatches the ideal ranking of project performance attributes in Table 2.1. We should anticipate the Tool's recommended procurement strategy to lean towards mismatching, rather than matching the actual procurement approach, when applying the Tool in review mode (i.e., Application Mode #3B).

The Tool's recommended procurement strategy for GCUH did substantially mismatch the actual procurement. This outcome is validated and shows the potential of the Tool to add significant value in the delivery of major projects.

The outcome from applying the Tool (Steps 1 to 5) on GCUH is presented in Section 4.

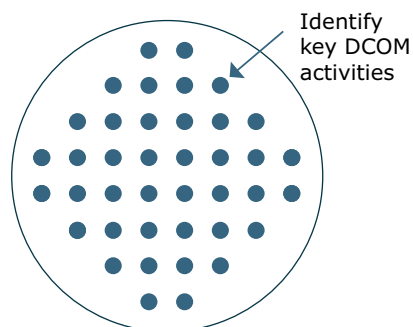
# Procedures and Examples

## 4.1 Step 1. Activity Analysis

### 4.1.1 Summary

As mentioned in Section 2.3.1, key DCOM activities comprise distinct knowledge and skill including the inherent management and supervision of the physical output of the activity that is sold as a good or service. These technologically bounded activities approximate to the highest level of specialised good or service offered by market firms.

In summary, the output from Step 1 is a short-list of DCOM activities, as depicted in Figure 4.1.



**Figure 4.1: Step 1. Short-List of DCOM Activities**

### 4.1.2 Input

The information required for Step 1 comprises the project details used (when applying the Tool in review mode) or proposed to be used (when applying the Tool in current or preview mode) to seek EoI or to assess qualification of interested bidders.

As a minimum, this is likely to include but not limited to:

1. Project's functional requirements and objectives
2. Schematic or reference design
3. Outline specification
4. Timeline to EoI or qualification, and
5. Budget.

As mentioned in Section 2.1, the efficient design level prior to signing contract/s (including substantial construction works) would have progressed right up to but, ideally, not a single detail further than what is needed to represent a robust design that is unlikely to change, and which clearly imparts the Client's requirements. As the efficient design level depends on the Client's circumstances, it could be that the project details associated with EoI or qualification are substantially more than the minimum details listed above.

### 4.1.3 Procedure

The procedure for Step 1 is as follows:

1. Divide the project into discrete parts. For a road project, discrete parts may comprise different sections of carriageways and/or different structures like tunnels, bridges, crossing/intersections/junctions, overpasses, underpasses, and viaducts. For a building project, discrete parts may comprise separate buildings, carparks, earth works and external works.
2. Identify DCOM activities in each part of the project. Start with construction and maintenance activities that broadly align with trades and subcontractors and suppliers; then consider design activities that are upstream of the each of the trade/subcontractor/supplier and often delineated by different engineers or consultant designers, then consider operations activities which include those activities where the service provider directly engages the asset to effect the way asset is used by the end users e.g. road agency controlling signaling on a road. Operations activities also include those non-core activities and soft facilities management activities that the Client wants to procure e.g., linen, and janitorial services in hospital. Again, identify of operations activities that align with market firms.
3. Write-up a longlist of DCOM activities in each part of the project. At this stage there is likely to be a lot of repetition of activities across the parts of the project and so this initial list is longer than is needed in this step.
4. Group similar activities across all parts of a road project (except design and construction activities in any tunnels) into a shortlist. In a road project, the trials and piloting of the Tool to date have shown its more accurate to keep design and construction activities in tunnel/s separate (because of their potential to generate high prices and/or costly variations) to create two shortlists i.e., the tunnel activities and the activities in the rest of road. In a building project, keep the individual buildings separate to create an activity shortlist for each separate building and the carparking and earthworks and the external work. Again, experience to date in applying the Tool has shown that high prices and/or costly variations are often contained within the envelope of different buildings. With more applications of the Tool and collective experience of these applications, future versions of the User Guide can document the most appropriate way/s to compartmentalise projects to make the preliminary bundling in Step 1 more accurate and to avoid using time and resources in Step 3 in dividing and refining the initial grouping of activities.

### 4.1.4 Examples of output

#### 4.1.4.1 TSRC

This project was divided into the following parts to develop the longlist of DCOM activities:

- Interchanges
- Overpasses
- Underpasses
- Viaduct
- Carriage ways, and
- Tunnel (although this was not built, it formed part of the EoI documents and would have contributed to the number of consortia expressing an interests and because EoI is part of the validation procedure when applying the Tool in review mode, the tunnel is included in this review application of the Tool).

Having identified DCOM activities in each of the above parts of the project and having written-up the Longlist of activities, the similar activities across all parts of the project were grouped to create a shortlist of 72 activities as listed in Tables 4.1 to 4.4.



**Table 4.1: Shortlist of *design* activities in TSRC**

Road (Interchanges, Overpasses, Underpasses, Carriage ways, Bridges)	Driven Tunnel
<p><b>Design of construction of road</b></p> <ol style="list-style-type: none"> <li>1. Geometric design</li> <li>2. Road design</li> <li>3. Pavement design</li> <li>4. Landscaping design</li> <li>5. Road lighting design</li> <li>6. Bridge and retaining wall design</li> <li>7. Noise mitigation design</li> <li>8. Drainage design</li> </ol> <p><b>Design of performance specification of maintenance to road</b></p> <ol style="list-style-type: none"> <li>9. Plan for routine maintenance, programmed maintenance and rehabilitation of road pavement, road furniture, drainage maintenance &amp; ITS</li> </ol>	<p><b>Design of construction of tunnel</b></p> <ol style="list-style-type: none"> <li>10. Space proofing</li> <li>11. Geometric design</li> <li>12. Structural design</li> <li>13. Mechanical/Ventilation design</li> <li>14. Electrical design</li> <li>15. Drainage design</li> <li>16. Rock mechanics/structural design</li> </ol> <p><b>Design of performance specification of maintenance to tunnel</b></p> <ol style="list-style-type: none"> <li>17. Plan for routine and programmed maintenance to specialist linings, mechanical and electrical and fire elements in driven tunnel</li> </ol>

**Table 4.2: Shortlist of *construction* activities in TSRC**

Road (Interchanges, Overpasses, Underpasses, Carriage Ways, Bridges)	Driven Tunnel
<ol style="list-style-type: none"> <li>18. Site preparation</li> <li>19. Drainage</li> <li>20. Earthworks</li> <li>21. Paving (base and sub-base)</li> <li>22. Asphalt surface</li> <li>23. Lining and marking</li> <li>24. Lighting</li> <li>25. Traffic signs and furniture</li> <li>26. Guardrail</li> <li>27. Landscaping</li> <li>28. Concrete barrier</li> <li>29. Kerbs and traffic islands</li> <li>30. Traffic management</li> <li>31. Bridge works including piling</li> <li>32. Retaining walls</li> </ol>	<ol style="list-style-type: none"> <li>33. Excavation</li> <li>34. Roof support</li> <li>35. In situ concrete works</li> <li>36. Formwork</li> <li>37. Reinforcement</li> <li>38. Drainage</li> <li>39. Mechanical fit-out</li> <li>40. Electrical fit-out</li> <li>41. Pavement</li> </ol>

**Table 4.3: Shortlist of *operations* activities in TSRC**

Road (Interchanges, Overpasses, Underpasses, Carriage Ways, Bridges) and Driven Tunnel	
<ol style="list-style-type: none"> <li>42. Intelligent Transport Systems</li> <li>43. Traffic operations</li> </ol>	<ol style="list-style-type: none"> <li>44. Incident response services</li> </ol>

**Table 4.4: Shortlist of *maintenance* activities in TSRC**

Road (Interchanges, Overpasses, Underpasses, Carriage Ways, Bridges) and Driven Tunnel	
<b>Inspections and data collection</b>	<b>Implementation of routine, programmed and reactive (emergency) maintenance</b>
45. Drainage	59. Drainage
46. Paving (base and sub-base)	60. Paving (base and sub-base)
47. Asphalt surface	61. Asphalt surface
48. Lining and marking	62. Lining and marking
49. Lighting	63. Lighting
50. Traffic signs and furniture	64. Traffic signs and furniture
51. Guardrail	65. Guardrail
52. Landscaping	66. Landscaping
53. Concrete barrier	67. Concrete barrier
54. Kerbs and traffic islands	68. Kerbs and traffic islands
55. Traffic management	69. Traffic management
56. Bridge works including piling	70. Bridge works including piling
57. Retaining walls	71. Retaining walls
58. Tunnel M&E systems	72. Tunnel M&E systems

#### 4.1.4.2 GCUH

This project was divided into the following eight parts to develop the longlist of DCOM activities:

1. Engineering Workshops
2. Central Energy Plant building
3. Mental Health building
4. Pathology and Education building
5. Clinical Services and IPU (West and South) building
6. Carpark (West)
7. Initial Works, and
8. External works.

The Australian Cost Management Manual (ACMM) – Volume 1 (2000) and Volume 2 (2001) was used to help identify activities in the following building elements in each of the above parts of the project:

- Substructure
- Superstructure (columns; upper floors; staircases; roof; external walls; windows; external doors; internal walls; internal screens & borrowed lights; internal doors)
- Finishes (wall finishes; floor finishes; ceiling finishes)
- Furniture; fittings/fixings and equipment
- Services (sanitary fixtures; sanitary plumbing; water supply; gas service; space heating; ventilation; evaporative cooling; air conditioning; fire protection; electric, light and power, communications, transportation systems; special services)
- Centralised energy systems
- Site works (site preparation; roads, footpaths and paved areas, boundary walls, fencing, gates, outbuildings and covered ways; landscaping)
- External Services (stormwater draining; sewer drainage; water supply; external gas; fire protection; electric light and power; communications; special services), and

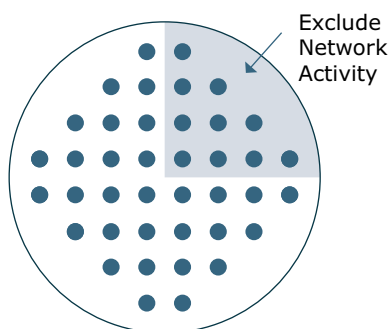
Having identified DCOM activities in the above building elements within each of the above eight parts of the project and having written-up the longlist of activities in each of the above eight parts of the project, the similar activities within each of the eight parts of the project were initially grouped to create shortlists of activities. In total, there were 614 DCOM activities across the shortlists of activities listed in Tables A-1 to A-31 in Appendix A.

## 4.2 Step 2. Project Specific-or-Network Analysis

### 4.2.1 Summary

As mentioned in Section 2.3.2, Project Specific Activities generated by the new project are either one-off activities or recurrent activities. These new one-off activities or new recurrent activities are appreciably different to any existing recurrent activities in a current network operated by the Client and these new activities create the potential to deliver efficiency gains through economies of scope. In contrast, new Network Activities generated by new project are new recurrent activities that are like existing recurrent activities in a current network operated by the Client. This time, these new recurrent activities create the potential to deliver efficiency gains through economies of scale when they are procured with similar existing recurrent activities in a current network operated by the Client.

In summary, the output from Step 2 is each shortlist divided into Project Specific Activities and Network Activities. Network activities are then excluded from subsequent analysis in the Tool, as depicted in Figure 4.2.



**Figure 4.2: Step 2. Project Specific Activities and Network Activities**

### 4.2.2 Input

The output from Step 1 i.e., Shortlist/s of DCOM activities provides part of the information required for Step 2.

Further information is required of any recurrent work in an existing network operated by the Client that includes any of the operations and maintenance activities identified in any of the shortlist/s from Step 1. This information is to include the volume of the recurrent work in the existing network along with staff and other internal resources used to deliver all or part of this recurrent work and number and value of external contracts used to deliver all or part of this recurrent work.

An existing network may cover a wide geographical area e.g., in the case of power generation, transmission, and distribution, or it may occupy a small area in the case of a portfolio of buildings or campuses that while spatially dispersed are operated by the same Client and akin to a nodal network.

## 4.2.3 Procedure

The procedure for Step 2 is as follows:

1. Identify which of the shortlist/s are Network Activities, by using the following definition of a Network Activity, or:
  - a. Design or implementation of operations and/or maintenance activities i.e., recurrent work, likely to occur on at least one occasion each year for three years or more (and so excludes rehabilitation in roads and major refurbishment works in buildings because rehabilitation and major refurbishment are unlikely to occur each year), and
  - b. Similar to operations and/or maintenance activities in an existing network that is also recurrent, likely to occur on at least one occasion each year for three years or more.
2. Identify which of the shortlist/s are Project Specific Activities by virtue of not meeting the definition for a Network Activity.
3. Divide each shortlist into Project Specific Activities and Network Activities.
4. Exclude Network Activities, which are to be procured by the Client as part of their existing network Therefore, the Tool is silent about Network Activities from and including the next Step 3.
5. Proceed in the next Step 3 to analyse only the Project Specific Activities.

## 4.2.4 Examples of output

### 4.2.4.1 TSRC

The activity of designing/planning for maintenance of the road and the tunnel (Activities 9 and 17, Table 4.1) and each of the operations and maintenance activities in Tables 4.3 and 4.4 were considered to meet the definition for Network Activity. Therefore, the design and construction of the road (Activities 1-8 and 18-32, in Table 4.1 and Table 4.2) and the design and construction of the tunnel (Activities 10-16 and 33-41 in Table 4.1 and Table 4.2) were deemed Project-Specific Activities, mainly because of their 'one-off' requirement and their unique geographical location. This is summarised in Table 4.5.

**Table 4.5: Project Specific Activities and Network Activities in TSRC**

Project Specific Activities (to be analysed in Steps 3-5)	Network Activities (to be excluded from subsequent analysis in Steps 3-5)
<ul style="list-style-type: none"><li>• Design of road</li><li>• Design of tunnel</li><li>• Construction of road</li><li>• Construction of tunnel</li></ul>	<ul style="list-style-type: none"><li>• Design of maintenance to road and tunnel</li><li>• Operations</li><li>• Maintenance</li></ul>

### 4.2.4.2 GCUH

The activity of designing/planning for maintenance of the buildings, car park and external works and mostly all operations activities (or "Soft" Facility Management/FM e.g., cleaning) were considered to meet the definition for Network Activity. Therefore, design and construction of the buildings, car park and external works, some "Soft" FM and all maintenance (or "Hard" FM) activities were deemed Project Specific Activity.

Design and construction activities did not meet the definition for Network Activity because of their one-off/non-recurring nature. Some "Soft" FM while recurrent, did not meet the definition for Network Activity because of their immediacy and site specificity. Maintenance activities while recurrent, again did not meet the definition for Network Activity because they are different to maintenance activities in other hospitals operated by the Client. The differences in maintenance largely arise because of the time needed for maintenance operatives to achieve full output because of the accumulated knowledge (incorporating a significant component of tacit knowledge) required to efficiently implement maintenance in different physical and logistical conditions across the various unique hospital facilities. This is summarised in Table 4.6.

**Table 4.6: Project Specific Activities and Network Activities in GCUH**

Project Specific Activities (to be analysed in Steps 3-5)	Network Activities (to be excluded from subsequent analysis in Steps 3-5)
<ul style="list-style-type: none"> <li>• Design of construction</li> <li>• Design of maintenance</li> <li>• Construction</li> <li>• Operations ("Soft" FM) i.e., <i>ad hoc</i>/immediate response "Soft" FM and Routine Building Services Control ("Hard" FM)</li> <li>• Maintenance ("Hard" FM) of building fabric and carpark fabric and building services and initial works and external works</li> </ul>	<ul style="list-style-type: none"> <li>• Operations ("Soft" FM) – including Routine (day-to-day) Cleaning and Catering Services and Pest Control and Waste Management and Carparking Services</li> </ul>

### 4.3 Step 3. Risk (Make-or-Buy) Analysis

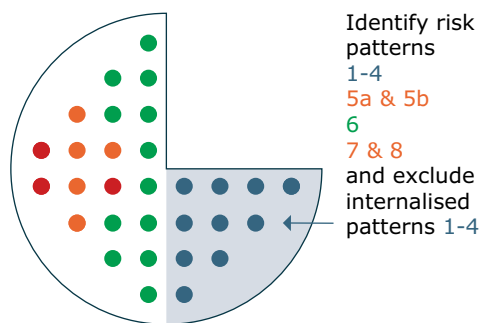
#### 4.3.1 Summary

The output from Step 3 comprises the identification of Project Specific activities that are more efficiently internalised (Risk Patterns 1 to 4) and Project Specific activities that are more efficiently externalised (Risk Patterns 5 to 8). Project Specific activities that are more efficiently internalised (Risk Patterns 1 to 4) are excluded from subsequent analysis in the Tool.

Four out of the five Risk Patterns associated with the Project Specific activities that are more efficiently externalised, reflect microeconomic risks that could lead to a lack of competition and high to very high prices (Risk Patterns 7 and 8) or high switching costs, which could lead to hold-up and costly variations (Risk Patterns 5a and 5b). These risks need to be treated (in the next two steps of the Tool) to avoid high prices and to avoid costly variations.

With regards to the remaining Risk Pattern 6, this is associated with externalised Project Specific activities that carry a low risk of high prices and costly variations. Low-Risk Pattern 6 activities do not require any treatment and can be bundled and efficiently transferred to suppliers using standard contracting terms.

The nine Risk Patterns were shown in Table 2.3 and the output from Step 3 is depicted in depicted in Figure 4.3.



**Figure 4.3: Step 3. Internalised and Externalised Risk Patterns**

### 4.3.2 Input

The output from Step 2 i.e., shortlist/s of Project Specific Activities provides part of the information required for Step 3.

Further information concerning the potential for High Prices and the potential for Costly Variations is required to help users answer the questions in Step 3. These answers will lead to the assignment of one of the nine Risk Patterns to each of Project Specific Activities.

With regards to helping surface the potential for High Prices, market structures reflect the likely level of price competition associated with each of the Project Specific activities, which tend towards perfect competition with a high level of price competition (Risk Patterns 5a; 5b and 6) though oligopoly to monopoly, with much less price competition (Risk Patterns 7 and 8). Hence, details concerning the market structure will help improve the accuracy of the answers in response to the questions concerning high prices.

These details include numbers of firms and any unique points of differentiation between these firms – in terms of the good and/or service they deliver. Given the context of the Tool is major projects, these details cover both domestic and international firms of independent specialised consultants, subcontractors, and suppliers, who are thought to be likely to be interested to deliver each of the Project Specific activities, along with market structures of multidisciplinary consultants and main contractors, who again are thought to be likely to be interested to deliver and manage the Project Specific activities.<sup>6</sup>

In terms of helping to improve the accuracy of the answers in response to the questions concerning Costly Variations, a useful point of reference becomes the Client's ranking of the project performance attributes and accompanying justification statement and associated EoI timeline (as per Section 2.1). Answers provided in response to the questions on unpredictability (associated with costly variations) should be consistent with the Client's ranking of the project performance attributes and accompanying justification statement and associated EoI timeline.

A risk assessment, or Risk Register, will also help to improve the accuracy of the answers in response to the questions concerning unpredictability (associated with costly variations). The Risk Register will focus on technical and logistical risks and its level of detail should reflect the level of design which, in turn, should represent the Optimal Design Level for the Client to complete prior to signing contract/s (including substantial construction works). As mentioned in Section 2.1, Optimal Design Level establishes a design that is sufficiently robust such that it is unlikely to change and clearly imparts the Client's requirements. The Optimal Design Level will depend on the Client's circumstances. Hence, the Optimal Design Level may range from schematic design to near full working drawings – though not reaching full working drawings. The important point is that the design progresses right up to but, ideally, not a single detail further than what is required to achieve the Optimal Design Level. The more complete the Optimal Design Level, the more detailed the Risk Register. Even with a functional specification and schematic, however, the number of items in the Risk Register could still be in the order of 500 to 1,000 risks vis-à-vis major projects.

Before using the Risk Register as part of the input, each of the risk items are reviewed in conjunction with the Client's ranking of the project performance attributes and accompanying justification statement and associated EoI timeline (as per Section 2.1) to delete those risk items that are anticipated as being resolved prior to signing contract/s (including substantial construction works). The residual risk items in the Risk Register are anticipated as remaining active when signing contract/s (including substantial construction works). These residual risk items in the Risk Register are then assigned to one or more of the externalised Project Specific activities.

---

<sup>6</sup> Bridge (2008) provides an explanation and examples of the way to construct and describe a market structure for construction and maintenance activities.

### 4.3.3 Procedure

The procedure for Step 3 is as follows:

1. Apply questions in Box 4.1 and Box 4.2 to all Project Specific activities in all parts of the project. There are up to 14 questions applicable to a Project Specific activity. However, Question HP2b and Question HP3 are likely applicable to a very small proportion of the Project Specific activities and so 12 questions are likely applicable to a very large proportion of the Project Specific activities.

#### Box 4.1 Questions on High Prices (HP)

**Dimension 1. Complementarity:** The questions in this dimension mainly contribute to capturing the relative efficiency of internalisation versus externalisation.

- **Question HP1a.** Did the Client have the in-house *capability* (*breadth* of knowledge and skills, amongst permanent/ongoing staff, *excluding* temporary/casual staff, as well as other resources) to deliver the management and implementation of the activity across the entire project?
- **Question HP1b.** Did the Client have the in-house *capacity* (*depth* of knowledge and skills amongst permanent/ongoing staff, *excluding* temporary/casual staff, as well as other resources) to deliver the management and implementation activity across the entire project?
- **Question HP1c.** If the answer to Question HP1a is "No", then did, or could, the Client have the in-house *capability* (*breadth* of knowledge and skills, amongst permanent/ongoing staff, *including* up to 20% additional staff employed on a temporary/casual basis, as well as other resources) to deliver the management and implementation of the activity across the entire project?
- **Question HP1d.** If the answer to Question HP1b is "No", then did, or could, the Client have the in-house *capacity* (*depth* of knowledge and skills amongst permanent/ongoing staff, *including* up to 20% additional staff employed on a temporary/casual basis, as well as other resources) to deliver the management and implementation activity across the entire project?

**Dimension 2. Rarity:** The questions in this dimension mainly contribute to capturing the likelihood of High Prices.

- **Question HP2a.** How much was there likely to be a sufficient supply (5 or more market firms) capable of delivering the activity across the entire project *and* likely to have the capacity and interest to express an interest/apply for qualification to deliver the activity (when the activity is part of the typical size and type of contract that these market firms are thought to prefer)?
- **Question HP2b.** If the answer is "Yes" to any of the three geographical tiers, then was there anything about the project that would likely have given a significant competitive advantage to any of those market firms – *vis-à-vis* the activity and which would have effectively reduced your choice of supply of the activity to 4 or less market firms?

**Dimension 3. Costly to Imitate:** The questions in this dimension mainly contribute to capturing the likelihood of High Prices.

- **Question HP3.** If the answer is "Yes" to one or more of the geographical tiers in HPQ2a i.e., across one or more of the geographical tiers there are 5 firms or more and this number *is* reduced to 4 or less firms because of a "Yes" answer to any of the geographical tiers in HPQ2b, then how difficult would it have been for other rival market firms to develop and match this competitive advantage – within the project's timeline to increase the supply to 5 or more firms?

## Box 4.1 Questions on Costly Variations (CV)

**Dimension 1. Sunk Costs and/or Timely Delivery:** The questions in this dimension mainly contribute to capturing the likelihood of Costly Variations. Question CV1a concerns sunk costs that can drive switching costs and which can be a key part of driving Costly Variations. Question CV1b concerns the time-critical nature of delivery that can also drive switching costs and which can also be a key part of driving Costly Variations.

- **Question CV1a.** How much would a Supplier of the activity i.e., firm specialising in either the design, construction, operations or maintenance of the activity, upon award of a contract to deliver the activity – as part of the typical size and type of contract that these market firms are thought to prefer, need to customise its existing knowledge and/or skills and/or other internal resources to deliver the entire activity within project?
- **Question CV1b.** At the start of the activity was there any flexibility to extend the period initially allowed for the activity in the project?

**Dimension 2. Unpredictability:** The questions in this dimension mainly contribute to capturing the likelihood of Costly Variations.

- **Question CV2a.** Is the Client's requirements (scope and/or specification) likely to change and materially disrupt the scope of work and/or the supplier's planned method of delivery?
- **Question CV2b.** Are third parties, whose involvement is expected at the start of the activity, likely to change and materially disrupt the scope of work and/or the supplier's planned method of delivery?
- **Question CV2c.** Are environment changes likely to change and materially disrupt the scope of work and/or the supplier's planned method of delivery?

**Dimension 3. Frequency:** These questions in this dimension mainly contribute to capturing the relative efficiency of internalisation versus externalisation i.e., the potential for the Client to generate a level of *sufficient* and *continuous* demand for the activity – *relative to* the workload for the activity that individual leading market firms can generate by aggregating demand from many clients. Question CV3a captures the potential for the Client to efficiently internalise the activity based on achieving similar *economies of scale* as individual leading market firms. Question CV3b captures the potential for the Client's demand for the activity to be undermined by an intermittent flow of the activity that would reduce *learning curve economies* and which may create additional costs to allow flexibility e.g., use of agency staff to smooth out fluctuations in demand and/or additional external transactions costs associated with a hire-and-fire approach to staff.

- **Question CV3a.** What was the total amount and value of work for the activity across all the Client's projects and any network being designed or being constructed or being operated or being maintained by the Client *relative to* the scale and turnover of the activity being designed or being constructed or being operated or being maintained by leading national or international market firms specialising in the activity?
- **Question CV3b.** How confident would the Client have been in forecasting, beyond the focal Quarter in Question CV3a, a continuous flow of the total amount and value of work for the activity in Question CV3b?

2. Change the tense of the questions – as required. The Questions in Box 4.1 and Box 4.2 is given in past tense because the Tool is applied in review mode. The tense needs to be changed to present tense for current mode and future tense for preview mode. In terms of preview mode, the period that the question concerns the time until the end of the delivery of the focal activity.
3. Adapt and customise the questions – if necessary, to suit the characteristics and context of the project and the way (or mode) by which the Tool is being applied. However, take extreme care when making any changes to the questions, to ensure the microeconomic integrity of each question is maintained.



4. Start with the questions concerning High Prices and move onto the questions concerning Costly Variations. Apply one question at a time to all Project Specific activities in one part of the project of the project. For example, in a road this may be the Project Specific activities in the shortlist of activities in a tunnel or the Project Specific activities in the shortlist of activities in the rest of road sections; and in building project this may be the Project Specific activities in the shortlist of activities in a separate building. Then move onto the next question and apply this to all project specific activities in another part of the project and so on, until the focal question has been applied to all project specific activities in all parts of the project. Then, move onto next question and so on, until all the questions have been applied to all Project Specific activities in all parts of the project. This approach is the most reliable and quickest way to obtain answers to all the questions because it is the least cognitively demanding approach i.e., holding the focal question and the context of the focal part in-mind while changing only the Project Specific activity to provide the answer, requires the least adjustments to the memory of the person answering the question.
5. Apply all questions and obtain all answers in a group setting amongst at least 2 people, in which one or more people ask the question (and record answers) and one or more people answer the question verbally. This helps the person/s answering the questions maintain their focus on the question and the context of the focal part of the project and the focal Project Specific activity. Also, to help the person/s answering the questions maintain their focus incorporate plenty of breaks in this process of collecting the answers to the questions.
6. Assess the level (i.e., High or Low) of the three columns (or dimensions) of High Prices and the three dimensions of Costly Variations by using the answer/response format (mostly "Yes" or "No") to each question.
  - a. Questions on the three dimensions of **High Prices (HP)**
    - Dimension 1. Complementarity:
      - **Question HP1a.** Did the Client have the in-house *capability* (*breadth* of knowledge and skills, amongst permanent/ongoing staff, *excluding* temporary/casual staff, as well as other resources) to deliver the management and implementation of the activity across the entire project?
        - Answer:
          - "Yes (Capable)" or
          - "No (Not Capable)
      - **Question HP1b.** Did the Client have the in-house *capacity* (*depth* of knowledge and skills amongst permanent/ongoing staff, *excluding* temporary/casual staff, as well as other resources) to deliver the management and implementation activity across the entire project?
        - Answer:
          - "Yes (Capacity)" or
          - "No (No Capacity)
      - **Question HP1c.** If the answer to Question HP1a is "No", then did, or could, the Client have the in-house *capability* (*breadth* of knowledge and skills, amongst permanent/ongoing staff, *including* up to 20% additional staff employed on a temporary/casual basis, as well as other resources) to deliver the management and implementation of the activity across the entire project?
        - Answer:
          - "Yes (Capable)" or
          - "No (Not Capable)

- **Question HP1d.** If the answer to Question HP1b is “No”, then did, or could, the Client have the in-house *capacity* (*depth* of knowledge and skills amongst permanent/ongoing staff, *including* up to 20% additional staff employed on a temporary/casual basis, as well as other resources) to deliver the management and implementation activity across the entire project?
  - Answer:
    - “Yes (Capacity)” or
    - “No (No Capacity)”
- **Assessment**
  - *High* = “Yes” to Q1a and “Yes” to HPQ1b
  - *Moderate* = “Yes” to HPQ1c and “Yes” to HPQ1d
  - *Low* = “No” to either HPQ1a, HPQ1b, HPQ1c or HPQ1d

- Dimension 2. **Rarity**

- **Question HP2a.** How much was there likely to be a sufficient supply (5 or more market firms) capable of delivering the activity across the entire project *and* likely to have the capacity and interest to express an interest/apply for qualification to deliver the activity (when the activity is part of the typical size and type of contract that these market firms are thought to prefer)?

The User of the Tool selects the geographical tier/s i.e., local and/or national and/or international that the Client’s chooses to apply to the project.

- Answer:
  - “Yes (Sufficient/5 or more - locally)” or “No (Insufficient/4 or less)”
  - “Yes (Sufficient/5 or more - nationally)” or “No (Insufficient/4 or less)”
  - “Yes (Sufficient/5 or more - internationally)” or “No (Insufficient/4 or less)”
- **Question HP2b.** If the answer is “Yes” to any of the three geographical tiers, then was there anything about the project that would likely have given a significant competitive advantage to any of those market firms – *vis-à-vis* the activity and which would have effectively reduced your choice of supply of the activity to 4 or less market firms?
  - Answer:
    - “Yes (Reduced Supply/4 or less - locally)” or “No (Reduced Supply/4 or less - locally)”
    - “Yes (Reduced Supply /4 or less - nationally)” or “No (Reduced Supply/4 or less - nationally)”
    - “Yes (Reduced Supply/4 or less - internationally)” or “No (Reduced Supply/4 or less - internationally)”
- **Assessment**
  - *High* = “No” to each of the geographical tiers in HPQ2a
  - *Low* = “Yes” to one or more of the geographical tiers in HPQ2a i.e., across one or more of the geographical tiers there are 5 firms or more and this number is not reduced to 4 or less firms because of a “Yes” answer to any of the geographical tiers in HPQ2b

- Dimension 3. **Costly to Imitate**

- **Question HP3.** If the answer is "Yes" to one or more of the geographical tiers in Q2a i.e., across one or more of the geographical tiers there are 5 firms or more and this number *is* reduced to 4 or less firms because of a "Yes" answer to any of the geographical tiers in Q2b, then how difficult would it have been for other rival market firms to develop and match this competitive advantage – within the project's timeline to increase the supply to 5 or more firms?

- Answer:
  - "Yes (Difficult)" or
  - "No (Not Difficult)"

- **Assessment**

- *High* = "Yes" to HPQ3
- *Low* = "No" to HPQ3

b. Questions on the three dimensions of **Costly Variations (CV)**

- Dimension 1. **Sunk Costs and/or Timely Delivery**

- **Question CV1a.** How much would a Supplier of the activity i.e., firm specialising in the either the design, construction, operations or maintenance of the activity, upon award of a contract to deliver the activity – as part of the typical size and type of contract that these market firms are thought to prefer, need to customise its existing knowledge and/or skills and/or other internal resources to deliver the entire activity within project?

For example, customisation could involve adaption to standard hardware or software but which the supplier cannot use in other projects with different clients. In other words, this question captures how much unique investment is made by the Client and the Supplier to deliver the activity and, in turn, how much the Client then becomes dependent the Supplier and which can drive costs for Client to switch from the existing Supplier to a new Supplier. These costs comprise disestablishment costs including any damages payable to the existing Supplier because of the contract break and re-establishment costs including re-investment costs associated with the new Supplier and the time taken by the new Supplier to regain the level of productivity achieved by the existing Supplier.

- Answer:
  - "Yes (Significant Customisation i.e.,  $\geq 20\%$  of the Supplier's total time and cost required to deliver the activity)" or
  - "No (Insignificant Customisation i.e.,  $\leq 20\%$  of the Supplier's total time and cost required to deliver the activity)"

- **Question CV1b.** At the start of the activity was there any flexibility to extend the period initially allowed for the activity in the project?

The start of the activity means:

- the start of design in the activity – if it is a design activity; or
- the start of construction/installation in the activity – if it is a construction activity; or
- the start operations in the activity – if it is an operations activity; or
- the start of the maintenance in the activity – if it is a maintenance activity.

- This question captures broader switching costs associated with costs to the Client's core business and/or reputation should the project end-date be delayed.

For example, if design and construction activities are on the critical-path they may have little or no flexibility. If the activity has some float-time (i.e., at least 20% or of the original timeline for the activity), then the answer would be "Some Flexibility".

In some operations and maintenance activities there may be both some flexibility and little or no flexibility e.g., inspections may allow some flexibility but statutory requirements including health and safety requirements may not allow any flexibility. In these cases, the activity would need to be divided into sub-activities based on technical requirements i.e., a sub-activity that requires an urgent response and a sub-activity that allow a non-urgent response, to allow a clear "Yes" or "No" answer on this question. This process of sub-dividing activities is explained below in Procedure #7 in this step.

- Answer:
  - "Yes (Some or A Lot of Flexibility)"
  - "No (Little or No Flexibility)"

- **Assessment**

- *High* = "Yes" to CVQ1a or "Yes" to CVQ1b
- *Low* = "No" to CVQ1a and "No" to CVQ1b

- Dimension 2. **Unpredictability**

- **Question CV2a.** Is the Client's requirements (scope and/or specification) likely to change and materially disrupt the scope of work and/or the supplier's planned method of delivery?

These changes include both client-initiated change and changes arising because of inadequate project documentation and both kinds of client changes could trigger the unexpected involvement of third parties.

- Answer:
  - "Yes (Appreciable Client's Requirements changes and disruption)"
  - "No (Negligible Client's Requirements changes)"

- **Question CV2b.** Are third parties, whose involvement is expected at the start of the activity, likely to change and materially disrupt the scope of work and/or the supplier's planned method of delivery?

- Answer:
  - "Yes (Appreciable Third-Party involvement and disruption)"
  - "No (Negligible Third-Party involvement)"

- **Question CV2c.** Are environment changes likely to change and materially disrupt the scope of work and/or the supplier's planned method of delivery?

- Answer:
  - "Yes (Appreciable environmental changes and disruption)"
  - "No (Negligible environmental changes)"

Environmental changes include factors completely beyond the control of the Client and suppliers, including changes to demand for the Client's good or service being facilitated by the project, changes to technology, changes to health and safety requirements and climate change. Except for an epidemic or pandemic, environment changes are more likely to apply to O&M activities (as opposed to D&C activities) because of the prolonged period of O&M from their commencement at the end of construction/installation to rehabilitation/major refurbishment. For example, the health service plan that incorporated trends in demographics and clinical services requirements and which informed GCUH, was a 10-year planning horizon. As O&M will continue well beyond these kinds of planning horizon, the answer to CV2c in respect of O&M activities could turn to "Yes" at some point in the future delivery of O&M.

If so, O&M activities would again need to be divided into sub-activities to allow a clear "Yes" or "No" answer on this question. This time, sub-dividing the activity is based on time i.e., a sub-activity that reflects the period of years after initial construction/installation that is *unaffected* by environmental changes and a sub-activity that reflects the period of years after initial construction/installation (until rehabilitation or major refurbishment) that is *affected* by environmental changes. As mentioned, this process of sub-dividing activities is explained below in Procedure #7 in this step.

- **Assessment**

- High = "Yes" to CVQ2a or "Yes" to CVQ2b or "Yes" to CVQ2c
- Low = "No" to CVQ2a and "No" to CVQ2b and "No" to CVQ2c

- Dimension #3. **Frequency**

- **Question CV3a.** What was the total amount and value of work for the activity across all the Client's projects and any network being designed or being constructed or being operated or being maintained by the Client *relative* to the scale and turnover of the activity being designed or being constructed or being operated or being maintained by leading national or international market firms specialising in the activity?

The total amount and value of work for the activity in this question is assessed very approximately in the Quarter in which the procurement decision was made and compared with the scale and turnover of the activity by leading national or international market firms in the same Quarter.

The potential for the Client to efficiently internalise the activity is based on achieving *economies of scale* similar or superior to individual leading market firms specialising in the activity. Hence, if the Client's total amount and value of work for the activity falls between one of the tiers of suppliers, then the next highest tier will likely be more efficient in delivering the activity because it has superior economies of scale, and when the lower tiers of market firms are likely not suited to delivering bundles of the activity associated with the Client's total amount and value of work for the activity.

The User of the Tool identifies approximate tiers of market firms delivering the activity. Tiers of firms are identified by partitioning those firms whose pricing decisions are affected by the other firms in the same tier (see reference in Footnote #6).

For example, if there were three tiers of leading market firms:

- Answer:
  - More ( $\geq 20\%$ ); or Same; or Less ( $\leq 20\%$ ) than the largest Tier (1) leading market firms
  - More ( $\geq 20\%$ ); or Same; or Less ( $\leq 20\%$ ) than the mid-Tier (2) leading market firms
  - More ( $\geq 20\%$ ); or Same; or Less ( $\leq 20\%$ ) than the smallest-Tier (3) leading market firms

- Dimension #3. **Frequency**
    - **Question CV3b.** How confident would the Client have been in forecasting, beyond the focal Quarter in Question CV3a, a continuous flow of the total amount and value of work for the activity in Question CV3b?
      - Answer:
        - Confident over 5 years from the focal Quarter; or
        - Confident for 3 to 5 years from the focal Quarter; or
        - Confident 1 to 3 years from the focal Quarter; or
        - Confident 1 to 12 months from the focal Quarter; or
        - Not Confident for any period from the focal Quarter
      - **Assessment**
        - *High* = More ( $\geq 20\%$ ) than the largest Tier and confident over 5 years from the focal Quarter
        - *Moderate* = Same as any tier and confident for over 3 years from the focal Quarter
        - *Low* = Less than Tier 3; More than Tier 3 but less than Tier 2; More than Tier 2 but less than Tier 1 and either not confident or confident for any period from the focal Quarter
7. Ungroup an activity (from the activity's initial grouping in Step 1) – if necessary, and divide this activity into two or more sub-activities.
    - a. Part/s of one or more dimensions of High Prices and/or part of one or more dimensions of Costly Variations activity can be assessed as "High" while the other part/s can be assessed as "Low" when part/s of the activity prompts a "Yes" answer and part of the activity prompts a "No" answer to one or more of the questions (for example, see the cases mentioned above Questions CV1b and CV2c). In which case, the activity is divided into the minimum number of sub-activities to allow each sub-activity to generate only a "Yes" or "No" answer to each of the questions and a "High" or "low" assessment of each of the dimensions of High prices and Costly Variations. This illustrates the procedure of refining the initial activities in Step 1 in terms of subsequently identifying sub-activities in Step 3. However, with the applications of the Tool to date, it's already been found that activities in tunnels are better kept separate from the activities in the rest of the road in Step 1 because of the likelihood of more specialist subcontractors and other suppliers and more unpredictable ground conditions. It has also been found that activities in one building is better kept separate from the activities in other buildings on a campus in Step 1 because of the specificity of the site and the possibility again of different ground conditions that can affect construction method e.g., location of crane/s. Plus, there is the possibility of different operating and maintenance regimes within different buildings. As applications of the Tool increase, then it's expected that the initial grouping of activities in Step 1 will become more precise and require less refinement/sub-division in Step 3.
  8. Assign a Risk Pattern for each Project Specific Activity by using the assessed level (i.e., High, Moderate or Low) of each of the three dimensions of High Prices and each of the three dimensions of Costly Variations for each Project Specific Activity and matching this with the closest Risk Pattern in Table 2.3.
  9. Check the validity of matching the Project Specific Activity with one of the Risk Patterns in Table 2.3, as follows:
    - a. With regards to the theoretical logic underpinning Table 2.3, only one of nine rows/nine Risk Patterns in Table 2.3 should appear as fully ticked/shaded.

- b. In terms of High Prices, compare the market structure surrounding each Project Specific activity assigned to one of the five externalisation Risk Patterns (i.e., Patterns 5a; 5b; 6; 7; and 8) with the expected market structures. These market structures tend towards perfect competition with a high level of price competition (Patterns 5a; 5b and 6), to oligopoly to monopoly with much less price competition (Patterns 7 and 8).
  - c. In relation to Costly Variations (Unpredictability) compare the Client's ranking of the project performance attributes and accompanying justification statement and associated EoI timeline (as per Section 2.1) for consistency with the responses to the questions on Unpredictability. It is expected that where the Client commits to effective planning and accurate documentation, then there should not be a high incidence of Project Specific activities assessed with a high level of Unpredictability, and visa-versa.
  - d. Again, regarding Costly Variations (Unpredictability) compare the Risk Register (comprising technical and logistical risks anticipated as remaining active when signing contract/s including substantial construction works) for consistency with the responses to the questions on Unpredictability. It is expected that a high proportion of the residual risk items on the Risk Register should be associated with High-Risk Pattern 5a and 5b activities.
10. Exclude Project Specific activities that are assigned a Risk Pattern 1 through Risk Pattern 4, as these are more efficiently internalised. Therefore, the Tool is silent about internalised activities from and including the next Step 4.
  11. List the Project Specific activities that are assigned an externalised Risk Patterns. Four of the five externalised Project Specific activities carry microeconomic risks that need to be treated (in the next two steps of the Tool) i.e., Risk Pattern 7 and Risk Pattern 8 activities need to be treated to avoid risks of High Prices and Risk Pattern 5a and Risk Pattern 5b activities need to be treated to avoid risks of Costly Variations. Risks of High Prices and Costly Variations are low in Pattern 6 activities and so Low-Risk Pattern 6 activities do not require any treatment, they can be bundled and efficiently transferred to suppliers using standard contracting terms.
  12. Proceed in the next Step 4 to analyse only the externalised Project Specific activities i.e., Project Specific activities assigned with Risk Patterns 5a; 5b, 6, 7 or 8.

## 4.3.4 Examples of output

### 4.3.4.1 TSRC

The procedure for Step 3 in TSRC was followed and summarised below:

1. The questions in Box 4.1 and Box 4.2 were applied to all Project Specific activities in all parts of TSRC.
2. The tense of the questions in Box 4.1 and Box 4.2 was not changed (as the Tool is applied in review mode) and no adaptations nor customisation was made to the questions.
3. The level (i.e., High or Low) of the three columns (or dimensions) of High Prices and the three dimensions of Costly Variations was assessed by using the answers to the Box 4.1 and Box 4.2 questions.
4. Regarding ungrouping activities (from an activity's initial grouping in Step 1), the design of the road and tunnel was ungrouped (from the activity's initial grouping in Step 1) and divided into two sub-activities i.e., outline design of the road and detailed design of road and outline design of the tunnel and detailed design of the tunnel. The outline design represents the Optimal Design Level for the Client to complete prior to signing contract/s (including substantial construction works) is a design that is sufficiently robust such that it is unlikely to change and clearly imparts the Client's requirements (as explained in Section 2.1). The ungrouping of the activity's initial grouping in Step 1 was needed because part of the initial activity (outline design) was assessed as "High" on the Unpredictability dimension and part of the initial activity (detailed design) was assessed as "Low" on the Unpredictability dimension. Additionally, ungrouping of initial activity grouping in Step 1 was needed because part of the initial activity (outline design of Mechanical and Electrical works in the tunnel) was assessed as "Low" on the Rarity and Costly

to Imitate dimensions and part of the initial activity (detailed design of Mechanical and Electrical works in the tunnel) was assessed as “High” on the Rarity dimension and “Low” on the Costly to Imitate dimension.

5. A Risk Pattern for the Project Specific Activities including the sub-divided activities, was assigned by using the assessed level (i.e., High, Moderate or Low) of each of the three dimensions of High Prices and each of the three dimensions of Costly Variations and was matched with the closest Risk Pattern in Table 2.3. Mostly all the Project Specific Activities in Table 4.1 and Table 4.2 were assigned a Pattern 6. The following Project Specific Activities were assigned a different pattern:
  - a. Outline design of the road and tunnel (assigned a Pattern 5b), and
  - b. Detailed design of Mechanical and Electrical works, in the tunnel, and the construction/ installation of the Mechanical and Electrical works, in the tunnel (assigned a Pattern 7).

An example of one of the Pattern 5b Project Specific activities (i.e., Outline Design of Pavement), along with an example of one of the Pattern 6 Project Specific activities (i.e., Detailed Design of the Pavement) and an example of the one the Pattern 7 Project Specific activities (i.e., Detailed Design of Mechanical works in the tunnel) is shown in Tables 4.7 to 4.9 respectively.

**Table 4.7: Outline design of pavement (Pattern 5b Activity) in TSRC**

Market Structure → High Prices			Switching Costs → Costly Variations			Activity	
Complementarity	Rarity	Costly to Imitate	Sunk Costs and/or Timeliness	Unpredictability	Frequency → Risk Pattern	→	Exchange Relationship
High	High	High	Low or High	Low or High	High	1	Internalise
High	High	Low	Low or High	Low or High	High	2	Internalise
High	Low	Low	Low or High	Low or High	High	3	Internalise
Moderate	Low	Low	High	High	High	4	Internalise
Moderate	Low	Low	High	High	Moderate or Low	5a	Externalise: Treat risks of very costly variations
Low	Low	Low	High	High	Low	5b	Externalise: Treat risks of costly variations
Low	Low	Low	Low or High	Low	Low	6	Externalise: Low risks of costly variations and low risks of high prices
Low	High	Low	Low or High	Low or High	Low	7	Externalise: Treat risks of high prices
Low	High	High	Low or High	Low or High	Low	8	Externalise: Treat risks of very high prices



**Table 4.8: Detailed design of pavement (Pattern 6 Activity) in TSRC**

Market Structure → High Prices			Switching Costs → Costly Variations			Activity	
Complementarity	Rarity	Costly to Imitate	Sunk Costs and/or Timeliness	Unpredictability	Frequency → Risk Pattern	→	Internalise or Externalise
High	High	High	Low or High	Low or High	High	1	Internalise
High	High	Low	Low or High	Low or High	High	2	Internalise
High	Low	Low	Low or High	Low or High	High	3	Internalise
Moderate	Low	Low	High	High	High	4	Internalise
Moderate	Low	Low	High	High	Moderate or Low	5a	Externalise: Treat risks of very costly variations
Low	Low	Low	High	High	Low	5b	Externalise: Treat risks of costly variations
Low	Low	Low	Low or High	Low	Low	6	Externalise: Low risks of costly variations and low risks of high prices
Low	High	Low	Low or High	Low or High	Low	7	Externalise: Treat risks of high prices
Low	High	High	Low or High	Low or High	Low	8	Externalise: Treat risks of very high prices

**Table 4.9: Detailed design of mechanical works (Pattern 7 Activity) in the tunnel in TSRC**

Market Structure → High Prices			Switching Costs → Costly Variations			Activity	
Complementarity	Rarity	Costly to Imitate	Sunk Costs and/or Timeliness	Unpredictability	Frequency → Risk Pattern	→	Internalise or Externalise
High	High	High	Low or High	Low or High	High	1	Internalise
High	High	Low	Low or High	Low or High	High	2	Internalise
High	Low	Low	Low or High	Low or High	High	3	Internalise
Moderate	Low	Low	High	High	High	4	Internalise
Moderate	Low	Low	High	High	Moderate or Low	5a	Externalise: Treat risks of very costly variations
Low	Low	Low	High	High	Low	5b	Externalise: Treat risks of costly variations
Low	Low	Low	Low or High	Low	Low	6	Externalise: Low risks of costly variations and low risks of high prices
Low	High	Low	Low or High	Low or High	Low	7	Externalise: Treat risks of high prices
Low	High	High	Low or High	Low or High	Low	8	Externalise: Treat risks of very high prices

6. The validity of matching each Project Specific Activity with one of the Risk Patterns in Table 2.3 was checked, as follows:
  - a. In each Project Specific Activity, only one of nine rows/nine Risk Patterns in Table 2.3 appeared as fully ticked/shaded. This is a check on the theoretical logic underpinning Table 2.3.
  - b. In relation to Costly Variations (Unpredictability) the Client’s assumed ranking of the project performance attributes and associated EoI timeline (Section 3.1.1 and Section 3.1.2) appears to convey a high level of planning and high-level adequacy of documentation, which is consistent with the responses to the questions on Unpredictability – where there is not a high incidence of Project Specific activities assessed with a high level of Unpredictability.

7. There were no Project Specific Activities that were assigned a Risk Pattern 1 through 4. Hence, none of the Project Specific Activities would have been more efficiently internalised and there was no need to exclude any of the Project Specific Activities from subsequent analysis in the next two steps of the Tool.
8. All the Project Specific Activities were assigned externalised Risk Patterns. The Risk Patterns associated with Outline Design of the road and tunnel (Pattern 5b) need to be treated to avoid risks of Costly Variations. The two Risk Pattern 7 activities (detailed design of Mechanical and Electrical works and construction of Mechanical and Electrical works) need to be treated to avoid risks of High Prices. Risks of High Prices and Costly Variations are low in all the other Pattern 6 activities in TSRC. Low-Risk Pattern 6 activities do not require any treatment, they can be bundled and efficiently transferred to suppliers using standard contracting terms.
9. In the next Step 4 all the externalised Project Specific activities i.e., Project Specific activities assigned with Risk Patterns 5b, 6 and 7 are analysed.

#### 4.3.4.2 GCUH

The procedure for Step 3 in GCUH was followed and summarised below:

1. The questions in Box 4.1 and Box 4.2 were applied to all Project Specific activities in all parts of GCUH.
2. The tense of the questions in Box 4.1 and Box 4.2 was not changed (as the Tool is applied in review mode) and no adaptations nor customisation was made to the questions.
3. The level (i.e., High or Low) of the three columns (or dimensions) of High Prices and the three dimensions of Costly Variations was assessed by using the answers to the Box 4.1 and Box 4.2 questions.
4. Regarding ungrouping activities (from an activity's initial grouping in Step 1):
  - a. Design of construction was ungrouped and divided into two sub-activities i.e., outline design of construction and detailed design of construction. This outline design represents the Optimal Design Level for the Client to complete prior to signing contract/s (including substantial construction works) is a design that is sufficiently robust such that it is unlikely to change and clearly imparts the Client's requirements (as explained in Section 2.1). The ungrouping of the activity's initial grouping in Step 1 was needed because part of the initial activity (outline design) was assessed as "High" on the Unpredictability dimension and part of the initial activity (detailed design) was assessed as "Low" on the Unpredictability dimension. Additionally, ungrouping of initial activity design of construction (in Step 1) into outline design of construction and detailed design of construction was needed because part of the initial activity (outline design of very specialised building services and equipment and installations i.e., generators, lifts, pneumatic tubes, cool rooms, medical gases and helipad) was assessed as "Low" on the Rarity and Costly to Imitate dimensions of High Prices. Meanwhile, part of the initial activity (detailed design of generators, lifts, pneumatic tubes, cool rooms, medical gases) was assessed as "High" on the Rarity dimension and "Low" on the Costly to Imitate dimension of High Prices and part of the initial activity (detailed design of the helipad) was assessed as "High" on the Rarity dimension and "High" on the Costly to Imitate dimension of High Prices.
  - b. Construction was ungrouped and divided into two sub-activities i.e., Supply-Only and Construction (comprising supply of materials/components and build/install) in terms of the Pathology Modules, Curtain Wall and Helipad. The ungrouping of the activity's initial grouping in Step 1 was needed because part of the initial activity (the Supply of the supply of the materials/components) was assessed as "High" on the Rarity and Costly to Imitate dimensions and "Low" and part of the initial activity (build/installation) was assessed as "Low" on the Rarity and Costly to Imitate dimensions.

- c. Operations was ungrouped and divided into two sub-activities i.e., immediate response (*ad hoc*) operations and routine (day-to-day) operations. The ungrouping of the activity's initial grouping in Step 1 was needed because part of the initial activity (immediate *ad hoc* response operations) was assessed as "High" on the Unpredictability dimension and part of the initial activity (routine day-to-day operations) was assessed as "Low" on the Unpredictability dimension.
  - d. Maintenance was ungrouped and divided into three sub-activities i.e., Emergency Maintenance and Routine (basic day-to-day) Maintenance and Planned Preventive Maintenance. Again, ungrouping was needed because of different assessments of the Unpredictability. Planned Preventive maintenance activities were further ungrouped and divided into two further sub-activities. This further ungrouping was needed because part of the initial activities on Planned Preventive Maintenance was assessed as "Low" (up to 10 years from opening date) on the Unpredictability dimension and part of the initial activities on Planned Preventive "Hard" FM activities was assessed as "High" (over 10 years from opening date) on the Unpredictability dimension.
5. A Risk Pattern for the Project Specific Activities including the sub-divided activities was assigned by using the assessed level (i.e., High, Moderate or Low) of each of the three dimensions of High Prices and each of the three dimensions of Costly Variations and was matched with the closest Risk Pattern in Table 2.3. Mostly all of the Design, Construction and Maintenance Project Specific Activities across Appendix A-1 to A-31 were assigned a Pattern 6. The following Project Specific Activities were assigned a different pattern:
- a. Pattern 3s
    - i. Routine (day-to-day) operation/control of all the building and carpark and initial works and externals works
    - ii. Routine and basic (day-to-day) maintenance (including minor repairs) of all the building and carpark fabric and building services and initial works and external works
  - b. Pattern 4s
    - i. Immediate response (*ad hoc*) operations
    - ii. Emergency (basic) maintenance of all the building and carpark and initial works and external works
  - c. Pattern 5bs
    - i. Outline design of all construction activities including outline design of the buildings and carpark fabric and all services and initial works and external works and design of plan/specification of maintenance
    - ii. Planned Preventive Maintenance (including replacement) of the building and carpark fabric and building services and initial works and external works – over 10 years from opening date
  - d. Pattern 7s
    - i. Detailed design of special building services i.e., Generators, Lifts, Pneumatic Tubes, Cool Rooms, Medical Gases
    - ii. Construction of special building services i.e., Generators, Lifts, Pneumatic Tubes, Cool Rooms, Medical Gases
    - iii. Maintenance (Emergency and Planned Preventive Maintenance up to 10 years and after 10 years) of special building services i.e., Generators, Lifts, Pneumatic Tubes, Cool Rooms, Medical Gases
  - e. Pattern 8s
    - i. Detailed design of Curtain Wall, Helipad, Pathology Modules and utilities diversions/connections
    - ii. Supply-Only Curtain Wall, Helipad and Pathology Modules
    - iii. Construction of utilities diversions/connections
    - iv. Maintenance (Emergency and Planned Preventive Maintenance up to 10 years and after 10 years) of Curtain Wall, Helipad, Pathology Modules and utilities connections

6. The assessment of Risk Patterns in GCUH surfaced three Risk Patterns (Patterns 3, 4, and 8) beyond the three Risk Patterns (Patterns 5b, 6 and 7) identified in TSRC. An example of each of these three patterns is listed below and shown in Tables 4.10 to 4.12.
- Pattern 3: A routine maintenance (day-to-day maintenance including minor repairs) of the building fabric and external grounds "Hard" FM activity e.g., repairs to sanitary fixtures.
  - Pattern 4: An emergency breakdown maintenance of the building fabric and external grounds "Hard" FM activity e.g., repairs to access door/s in the Mental Health building.
  - Pattern 8: Detailed design of the helipad.

**Table 4.10: Routine maintenance to sanitary fixtures (Pattern 3 Activity) in GCUH**

Market Structure → High Prices			Switching Costs → Costly Variations			Activity	
Complementarity	Rarity	Costly to Imitate	Sunk Costs and/or Timeliness	Unpredictability	Frequency → Risk → Pattern		Internalise or Externalise
High	High	High	Low or High	Low or High	High	1	Internalise
High	High	Low	Low or High	Low or High	High	2	Internalise
High	Low	Low	Low or High	Low or High	High	3	Internalise
Moderate	Low	Low	High	High	High	4	Internalise
Moderate	Low	Low	High	High	Moderate or Low	5a	Externalise: Treat risks of very costly variations
Low	Low	Low	High	High	Low	5b	Externalise: Treat risks of costly variations
Low	Low	Low	Low or High	Low	Low	6	Externalise: Low risks of costly variations and low risks of high prices
Low	High	Low	Low or High	Low or High	Low	7	Externalise: Treat risks of high prices
Low	High	High	Low or High	Low or High	Low	8	Externalise: Treat risks of very high prices

**Table 4.11: Emergency maintenance to access door/s (Pattern 4 Activity) in Mental Health building GCUH**

Market Structure → High Prices			Switching Costs → Costly Variations			Activity	
Complementarity	Rarity	Costly to Imitate	Sunk Costs and/or Timeliness	Unpredictability	Frequency → Risk → Pattern		Internalise or Externalise
High	High	High	Low or High	Low or High	High	1	Internalise
High	High	Low	Low or High	Low or High	High	2	Internalise
High	Low	Low	Low or High	Low or High	High	3	Internalise
Moderate	Low	Low	High	High	High	4	Internalise
Moderate	Low	Low	High	High	Moderate or Low	5a	Externalise: Treat risks of very costly variations
Low	Low	Low	High	High	Low	5b	Externalise: Treat risks of costly variations
Low	Low	Low	Low or High	Low	Low	6	Externalise: Low risks of costly variations and low risks of high prices
Low	High	Low	Low or High	Low or High	Low	7	Externalise: Treat risks of high prices
Low	High	High	Low or High	Low or High	Low	8	Externalise: Treat risks of very high prices

**Table 4.12: Detailed design of the helipad (Pattern 8 Activity) in GCUH**

Market Structure → High Prices			Switching Costs → Costly Variations			Activity	
Complementarity	Rarity	Costly to Imitate	Sunk Costs and/or Timeliness	Unpredictability	Frequency → Risk Pattern		Internalise or Externalise
High	High	High	Low or High	Low or High	High	1	Internalise
High	High	Low	Low or High	Low or High	High	2	Internalise
High	Low	Low	Low or High	Low or High	High	3	Internalise
Moderate	Low	Low	High	High	High	4	Internalise
Moderate	Low	Low	High	High	Moderate or Low	5a	Externalise: Treat risks of very costly variations
Low	Low	Low	High	High	Low	5b	Externalise: Treat risks of costly variations
Low	Low	Low	Low or High	Low	Low	6	Externalise: Low risks of costly variations and low risks of high prices
Low	High	Low	Low or High	Low or High	Low	7	Externalise: Treat risks of high prices
Low	High	High	Low or High	Low or High	Low	8	Externalise: Treat risks of very high prices

7. The validity of matching each Project Specific Activity with one of the Risk Patterns in Table 2.3 was checked, as follows:
  - a. In each Project Specific Activity, only one of nine rows/nine Risk Patterns in Table 2.3 appeared as fully ticked/shaded. This is a check on the theoretical logic underpinning Table 2.3.
  - b. In relation to Costly Variations (Unpredictability) the Client’s assumed ranking of the project performance attributes and associated EoI timeline (Section 3.2.2 and Section 3.2.1) appears to convey a lower-level of planning and lower-level detailed documentation, which is consistent with the responses to the questions on Unpredictability – where there is a higher incidence of Project Specific activities assessed with a high level of Unpredictability. This is consistent with the Client’s actual procurement i.e., Managing Contractor model. One of the reputed benefits of this model is an underdeveloped Client brief that can benefit from early contractor involvement.
8. Project Specific Activities assigned an internalised Risk Pattern 1 through 4 would have been more efficiently internalised, and so they are excluded from subsequent analysis in the next two steps of the Tool.
9. All other Project Specific Activities were assigned externalised Risk Patterns. The Risk Pattern 7 and 8 activities need to be treated to avoid risks of High Prices. Likewise, the Risk Pattern 5b activities need to be treated but this time to avoid Costly Variations. Risks of High Prices and Costly Variations are low in all other Pattern 6 activities in GCUH. Low-Risk Pattern 6 activities do not require any treatment, they can be bundled and efficiently transferred to suppliers using standard contracting terms.
10. In the next Step 4 only the externalised Project Specific activities i.e., Project Specific activities assigned with Risk Patterns 5b, 6, 7 and 8 are analysed.

## 4.4 Step 4. Contract Packaging (Bundling) Analysis

### 4.4.1 Summary

As mentioned in Section 2.3.4, the Tool maximises the benefits of bundling and minimises the costs of bundling, in pursuance of advancing value for money in accordance with the ranking of project performance attributes in Table 2.1.

The output from Step 4 comprises bundles, or contact packages, of externalised Project Specific activities comprising five Risk Patterns 5a; 5b; 6; 7; and 8.

In doing so, bundling is used to treat four of five externalised Project Specific activities that carry microeconomic risks that could lead to a lack of competition and high to very High Prices (Risk Patterns 7 and 8) or high switching costs, which could lead to hold-up and Costly Variations (Risk Patterns 5a and 5b). The remaining Risk Pattern 6 is associated with externalised Project Specific activities that carry a low risk of High Prices and Costly Variations. Low-Risk Pattern 6 activities do not require any treatment and can be bundled and efficiently transferred to suppliers using standard contracting terms. Step 4 is depicted in Figure 4.4.

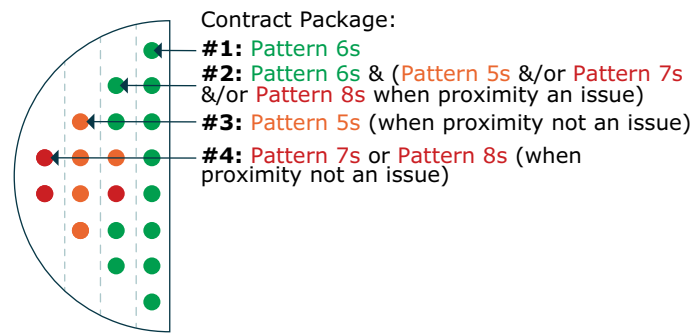


Figure 4.4: Step 4. Contract Packages

### 4.4.2 Input

The output from Step 3 (i.e., a list of the Project Specific activities that are assigned one of five externalised Risk Patterns namely Risk Patterns 5a; 5b; 6; 7; and 8) provides the information required for Step 4.

### 4.4.3 Procedure

The procedure for Step 4 is as follows:

1. Review the High-Risk Pattern 7 and Pattern 8 activities and sub-activities to check whether the size of activity or sub-activity has led to a High-Risk Pattern 7 or Pattern 8 and in which case subdivide the activity or further subdivide the sub-activity into a Low-Risk Pattern 6. This subdividing procedure could be based on geography and/or a stage in the process of design and/or construction and/or operations and/or maintenance. If the activity is reflected by a High-Risk Pattern 7 and Pattern 8 because of the technical and/or resource-availability nature of the activity, then it remains a High-Risk Pattern 7 and Pattern 8 activity.
2. As mentioned in Section 2.3.4.3, where proximity is an issue, then bundle High-Risk Pattern 5a and/or 5b and/or 7 and/or 8 activities in the most closely associated bundle of Low-Risk Pattern 6 activities. The High-Risk Patterns in these mixed bundles are treated using different contracting terms – in next and final Step 5).

3. Where are no proximity issues associated with the High-Risk Patterns 5a; 5b; 7; and 8, then treat these High-Risk Patterns by using separate bundles, or contract packages, i.e.,
  - a. Bundle High-Risk Pattern 5a and/or 5b activities
  - b. Bundle High-Risk Pattern 7 activities, and
  - c. Bundle High-Risk Pattern 8 activities
4. Bundle the remaining Low-Risk Pattern 6 activities.
5. Reassess the Risk Pattern at level of each bundle to check that a new High-Risk Pattern 7 and/or new High-Risk Pattern 8 has not arisen because of its size; In which case subdivide the bundle; In linear infrastructure subdivide the bundle along line of asset so as to maintain continuous lengths in each sub-bundle. In vertical infrastructure, subdivide in terms of separate clusters of buildings.
6. Where a bundle of mostly Low-Risk Pattern 6 activities with strong potential for efficiencies in whole-life costs and/or strong potential for quality (functionality) innovations is identified, then market sound this bundle for private finance. This bundle presents the opportunity for the cost of private finance (beyond the cost of government finance) to be outweighed by strong efficiency gains. Again though, care is needed to ensure that this private finance approach does not create a new High-Risk Pattern 7 or High-Risk Pattern 8 bundle. To help prevent this, the Client can consider mechanisms like upfront capital contributions to reduce the amount of private finance to perhaps increase the pool of capable consortium willing to express their interest. However, if a new High-Risk Pattern 7 or 8 bundle is still being created because of a lack of appetite from private finance providers, then this bundle/s of mostly Low-Risk Pattern 6 D&C and O&/orM activities is procured using government finance.

#### 4.4.4 Examples of output

##### 4.4.4.1 TSRC

The procedure for Step 4 in TSRC was followed and summarised below:

1. The High-Risk Pattern 7s (detailed design of Mechanical and Electrical works in the tunnel and the construction/installation of the Mechanical and Electrical works in the tunnel) were reviewed to check whether the size of these activities had led to a High-Risk Pattern 7. This was not the case because the "High" level of the Rarity dimension was caused by the technical requirements of the activities, regardless of the size of the activity. Therefore, these activities were not subdivided.
2. There are no proximity issues associated with the High-Risk Patterns 5b and 7 and so these High-Risk Patterns are treated by using separate bundles, or contract packages, i.e.,
  - a. Bundle #1. High-Risk Pattern 5b i.e., the outline design of the road and tunnel.
  - b. Bundle #2. High-Risk Pattern 7 activities i.e., detailed design and construction of Mechanical and Electrical works in the tunnel.
3. The remaining Low-Risk Pattern 6 detailed design and construction activities are bundled and comprise Bundle #3.
4. The Risk Pattern at the level of Bundle #1 and Bundle #3 was reassessed to check that a new High-Risk Pattern 7 and/or new High-Risk Pattern 8 has not arisen because of its size. This was not the case, because the size of each of these bundles would likely still attract a sufficient supply (5 or more market firms) capable of delivering each bundle.
5. While there was a bundle of mostly Low-Risk Pattern 6 activities i.e., Bundle #3, this bundle did not offer a strong potential for efficiencies in whole-life costs and/or strong potential for quality (functionality) innovations, and so this bundle is not market sounded for private finance.

6. In summary, three bundles, or contract packages, of externalised Project Specific activities are identified:
  - a. **Bundle #1.** High-Risk Pattern 5b i.e., the outline design of the road and tunnel.
  - b. **Bundle #2.** High-Risk Pattern 7 activities i.e., detailed design and construction of Mechanical and Electrical works in the tunnel.
  - c. **Bundle #3.** Low-Risk Pattern 6 activities i.e., detailed design of the road and detailed design of tunnel (excluding detailed design of Mechanical and Electrical works in the tunnel) and construction of road and construction of the tunnel (excluding construction of Mechanical and Electrical works in the tunnel).

#### 4.4.4.2 GCUH

The procedure for Step 4 in GCUH was followed and summarised below:

1. The High-Risk Pattern 7 activities and Pattern 8 activities (in Section 4.3.4.2/Procedure #5) were reviewed to check whether the size of activity or sub-activity has led to a High-Risk Pattern 7 or Pattern 8. This was not the case because the "High" level of the Rarity dimension was caused by the technical requirements of the activities, regardless of the size of the activity. Therefore, these activities were not subdivided.
2. There were proximity issues associated with High-Risk Patterns 7 and 8 activities. Therefore, these activities are included in the most closely associated bundle of Low-Risk Pattern 6 activities. And after 10 years, when the Low-Risk Pattern 6 Emergency Maintenance and Planned Preventative Maintenance activities turn into Pattern 5b activities, then High-Risk Patterns 7 and 8 activities are included in these Pattern 5b activities. The High-Risk Patterns in these mixed bundles are treated using different contracting terms (in the next and final Step 5).
3. There were no proximity issues associated with the High-Risk Patterns 5b. Therefore, these High-Risk Patterns are treated by using separate bundles, or contract packages, i.e.,
  - a. Bundle #1. High-Risk Pattern 5b activities i.e., outline design of all construction activities including outline design of building and carpark fabric and all services and initial works and external works and design of plan/specification of maintenance.
  - b. Bundle #2. High-Risk Pattern 5b activities i.e., Emergency and Planned Preventive Maintenance (including replacement) of the building and carpark fabric and building services and initial works and external works – over 10 years from opening date. As mentioned, this bundle also incorporates Emergency and Planned Preventive Maintenance over 10 years of Pattern 7 activities i.e., special building services i.e., Generators, Lifts, Pneumatic Tubes, Cool Rooms, Medical Gases and Emergency and Planned Preventive Maintenance over 10 years of Pattern 8 activities i.e., Curtain Wall, Helipad, Pathology Modules and utilities connections.
4. The remaining Low-Risk Pattern 6 activities are bundled and comprise detailed design of construction and maintenance and construction and emergency maintenance and planned preventative maintenance (including replacement maintenance) of the buildings and carpark fabric and building services and initial works and external grounds (up to 10 years from opening date). As mentioned, because of proximity issues, this bundle also incorporates High-Risk Patterns 7 and 8 activities, as follows:
  - a. Pattern 7s:
    - v. Detailed design of special building services i.e., Generators, Lifts, Pneumatic Tubes, Cool Rooms, Medical Gases
    - vi. Construction of special building services i.e., Generators, Lifts, Pneumatic Tubes, Cool Rooms, Medical Gases, and
    - vii. Maintenance (Emergency and Planned Preventive Maintenance up to 10 years) of special building services i.e., Generators, Lifts, Pneumatic Tubes, Cool Rooms, Medical Gases.



- b. Pattern 8s:
    - i. Detailed design of Curtain Wall, Helipad, Pathology Modules and utilities diversions/connections
    - ii. Supply-Only Curtain Wall, Helipad and Pathology Modules
    - iii. Construction of utilities diversions/connections, and
    - iv. Maintenance (Emergency and Planned Preventive Maintenance up to 10 years) of Curtain Wall, Helipad, Pathology Modules and utilities connections.
5. The Risk Pattern at the level of Bundle #1 and Bundle #2 and the Risk Pattern at the level bundle of Low-Risk Pattern 6 activities (incorporating the High-Risk Pattern 7 and 8 activities) was reassessed to check that a new High-Risk Pattern 7 and/or new High-Risk Pattern 8 has not arisen because of its size. This was not the case with the Bundle #1 and Bundle #2 because the size of these bundles would have likely created a sufficient supply of market firms (5 or more) capable of delivering this bundle. However, this was the case with the bundle of predominantly Low-Risk Pattern 6 activities that would have likely created an insufficient supply (4 or less) of market firms capable of delivering this bundle. This bundle was subdivided in terms of separate clusters of building i.e., Bundle #3 comprising the Clinical Services Building and IPU West & South buildings and Bundle #4 comprising Pathology & Education building and the Mental Health building and the Central Energy Plant building and Engineering Workshops; and the Carpark (West). This subdivision into Bundle #3 and Bundle #4, means initial works and external works would not be completely specific to these two clusters of buildings, and given the period between initial works and the end of external works, initial works and external works comprise separate bundles, i.e., Bundle #5 and Bundle #6.

In summary, six bundles, or contract packages, of externalised Project Specific activities are identified:

1. **Bundle #1.** High-Risk Pattern 5b activities i.e., outline design of all construction activities including outline design of building and carpark fabric and all services and initial works and external works and design of plan/specification of maintenance.
2. **Bundle #2.** High-Risk Pattern 5b activities i.e., Emergency and Planned Preventive Maintenance (including replacement) of the building and carpark fabric and building services and initial works and external works – over 10 years from opening date. As mentioned, this bundle also incorporates Emergency and Planned Preventive Maintenance over 10 years of Pattern 7 activities i.e., special building services i.e., Generators, Lifts, Pneumatic Tubes, Cool Rooms, Medical Gases and Emergency and Planned Preventive Maintenance over 10 years of Pattern 8 activities i.e., Curtain Wall, Helipad, Pathology Modules and utilities connections. The risks for the useful life of the key building plant and equipment would not be transferred to the Hard FM contractor. The Client would financially allow for the life cycle costs/replacement costs of plant and equipment beyond their useful life in Bundles #3 and #4 and the Hard FM contractor would oversee the design, construction/installation of these replacement works by independent contractors – who are appointed, where possible, under competitive tender. As there would continue to be maintenance of High-Risk Patterns 7 and 8 activities the Client would nominate contractors for these high-risk patterns as part of this bundle. And the Hard FM contractor would then subsequently manage the maintenance of the work by all the individual contractors. This bundle would likely be retendered every 3 to 5 years.

3. **Bundle #3.** Low-Risk Pattern 6 activities comprising detailed design of construction and maintenance and construction and emergency maintenance and planned preventative maintenance (including replacement maintenance) of the Clinical Services Building and IPU West & South buildings and their building services (up to 10 years from opening date). This bundle also incorporates High-Risk Patterns 7 and 8 activities, as follows:
- a. Pattern 7s:
    - i. Detailed design of special building services i.e., Lifts, Pneumatic Tubes, Cool Rooms, Medical Gases
    - ii. Construction of special building services i.e., Lifts, Pneumatic Tubes, Cool Rooms, Medical Gases, and
    - iii. Maintenance (Emergency and Planned Preventive Maintenance up to 10 years) of special building services i.e., Lifts, Pneumatic Tubes, Cool Rooms, Medical Gases
  - b. Pattern 8s:
    - i. Detailed design of Curtain Wall and Helipad
    - ii. Supply-Only Curtain Wall and Helipad, and
    - iii. Maintenance (Emergency and Planned Preventive Maintenance up to 10 years) of Curtain Wall and Helipad.

The capital cost of this bundle is estimated around \$900 million (2008 prices) and would have suited Tier 1 building contractors. This bundle would have had a strong potential for efficiencies in whole-life costs and/or strong potential for quality (functionality) innovations. This bundle, or contract package would have been market sounded for private finance. If the market did not respond favorably to this contract package (say because the market prefers a lower quantum of private finance) and if government were still keen to pursue private finance, then government could explore up-front capital contributions and/or developing the schematic to separate the IPU buildings. Alternatively, and again when seeking to reduce the amount of finance, the government could consider a 'shell & core' approach in which the PPP Co design and construct both shell and core (timing/proximity issues mean separate contractor for fit-out would be an issue) and then PPP Co have a long term contract for hard FM of the core only and the government takes responsibility for hard FM of the fit-out/shell. The 'shell & core' approach would be preferable, relative to a shorter contract duration approach, where government thinks that extensive conversion/alteration works in key spaces are unavoidable within 10 years. However, where government can deliver effective health planning (in conjunction with flexible delivery and future-proofing measures highlighted in this report) then, efficiency-wise, the shorter contract duration approach is a clearer approach than the 'shell & core' approach. That is, the boundary between the shell and core needs to be very carefully considered in order to ensure that the significant positive externalities arising from economies of scope mentioned above, i.e., efficiency gains driven by decisions in design and workmanship in construction, are still realised in the life-cycle/whole-life costs of the facility. Furthermore, when adopting a 'shell & core' approach there needs to be confidence that any major changes to the core would not impact the shell (including mechanical, electrical and other specialist services in the shell). If this bundle does not generate sufficient interest from 5 or more consortia, then this bundle is procured using government finance.

4. **Bundle #4.** Low-Risk Pattern 6 activities comprising detailed design of construction and maintenance and construction and emergency maintenance and planned preventative maintenance (including replacement maintenance) of the Pathology & Education building and the Mental Health building and the Central Energy Plant building and Engineering Workshops; and the Carpark (West) and their building services (up to 10 years from opening date) and emergency maintenance and planned preventative maintenance (including replacement maintenance) of the initial works and external works (up to 10 years from opening date). This bundle also incorporates High-Risk Patterns 7 and 8 activities, as follows:
  - a. Pattern 7s:
    - i. Detailed design of special building services i.e., Generators, Lifts, Pneumatic Tubes, Cool Rooms
    - ii. Construction of special building services i.e., Generators, Lifts, Pneumatic Tubes, Cool Rooms, and
    - iii. Maintenance (Emergency and Planned Preventive Maintenance up to 10 years) of special building services i.e., Generators, Lifts, Pneumatic Tubes, Cool Rooms.
  - b. Pattern 8s:
    - i. Detailed design of Pathology Modules
    - ii. Supply-Only Pathology Modules, and
    - iii. Maintenance (Emergency and Planned Preventive Maintenance up to 10 years) of Pathology Modules and utilities connections.

This bundle, or contract package, would have been market sounded for private finance. However, with the capital cost of this bundle is estimated around \$200 million (2008 prices) and would have had much less potential for efficiencies in whole-life costs and/or quality (functionality) innovations than Bundle #3. It's more likely that this bundle is procured using government finance.

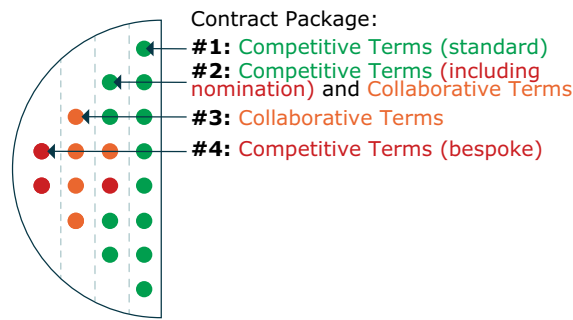
3. **Bundle #5.** Low-Risk Pattern 6 activities i.e., detailed design and construction of initial works. As mentioned, this bundle also incorporates a High-Risk Patterns 8 activities i.e., construction of utilities diversions/connections.
4. **Bundle #6.** Low-Risk Pattern 6 activities i.e., detailed design and construction of external works.

## 4.5 Step 5. Collaborative-or-Competitive Contracting (Exchange Relationship) Analysis

### 4.5.1 Summary

As mentioned in Section 2.3.5, each contract used to procure each bundle of activities requires the Client to identify the most efficient exchange relationship with the counterparty market firm/supplier at the head of the supply chain of each bundle of activities. The exchange relationship is a continuum from relational exchange (collaborative contracting) to arm's length or discrete exchange (competitive contracting). Competitive contracting becomes more extreme (and further away from collaborative contracting) when it includes bespoke contracts and/or costly-to-write credible threats concerning performance (e.g., a substantial performance bond). Credible threats are designed to pre-empt a strong balance of power held by suppliers in thin markets.

The output from Step 5, and the Tool, are contract packages of externalised Project Specific activities with assigned contracting terms i.e., competitive (standard competitive or bespoke competitive) or collaborative or standard competitive (with some bespoke competitive terms and/or some collaborative terms), as depicted in Figure 4.5.



**Figure 4.5: Step 5. Contract Packages and Contract Terms**

## 4.5.2 Input

The output from Step 4 are bundles, or contract packages, of externalised Project Specific activities comprising five Risk Patterns 5a; 5b; 6; 7; and 8 provides the information required for the final Step 5.

## 4.5.3 Procedure

The procedure for Step 5 is as follows:

1. Assign an exchange relationship to each bundle, or contract package, using Table 2.7, as follows:
  - a. Collaborative contracting assigned to bundle/s of High-Risk Pattern 5a activities.
  - b. Collaborative contracting assigned to bundle/s of High-Risk Pattern 5b activities.
  - c. Standard Competitive contracting assigned to bundle/s of Low-Risk Pattern 6 activities.
  - d. Bespoke Competitive contracting to bundle/s of High-Risk Pattern 7 activities.
  - e. Bespoke Competitive contracting assigned to bundle/s of High-Risk Pattern 8 activities.
  - f. Mixed contracting to bundle/s of Low-Risk Pattern 6 activities and high-risk patterns. Also mentioned 2.3.5, it may not always be practical to separate High-Risk Pattern 5a, 5b, 7 and 8 activities from Low-Risk Pattern 6 activities because of proximity issue/s. Where High-Risk Pattern 5a and 5b activities cannot be practically separated from an otherwise Low-Risk Pattern 6 bundle of activities, then collaborative contracting terms are used for the High-Risk Pattern 5a and/or 5b activities within this otherwise predominantly Low-Risk Pattern 6 bundle of activities and when standard competitive contracting is used for the High-Risk Pattern 6 activities, creating a mixed contracting approach within the same bundle. Where High-Risk Pattern 7 and 8 activities cannot be practically separated from an otherwise Low-Risk Pattern 6 bundle of activities, then each of these High-Risk Pattern 7 and 8 activities are procured as a nominated supplier using a trilateral contract between the Client, the supplier at the head of the contract bundle and the nominated supplier of the High-Risk Pattern 7 or 8 activity. Again, a mixed contracting approach is created when standard competitive contracting is used for the predominant Low-Risk Pattern 6 activities and bespoke competitive contracting used for the High-Risk Pattern 7 and 8 activities in the same bundle.
2. Consider whether there could be elements of the work e.g., quantities of materials and/or prices of resources that are not predictable in a bundle of otherwise predictable work – in any of the above bundles that would otherwise be a fixed-price. Where quantities are likely not to be predictable, then an adaptive mechanism is applied e.g., schedule of rates with remeasurement of quantities upon completion of the work, which is suited to groundworks lacking geotechnical details and refurbishment work. Where prices are likely not to be predictable, then again, an adaptive mechanism is applied e.g., rise and fall mechanisms, which are suited to periods of significant rising inflation. However, these adaptive mechanisms are applied within a contracting framework that is still competitive.

3. Where practicable, select a standard contract to reflect the exchange relationship assigned to each bundle, or contract package. For example, the New Engineering Contract (NEC), “is a family of contracts that facilitates the implementation of sound project management and procurement principles and practices, as well as defining legal relationships” (NEC, 2022).<sup>7</sup>
4. The NEC family of contracts can be applied to the above bundles in Step 5. Procedure #1. To follow is an indicative application of NEC:
  - a. Bundle/s of High-Risk Pattern 5a activities (or scope of DCOM work) assigned Collaborative contracting:
    - i. NEC Engineering & Construction (ECC) Contract or Alliance Contract (where scope of works involves a significant level of experimentation with new technology and/or new design methods and/or new construction methods).
    - ii. Main Payment Option C (Target Contract with activity schedule) or Option D (Target Contract with bills of quantities).
    - iii. Secondary Option X1 – Price adjustment for inflation (where appropriate).
    - iv. Secondary Option X15 – Contractor’s design (where appropriate).
  - b. Bundle/s of High-Risk Pattern 5b activities (or scope of DCOM work) assigned Collaborative contracting:
    - i. ECC.
    - ii. Main Payment Option C (Target Contract with activity schedule) or Option D (Target Contract with bills of quantities).
    - iii. Secondary Option X1 – Price adjustment for inflation (where appropriate).
    - iv. Secondary Option X15 – Contractor’s design (where appropriate).
  - c. Bundle/s of Low-Risk Pattern 6 activities (or scope of DCOM work) assigned Standard Competitive contracting:
    - i. ECC.
    - ii. Main Payment Option A (Priced contract with activity schedule) or Option B (Priced contract with bills of quantities).
    - iii. Secondary Option X1 – Price adjustment for inflation (where appropriate).
    - iv. Secondary Option X15 – Contractor’s design (where appropriate).
  - d. Bundle/s of High-Risk Pattern 7 and 8 activities (or scope of DCOM work) assigned Bespoke Competitive contracting:
    - i. ECC.
    - ii. Main Payment Option A (Priced contract with activity schedule) or Option B (Priced contract with bills of quantities).
    - iii. Where appropriate, include Secondary Option X1 – Price adjustment for inflation.
    - iv. Secondary Option X13 – Performance bond.
    - v. Secondary Option X15 – Contractor’s design (where appropriate).
    - vi. Secondary Option X17 – Low performance damages.
    - vii. Secondary Option Z additional conditions of contract concerning credible threats for low performance or non-performance (to complement Options X13 and X17).

<sup>7</sup> A website comprising case studies of NEC applications including road and health projects can be found at: <https://www.neccontract.com/projects>.

- e. Bundle/s of activities assigned mixed contracting within one/the same Engineering & Construction Contract:
  - i. Main-Bundle of Low-Risk Pattern 6 activities (or scope of DCOM work) assigned Standard Competitive contracting (see above Step 5. Procedure #4c for main payment option and secondary options).
  - ii. Sub-Bundle/s of High-Risk Pattern 5a and/or 5b activities (or scope of DCOM work) assigned Collaborative contracting (see above Step 5. Procedure #4a and #4b for main payment option and secondary options).
  - iii. Sub-Bundle/s of High-Risk Pattern 7 and/or 8 activities assigned Bespoke Competitive contracting, incorporating subcontractor and/or supplier nomination/s (see above Step 5. Procedure #4d for main payment option and secondary options).

## 4.5.4 Examples of output

### 4.5.4.1 TSRC

The procedure for Step 5 in TSRC was followed and using NEC as an example standard contract. This led to the following output:

1. **Contract #1 (using Collaborative contracting).** Scope of the works: High-Risk Pattern 5b i.e., the outline design of the road and tunnel:
  - a. NEC Professional Services Contract.
2. **Contract #2 (using Bespoke Competitive contracting).** Scope of the works: High-Risk Pattern 7 activities i.e., detailed design and construction of Mechanical and Electrical works in the tunnel:
  - a. NEC ECC including:
    - i. Main Payment Option A (Priced contract with activity schedule)
    - ii. Secondary Option X13 – Performance bond
    - iii. Secondary Option X15 – Contractor’s design
    - iv. Secondary Option X17 – Low performance damages, and
    - v. Secondary Option Z additional conditions of contract concerning credible threats for low performance or non-performance (to complement Options X13 and X17).
3. **Contract #3 (using Standard Competitive contracting).** Scope of the works: Low-Risk Pattern 6 activities i.e., detailed design of the road and detailed design of tunnel (excluding detailed design of Mechanical and Electrical works in the tunnel) and construction of road and construction of the tunnel (excluding construction of Mechanical and Electrical works in the tunnel):
  - a. NEC ECC including:
    - i. Main Payment Option B (Priced contract with bills of quantities), and
    - ii. Secondary Option X15 – Contractor’s design.

#### 4.5.4.2 GCUH

The procedure for Step 5 in TSRC was followed and using NEC as an example standard contract and assuming government finance. This led to following output:

1. **Contract #1 (using Collaborative contracting)**. Scope of the works: High-Risk Pattern 5b activities i.e., outline design of all construction activities including outline design of building and carpark fabric and all services and initial works and external works and design of plan/specification of maintenance.
  - a. NEC Professional Services Contract.
    - i. This is one contract to a consortium of designers. If the market does not respond favourably to this approach (at least 5 consortia expressing an interest) then multiple Professional Services Contracts are used and linked using X12 – Multiparty Collaboration.
    - ii. A range of reimbursement and target payment options through the process of developing the Client’s brief to schematic design and including value engineering workshops.
2. **Contract #2 (using Collaborative contracting)**. Scope of the works: High-Risk Pattern 5b activities i.e., Emergency and Planned Preventive Maintenance (including replacement) of the building and carpark fabric and building services and initial works and external works – over 10 years from opening date. And High-Risk Pattern 7 activities i.e., Emergency and Planned Preventive Maintenance over 10 years of special building services i.e., Generators, Lifts, Pneumatic Tubes, Cool Rooms, Medical Gases. And High-Risk Pattern 8 activities i.e., Emergency and Planned Preventive Maintenance over 10 years of Pattern 8 activities i.e., Curtain Wall, Helipad, Pathology Modules and utilities connections. This bundle would likely be retendered every 3 to 5 years.
  - a. NEC Term Services Contract (or upcoming NEC Facilities Management Contract) including:
    - i. A range of collaborative payment options, and
    - ii. Nomination of subcontractors (defined in the works in the project specific information in the contract data) for Generators, Lifts, Pneumatic Tubes, Cool Rooms, Medical Gases, Curtain Wall, Helipad, Pathology Modules and utilities connections.
3. **Contract #3 (Mixed contracting using standard competitive contracting and bespoke competitive contracting)**. Scope of the works: Low-Risk Pattern 6 activities comprising detailed design of construction and maintenance, and construction, and emergency maintenance, and planned preventative maintenance (including replacement maintenance) of the Clinical Services Building and IPU West & South buildings and their building services (up to 10 years from opening date). And High-Risk Patterns 7 and 8 activities, as follows:
  - a. Pattern 7s: Detailed design, construction, and maintenance (Emergency and Planned Preventive Maintenance up to 10 years) of special building services i.e., Lifts, Pneumatic Tubes, Cool Rooms, Medical Gases
  - b. Pattern 8s: Detailed design, supply-only, and maintenance (Emergency and Planned Preventive Maintenance up to 10 years) of Curtain Wall and Helipad.
  - c. NEC Design Build and Operate Contract including:
    - i. Main payment Option A (Priced with activity schedule)
    - ii. Secondary Option X15 – Contractor’s design, and
    - iii. Nomination of subcontractors (defined in the works in the project specific information in the contract data) for Lifts, Pneumatic Tubes, Cool Rooms, Medical Gases, Curtain Wall and Helipad, including Secondary Option X13 – Performance bond; Secondary Option X17 – Low performance damages, and Secondary Option Z additional conditions of contract concerning credible threats for low performance or non-performance – to complement Options X13 and X17, for the nominated subcontractors.

4. **Contract #4 (Mixed contracting using standard competitive contracting and bespoke competitive contracting)**. Scope of the works: Low-Risk Pattern 6 activities comprising detailed design of construction and maintenance, and construction, and emergency maintenance and planned preventative maintenance (including replacement maintenance) of the Pathology & Education building and the Mental Health building and the Central Energy Plant building and Engineering Workshops; and the Carpark (West) and their building services (up to 10 years from opening date) and emergency maintenance and planned preventative maintenance (including replacement maintenance) of the initial works and external works (up to 10 years from opening date). And High-Risk Patterns 7 and 8 activities, as follows:
  - a. Pattern 7s: Detailed design and construction and maintenance (Emergency and Planned Preventive Maintenance up to 10 years) of special building services i.e., Generators, Lifts, Pneumatic Tubes, Cool Rooms
  - b. Pattern 8s: Detailed design, supply only and maintenance (Emergency and Planned Preventive Maintenance up to 10 years) of Pathology Modules and utilities connections.
  - c. NEC Design Build and Operate Contract including:
    - i. Main payment Option A (Priced with activity schedule)
    - ii. Secondary Option X15 – Contractor’s design, and
    - iii. Nomination of subcontractors (defined in the works in the project specific information in the contract data) for Generators, Lifts, Pneumatic Tubes, Cool Rooms, Pathology Modules and utilities, including Secondary Option X13 – Performance bond; Secondary Option X17 – Low performance damages, and Secondary Option Z additional conditions of contract concerning credible threats for low performance or non-performance – to complement Options X13 and X17, for the nominated subcontractors.
5. **Contract #5 (using Competitive contracting)**. Scope of the works: Low-Risk Pattern 6 activities i.e., detailed design and construction of initial works. And High-Risk Patterns 8 activities i.e., construction of utilities diversions/connections.
  - a. NEC ECC including:
    - i. Main Payment Option B (Priced contract with bills of quantities)
    - ii. Secondary Option X15 – Contractor’s design, and
    - iii. Nomination of subcontractors (defined in the works in the project specific information in the contract data) for utilities.
6. **Contract #6 (using Standard Competitive contracting)**. Scope of the works: Low-Risk Pattern 6 activities i.e., detailed design and construction of external works.
  - a. NEC ECC including:
    - i. Main Payment Option A (Priced contract with activity schedule), and
    - ii. Secondary Option X15 – Contractor’s design.

## 4.6 Validation

### 4.6.1 Summary

As mentioned in Section 2.3.5, in order to validate the procurement strategy recommended by the Tool (based on Table 2.1 ranking of project performance attributes) – when this matches the actual procurement approach (where a Client ranking of project performance attributes similar to Table 2.1) and when this mismatches the actual procurement approach (where a Client ranking of project performance attributes is dissimilar to Table 2.1), an assessment of value for money achieved/ achievable by the actual approach versus the approach recommended by the Tool is required.



In the absence of the ability to directly assess value for money achieved/achievable from the actual approach versus the approach recommended by the Tool by using actual procurement related whole-life costs and benefits, an indirect approach is used as an indicator of value for money, i.e., EoI are used to validate the outcomes of the Tool, where these match or mismatch the actual procurement approach, as follows:

Actual competition is expected to be within the optimum range of competition, i.e., 5 to 8 EoI inclusive, in cases where actual procurement substantially matches the procurement strategy recommended by the Tool; and actual competition is expected to be outside the optimum range of competition i.e., 4 or less EoI, or 9 or more EoI, in cases where actual procurement substantially mismatches the procurement strategy recommended by the Tool.

Additionally, the EoI validation approach can be corroborated by using the Client's ranking of the project performance attributes and accompanying justification statement (detailed in Section 2.1).

## 4.6.2 Input

The output from Step 5, and the Tool i.e., contact packages of externalised Project Specific activities with assigned contracting terms i.e., competitive (standard competitive or bespoke competitive) or collaborative or standard competitive (with some bespoke competitive terms and/or some collaborative terms), provides part of the information required for validation.

Further information concerning EoI is required for validation. Actual EoI known at time applying the Tool are used when applying the Tool in review mode, while actual EoI established after applying the Tool are used in either current or preview mode.

Additionally, the Client's ranking of the project performance attributes and accompanying justification statement (detailed in Section 2.1) is the remaining part of the information required for validation.

## 4.6.3 Procedure

The procedure for validation is as follows:

1. When applying the Tool in either review mode or current mode, the procurement strategy recommended by the Tool is validated when either:
  - a. The procurement strategy recommended by the Tool appreciably *matches* the actual procurement, and EoI are *within* the optimum range of competition, i.e., 5 to 8 EoI inclusive, and the Client ranking of project performance attributes is *similar* to Table 2.1, or
  - b. The procurement strategy recommended by the Tool appreciably *mismatches* the actual procurement, and EoI are *outside* the optimum range of competition, i.e., 4 or less, or 9 or more, and the Client ranking of project performance attributes is *different* to Table 2.1.
2. When applying the Tool in preview mode, there is no current or past procurement decision by which to compare with the procurement strategy recommended by the Tool, and so the procurement strategy recommended by the Tool is validated when EoI are later established and when EoI are *within* the optimum range of competition, i.e., 5 to 8 EoI inclusive, and the Client ranking of project performance attributes is *similar* to Table 2.1.

## 4.6.4 Examples of output

### 4.6.4.1 TSRC

The procedure for validation in TSRC was followed i.e., validation procedure #1 (as the Tool is applied in review mode). This led to the following output:

1. The comparison of the procurement strategy recommended by the Tool and actual procurement is summarised in Table 4.13.

**Table 4.13: Comparison of procurement in TSRC**

Tool's recommended procurement strategy recommended	Actual procurement
Professional Services Contract/s for outline design of road and tunnel	Professional Services Contract/s for reference design
Detailed Design and Construction Contract for road and tunnel	Detailed Design and Construction and Maintenance Contract for road and tunnel
Detailed Design and Construction Contract for M&E works in the tunnel	
Operations and Maintenance procured as part of the Client's existing network	

2. Given the substantial proportion of project cost comprising capital costs are associated with those parts of the procurement strategy recommended by the Tool that appreciably matched actual procurement, and EoI were within the optimum range of competition (i.e., between 5 to 8, Austroads, 2020), and the Client's ranking of project performance attributes is similar to Table 2.1, the outcomes of Tool on TSRC are validated.

### 4.6.4.2 GCUH

The procedure for validation in GCUH was followed i.e., validation procedure #1 (as the Tool is applied in review mode). This led to the following output:

1. The comparison of the procurement strategy recommended by the Tool and actual procurement is summarised in Table 4.14.

**Table 4.14: Comparison of procurement in TSRC**

Tool's recommended procurement strategy recommended	Actual procurement
Professional Services Contract/s for outline design	Professional Services Contract/s to and including schematic design
Initial Works (Detailed Design and Construction Contract)	Single Managing Contractor Contract for developed design and construction
Main Clinical Building and Accommodation Wards (Detailed Design and Construction Contract and Maintenance Contract 10 years from opening)	
Other buildings and Carpark (West) (Detailed Design and Construction Contract and Maintenance Contract 10 years from opening)	PPP Contract for Carpark (West)
Externals Works (Detailed Design and Construction Contract)	
All building and externals works (renewable maintenance contracts from and including 11 years after opening)	
Operations and Maintenance procured as part of the Client's existing network	Soft FM and Hard FM contracts

2. Given the procurement strategy recommended by the Tool appreciably mismatched actual procurement, and EoI for the Managing Contractor role were outside the optimum range of competition (i.e., 4 or less), and the Client's ranking of project performance attributes is dissimilar to Table 2.1, the outcomes of Tool on GCUH are validated.
3. It is relevant note:
  - a. Consistent with Client's ranking of project performance mismatching the ranking in Table 2.1, QAO consider the Client selected its preferred procurement delivery model – Managing Contractor with a guaranteed construction sum ahead of the business case and not in accordance with the government's value for money/project assurance framework, because of QH's decision to focus on achieving project time frames within budget, rather than identifying an innovative and best value for money solution (QAO, 2014: 28)
  - b. The Tool's recommended approach would likely have attracted between 5-8 EoI in terms of the major construction contract for the Main Clinical Building and Accommodation Wards (based on EoI data from a national survey of health projects, Bridge and Bianchi, 2014 and Teo, 2014), and
  - c. The selected Managing Contractor developed a procurement approach for construction similar to the Tool's recommended approach. The approach by the Managing Contractor was based on six major areas of work/micro-projects (Lend Lease, 2014: 8).

## Section 5

# Mobilising

An indication of the personnel and time required to apply the Tool on a project with up to 500 activities is shown in Table 5.1.

**Table 5.1: Indicative personnel and time requirements**

Step	Procedure	Personnel (Minimum)	Approximate Time (for project up to 500 activities)
<b>1. Activity Analysis</b>			
	Input information (project details to date)		Client to determine
1.	Divide the project into discrete parts	Project Director and Technical Analyst (familiar with the Tool)	½ day x 2 personnel = 1 day
2.	Identify DCOM activities in each part of the project	Project Director and Technical Analyst (familiar with the Tool)	Included above
3.	Write-up longlists	Technical Analyst (familiar with the Tool)	½ day x 1 personnel = ½ day
4.	Write-up shortlists	Project Director and Technical Analyst (familiar with the Tool)	½ day x 2 personnel = 1 day
<b>2. Project Specific-or-Network Analysis</b>			
	Input Information (Step 1 output and details on Client's existing network)		Client to determine
1.	Identify which of the shortlist/s are Network Activities or Project Specific Activities	Project Director and Technical Analyst (familiar with the Tool)	½ day x 2 personnel = 1 day
<b>3. Risk (<i>Make-or-Buy</i>) Analysis</b>			
	Input Information (Step 2 Output and Client's ranking of the project performance attributes and accompanying justification statement and associated EoI timeline and initial Risk Register)		Client to determine
1.	Apply questions to all Project Specific activities in all parts of the project.	Project Director and Technical Analyst (familiar with the Tool)	5 days x 2 personnel = 10 days
2.	Assess the level of the three columns (or dimensions) of High Prices and the three dimensions of Costly Variations	Project Director and Technical Analyst (familiar with the Tool)	Included above

Step	Procedure	Personnel (Minimum)	Approximate Time (for project up to 500 activities)
3.	Ungroup an activity (from the activity's initial grouping in Step 1) – if necessary and divide this activity into two or more sub-activities	Project Director and Technical Analyst (familiar with the Tool)	Included above
4.	Assign a Risk Pattern for each Project Specific Activity by using the assessed level	Project Director and Technical Analyst (familiar with the Tool)	Included above
5.	Check the validity of matching the Project Specific Activity with one of the Risk Patterns	Project Director and Technical Analyst (familiar with the Tool)	Included above
6.	List the Project Specific activities that are assigned an externalised Risk Patterns	Project Director and Technical Analyst (familiar with the Tool)	Included above
<b>4. Contract Packaging (<i>Bundling</i>) Analysis</b>			
Input Information (Step 3 Output)			
1.	Review the High-Risk Pattern 7 and Pattern 8 activities and sub-activities	Project Director and Technical Analyst (familiar with the Tool)	½ day x 2 personnel = 1 day
2.	Initial Bundling	Project Director and Technical Analyst (familiar with the Tool)	Included above
3.	Reassess the Risk Pattern at level of each bundle to check that a new High-Risk Pattern 7 and/or new High-Risk Pattern 8 has not arisen	Project Director and Technical Analyst (familiar with the Tool)	Included above
4.	Market sound for private finance (where appropriate bundle identified)	Treasury Director	Client to determine
<b>5. Collaborative-or-Competitive Contracting (<i>Exchange Relationship</i>) Analysis</b>			
Input Information (Step 4 Output)			
1.	Assign an exchange relationship to each bundle, or contract package	Project Director and Technical Analyst (familiar with the Tool)	½ day x 4 personnel = 2 days
2.	Where practicable, select a standard contract e.g., NEC to reflect the exchange relationship assigned to each bundle, or contract package	Project Director and Technical Analyst (familiar with the Tool) and Contracts Director and Treasury Director	Included above
<b>Validation</b>			
Input Information (EoI and Client's ranking of the project performance attributes)			
1.	Select validation approach depending on mode of application	Technical Analyst (familiar with the Tool)	½ day x 1 personnel = ½ day

# Practical Implications

## 6.1 Differences Between the Tool and STEPS

### 6.1.1 Summary

The OECD collaborated with QUT to further develop and pilot the Tool outside Australia. This collaboration resulted in the OECD developing a version of the Tool that the OECD named STEPS (*Strategic Tool for Effective Procurement Strategy*). The OECD made three discernible changes to the Tool and included these changes in STEPS. These changes are described in Section 5 of the OECD's Public Governance Policy paper on STEPS (OECD, 2021).

Two of the changes made by the OECD in STEPS concern the presentation of the analysis of microeconomic risks of High Prices and Costly Variations i.e., the risk patterns in Table 2.3 of the Tool's Step 3. These changes are not a source of any material difference in the outcome, or procurement strategy, recommended by the Tool and the procurement strategy recommended by STEPS. However, these two changes do create a source of weakness in STEPS and a corresponding source of strength in the Tool.

The third change concerns the cost and benefits of bundling, and this change could be a potential source of a material difference in the outcome, or procurement strategy, recommended by the Tool and the procurement strategy recommended by STEPS. This change creates a more significant source of weakness in STEPS than the other two changes, and a corresponding significant source of strength in the Tool.

In the following sections, a response is given to the OECD's critique of the Tool in Section 5 of the OECD's Public Governance Policy paper on STEPS (OECD, 2021). In doing so, the weaknesses created by the three changes in STEPS are explained and the corresponding strengths of the Tool justified.

Outside of these three changes, STEPS is aligned with the Tool and so the two tools are substantially the same.

In Section 5 of the OECD's Public Governance Policy paper on STEPS, the OECD also clarified the position of STEPS vis-à-vis a paper by Argyres and Zenger (2012) on the complementarity of two theories used in STEPS i.e., Transaction Cost Economics (TCE) and Resource-based Theory (RBT). A different clarification is given in Appendix B of the position of the Tool vis-à-vis this paper by Argyres and Zenger on the complementarity of TCE and RBT used in the Tool.

### 6.1.2 OECD change #1: Complementarity dimension in RBT

In the first change in STEPS, the OECD omit the complementarity dimension (or Value variable) in RBT in Table 2.3 of the Tool's Step 3. They argue that this variable is hard to measure and does not add explanatory power.

However, when the RBT Value variable is expressed in terms of capability and capacity (as per Question HP1a-d in Box 4.1), it has been found to be straightforward to answer and, therefore, effectively measurable. In terms of the explanation power of RBT's Value variable, and in its absence, STEPS places reliance on the Frequency dimension to develop the correct risk pattern including discerning between internalisation and externalisation. While this approach in STEPS does not create a source of a material difference in the procurement strategy recommended by the Tool and the procurement strategy recommended by STEPS, this approach in STEPS misses the opportunity to use the assessment of the Complementarity dimension as a check on validity of answers and assessment of the Frequency dimension. The assessment of the Complementarity dimension and the Frequency dimension correlate and are mutually supportive.

### 6.1.3 OECD change #2: Risk patterns

In the second change in STEPS, the OECD merge Risk Pattern 1 and 2, and merge Risk Pattern 7 and 8 to reduce the total risk patterns to 6 risk patterns in STEPS from 8 risk patterns in the Tool. They argue that these mergers do not affect the subsequent treatment of risk and overplays the precision by which the dimensions that determine either a Risk Pattern 1 or 2, or a Risk Pattern 7 or 8 can be assessed.

Again, while this approach in STEPS does not create a source of a material difference in the procurement strategy recommended by the Tool and the procurement strategy recommended by STEPS, this approach in STEPS undermines the validity of the way that the risks represented by Pattern 7 and 8 activities are treated in STEPS. As per Table 2.3, there is a difference, by degree, in terms of the risk of high prices arising from Pattern 7 and 8 activities – with this risk being higher in Pattern 8 activities. The Tool is sensitive to this differential risk. Accordingly, the Tool would prompt more extreme versions of credible threats and bespoke competitive contracting needed in Pattern 8 activities, in contrast to those credible threats in Pattern 7 activities, to pre-empt post-contract bargaining power held by suppliers of these activities. STEPS is not sensitive to this differential risk because it merges Pattern 7 and 8.

In terms of the precision required to identify a Pattern 7 or 8 Risk Pattern, only a "High" or "Low" assessment needs to be made on the Costly to Imitate dimension – by answering "Yes" or "No" to the corresponding question i.e., Question HP3 in Box 4.1. Answers to this question have also been found to be satisfactory and so maintaining 8 risk patterns does not give a false impression of the precision of measurement.

### 6.1.4 OECD change #3: Bundling costs and benefits

In the third change in STEPS, the OECD recommend that bundling design with construction, or bundling design with construction and operations and/or maintenance only occurs when the Client judges there to be the likelihood of a superior engineering solution developed by the winning proponent and when the benefits of this superior engineering solution offset the cost of inefficient risk pricing by the proponents. The OECD argue risk pricing inefficiency, i.e., internal contingencies associated with a lack of detail in tendering documentation, create risk premia embedded in tenders and unduly high prices and which significantly undermines the viability of bundling. In doing so, the OECD emphasises in STEPS the costs of risk pricing inefficiency in bundling, when the Tool emphasises the net benefits of bundling. This difference between STEPS and the Tool could lead to an appreciably different procurement strategy recommended by STEPS to the procurement strategy recommended by the Tool.

The OECD justifies its focus on the costs of risk pricing inefficiency in bundling by reference to several empirical studies. However, the empirical evidence to which the OECD refers do not directly relate to internal contingencies that might arise because of a lack of design detail associated with bundling design with construction and/or operation and maintenance. Rather, the empirical evidence cited by the OECD concerns the disproportionate improvement in prices arising in response to the client retaining the risk of cost increases on a production input, the release of a fully costed design and switching from lump sum pricing to pricing based on a bill of quantities (OECD, 2021: 50). The

OECD hypothesise that this evidence applies to bundling. This hypothesis is highly questionable because of the lack of relevance of the data supporting this hypothesis. Plus, the empirical evidence cited by the OECD is derived from very small scale (up to EUR 5 million) Design-Bid-Build roads contracts in which it is not surprising that very small contractors are extremely sensitive to small adjustments in the risk profile of projects. The context of STEPS and the Tool are projects at the other end of the spectrum in terms of project size and attract contractors whose core business includes management of both design and construction activities. The data on which the OECD develops its focus on the risk pricing inefficiency is practically not applicable. Therefore, the OECD's focus on the costs of risk pricing inefficiency in the context of major and mega projects lacks justification.

The OECD's focus on a superior engineering solution as comprising the benefit of bundling is a very narrow view of the benefits of bundling. In a fixed priced bundled contract, there is normally no incentive for the contractor to deliver improvements in design that improve the performance of the asset from the user's perspective. Indeed, competent design is usually held as reasonable skill and care and is not judged in terms of fit for purpose. Also, the user's performance attributes are often difficult to assess. Even when these performance attributes are more objective, and in conjunction with a bonus fund for performance improvements, the differential potential of design and build contractors to deliver these improvements is very difficult to assess when evaluating tenders.

Instead, the strong incentive that exists in bundling concerns the range of benefits listed in Tables 2.4 to 2.6 including:

- Whole-Life-Cost improvements
- More certainty in time, cost and quality, and
- Less absolute time.

With regards to Whole-Life-Cost, often improvements that can lead to significant improvement in life cycle costs are mundane and small-scale including specification changes and often significant improvements in capital costs arise from changes that may again be mundane, including changes to construction method and elimination of unnecessary costs. While these changes may be mundane, relative to an innovative engineering solution, they are very important in terms of adding value for money. These changes are also the domain of the design and build contractor and it would be difficult for the Client to judge the potential for these improvements. The OECD's recommendation that bundling only occurs when the client can judge the potential for a superior engineering solution, at best introduces unnecessary subjectivity to STEPS and at worst will lead STEPS into developing inferior procurement strategy recommendations – in which Design-Bid-Build is likely to be STEPS "lowest unit of contracting", or default procurement strategy.

The OECD seems to be acknowledging these weaknesses in its focus on the cost of bundling, when it concedes its approach is "conservative". In other words, the OECD is recognising that its approach to bundling is deliberating overplaying the costs of bundling and deliberating underplaying the benefits if bundling (OECD, 2021: 54).

In contrast, the Tool emphasises the net benefits of bundling including the full range of benefits in Tables 2.4 to 2.6. Additionally, the Tool is not mute on reducing uncertainty (read unpredictability) when one of the key features of the Tool is to identify High-Risk Pattern 5 activities that can lead to costly variations and to treat these activities, along with treating High-Risk Pattern 7 and 8 activities that can lead to High prices, to minimise the costs of bundling.

As it stands, the Tool will likely recommend procurement strategies comprising more bundling and larger size contracts than will STEPS. In so doing, the Tool will identify more contracts that suit larger contractors and private investment and private finance in which the bundle of activities creates the potential for efficiency gains to offset higher cost of private project finance e.g., Contract #3 in GCUH. That said, the Tool's default procurement is not design and build. For example, the Tool will likely often recommend design-only contracts e.g., Contract #1 in TSRC and Contract #1 in GCUH. And the Tool will also often recommend small-scale contracts e.g., Contract #2 in TSRC and Contracts #5 and #6 in GCUH.



The OECD and the Tool's author agree that Bundling has often been poorly conceived and implemented in current procurement decision-making practice. The Tool can greatly advance Bundling and, indeed, STEPS can also achieve this – with some re-adjustment on its approach to bundling to align with the Tool.

## 6.2 Improvements to Productivity

### 6.2.1 Rationalisation of procurement

It is logical to expect that the application of the Tool will see the emergence of different approaches and innovations in patterns of procurement relating to the key procurement dimensions of size, bundling and exchange relationships. This is mainly because the Tool is exclusively a microeconomic tool, with a long-term orientation. For example, based on the current Australian market, it is likely that the Tool will restrict individual bundles and contracts up to \$1 billion. The Tool may encourage the rationalisation of procurement across different sectors. It is likely to reveal greater scope for bundling operations and maintenance with design and construction in health projects, and for the consideration of more of these projects as projects including private finance. It is also likely to promote the use of private finance for very large and complex projects and where a relatively high percentage of total cost are operations and maintenance costs. Increasing rationalisation of procurement across sectors is also likely to lead to less reliance on stereotypical procurement that tends to create incentives to minimise capital costs, and/or minimise construction time. The Tool is likely to display more finesse in deploying Alliancing so that this mode is only employed with regards to the new infrastructure project/parts of the new project if/when it can be efficient.

### 6.2.2 Deepening markets

The Tool is likely to create an improved pipeline of contracts for both local contractors and new entrants wishing to make Australia a long-term proposition. In this way, a win-win scenario would be created arising from more contracts and more widely distributed contracts to deliver megaprojects and major projects. This would be particularly important for attracting and justifying private investment and finance.

### 6.2.3 Integration of procurement-related tools

The Tool would best be applied in tandem with post-completion review tools, such as the Value Rating Tool being developed as part of an Australian Research Council funded project led by QUT.

<sup>8</sup> This is consistent with recommendations in the Productivity Commission (2014), the House of Representatives Standing Committee on Infrastructure, Transport and Cities (2022) and Infrastructure Australia (2021).

## 6.3 Flexibility of the Tool

The Tool's questions can be adapted to suit the procurement of any asset, beyond new built infrastructure, that meets the Tool's parameters in Section 2.4 e.g., defence assets.

The Tool can be applied in the same project but from the viewpoint of different clients or buyers in the supply chain. The Tool is applied in this User Guide based on the buyer being the Client that funds the project, but it could also be applied by the Main Contractor as the procurer of subcontractors and suppliers (with adjustments made to this buyer's procurement priorities and the ranking of the project performance attributes).

---

<sup>8</sup> Further details on the Value Rating Tool can be found at: <https://research.qut.edu.au/arcvio/>

## 6.4 Future Development of the Tool

Though the Tool is essentially an algorithm and expert system, there is the potential to develop its manual interface to create automatic prompts on the procedures in each step.

A future database of applications of the Tool (like the NEC database in Footnote #7) would help improve the procedure of developing shortlists in Step 1 and reduce the subsequent subdivision and refinement of activities in Step 3.

# Findings and Recommendations

## Summary

The Tool identifies the best value for money approach to two key infrastructure procurement decisions. These are contract packaging (the size and number of contracts) and their contract terms (using competitive and/or collaborative contracting). To achieve this, the Tool employs state-of-the-art microeconomic theory that was developed to address these two procurement decisions specifically and systematically.

The Tool highlights the criticality of the Client's procurement priorities in terms of ranking of project performance attributes. Where the Client's ranking of project performance attributes is consistent with Table 2.1, then the Tool will set the project on a procurement path to deliver optimal value for money. The application of Tool will promote the Client ranking the project performance attributes as per Table 2.1.

Regardless of the Client's ranking of project performance attributes, the Tool will deliver the basis of a significant improvement in value for money relative to current procurement decision-making practice.

Neither competition nor collaboration are virtues on their own. Rather, it is the Tool's strategic deployment and mixing of these approaches to contracting that is the key to optimising value for money, i.e., competition *and* collaboration leads to maximising cooperation.

## Key findings

The key findings arising from the User Guide (including the trial application of the Tool on GCUH) are as follows:

1. The Tool is a world-first; it is the only resource available to use across the globe to guide procurement decision-making based on state-of-the-art microeconomic theories (listed in Table B.1) and which has been successfully empirically tested. The significance of this becomes self-evident, given that value for money is an economic concept and requires an economic response.
2. The successful application of the Tool on GCUH adds to the other successful applications of the Tool (summarised in Appendix C) and provides very strong evidence of the effectiveness of the Tool in recommending a procurement strategy that can be expected to deliver superior value for money than current procurement decision-making practice.
3. More specifically, the Tool can be expected to make a significant contribution to addressing the recommendations by the Productivity Commission, the House of Representatives Standing Committee on Infrastructure, Transport and Cities and Infrastructure Australia (in Boxes 1.2 to 1.4) concerning improving current procurement decision-making practice.

4. In brief, the Tool can be expected to deliver the following important benefits:
  - a. Significant cost and time savings
  - b. Appreciable improvements in transparency, accountability, consistency, and reliability in procurement decision-making, and
  - c. More efficient deployment of private investment and finance.
5. The Tool is estimated to double the chance of more effective procurement decision-making in contrast to current procurement decision-making practice (Bridge and Bianchi, 2014).

## Recommendations

### Recommendation 1

Infrastructure Australia adopt the Procurement Decision Tool as the "Procurement Decision-Making Tool" to which Infrastructure Australia refers in its Infrastructure Plan 2021 (Recommendation 3.2b.1).

### Recommendation 2

Australian state and territory governments use the Tool in business case when seeking federal government funding in their new infrastructure projects, as well as using the Tool in business case when they are the sole funders of their projects.

# Shortlists of Activities in GCUH

**Table A-1: Shortlist of *design* activities in Engineering Workshops in GCUH (Based on ACMM, 2000 and 2001)**

<b>Engineering Workshops (<i>Design</i>)</b>		
1. Architectural Design	3. Mechanical Design	8. Maintenance Design (plan/specification of routine and programmed maintenance)
2. Structural Engineering Design	4. Electrical Design	
	5. Hydraulics Design	
	6. Fire Protection Design	
	7. Communications Design	

**Table A-2: Shortlist of *construction* activities in Engineering Workshops in GCUH (Based on ACMM, 2000 and 2001)**

<b>Engineering Workshops (<i>Construction</i>)</b>		
9. Piles and Piers	19. Hardware to Doors	34. Ventilation
10. Foundation Beams	20. Metal Studding Internal Walls	35. Air Conditioning
11. Ground Slabs	21. Plasterboard including Paintwork Wall Finishes	36. Fire Protection
12. Service Tunnel	22. Ceramic Wall Finishes	37. Electric Light and Power
13. Portal Frame	23. Trowelled Finish to Concrete Floor Finishes	38. Communications (including Voice and Data)
14. Coated Steel Roof Covering	24. Vinyl Floor Finishes	39. UPS
15. Sheet Cladding External Walls	25. Ceramic Tiles Floor Finishes	
16. Steel Windows	26. Carpet Finishes	
17. Metal Cored Doors	27. Plasterboard Ceiling Finishes	
18. Metal Frames to Doors	28. False Ceiling Finishes	
	29. Fitments (including Loose and Fixed Furniture)	
	30. Sanitary Fixtures	
	31. Sanitary Plumbing	
	32. Water Supply	
	33. Gas Service	

**Table A-3: Shortlist of *operations* activities in Engineering Workshops in GCUH (Based on ACMM, 2000 and 2001)**

<b>Engineering Workshops (<i>Operations</i>)</b>
40. Cleaning
41. Pest control
42. Waste management
43. Security
44. Building Services Control

**Table A-4: Shortlist of *maintenance* activities in Engineering Workshops in GCUH (Based on ACMM, 2000 and 2001)**

<b>Engineering Workshops (<i>Maintenance</i>)</b>		
45. Service Tunnel	50. Hardware to Doors	65. Ventilation
46. Coated Steel Roof Covering	51. Metal Studding Internal Walls	66. Air Conditioning
47. Sheet Cladding External Walls	52. Plasterboard including Paintwork Wall Finishes	67. Fire Protection
48. Steel Windows	53. Ceramic Wall Finishes	68. Electric Light and Power
49. Metal Cored Doors	54. Trowelled Finish to Concrete Floor Finishes	69. Communications (including Voice and Data)
Metal Frames to Doors	55. Vinyl Floor Finishes	70. UPS
	56. Ceramic Tiles Floor Finishes	
	57. Carpet Finishes	
	58. Plasterboard Ceiling Finishes	
	59. False Ceiling Finishes	
	60. Fitments (including Loose and Fixed Furniture)	
	61. Sanitary Fixtures	
	62. Water Supply	
	63. Sanitary Plumbing	
	64. Gas Service	

**Table A-5: Shortlist of *design* activities in Central Energy Plant building in GCUH (Based on ACMM, 2000 and 2001)**

<b>Central Energy Plant building (<i>Design</i>)</b>		
71. Architectural Design	73. Mechanical Design	79. Maintenance Design (plan/specification of routine and programmed maintenance)
72. Structural Engineering Design	74. Electrical Design	
	75. Hydraulics Design	
	76. Fire Protection Design	
	77. Medical Gases Design	
	78. Communications Design	

**Table A-6: Shortlist of *construction* activities in Central Energy Plant building in GCUH (Based on ACMM, 2000 and 2001)**

<b>Central Energy Plant building (<i>Construction</i>)</b>			
80. Basement Excavation	95. Hardware to Doors	110. Ventilation	
81. Piles and Piers	96. Metal Studding Internal Walls	111. Air Conditioning	
82. Foundation Beams	97. Plasterboard including Paintwork Wall Finishes	112. Fire Protection	
83. Ground Slabs	98. Ceramic Wall Finishes	113. Electric Light and Power	
84. Service Tunnel	99. Trowelled Finish to Concrete Floor Finishes	114. Communications (including Voice and Data)	
85. Structural Steel Columns	100. Vinyl Floor Finishes	115. UPS	
86. Insitu Slab Upper Floors	101. Ceramic Tiles Floor Finishes	116. Plant including Electricity Generating Plant	
87. Staircases including Landings, Tread and Rises Finishes	102. Carpet Finishes	117. Cooling towers	
88. Balustrades and Wall Handrails	103. Plasterboard Ceiling Finishes		
89. Concrete Roof	104. False Ceiling Finishes		
90. Roof Covering (trafficable)	105. Fitments (including Loose and Fixed Furniture)		
91. Sheet Cladding External Walls	106. Sanitary Fixtures		
92. Steel Windows	107. Sanitary Plumbing		
93. Metal Cored Doors	108. Water Supply		
94. Metal Frames to Doors	109. Gas Service		

**Table A-7: Shortlist of *operations* activities in Central Energy Plant building in GCUH (Based on ACMM, 2000 and 2001)**

<b>Central Energy Plant building (<i>Operations</i>)</b>
118. Cleaning
119. Pest Control
120. Waste Management
121. Security
122. Building Services Control

**Table A-8: Shortlist of *maintenance* activities in Central Energy Plant building in GCUH (Based on ACMM, 2000 and 2001)**

<b>Central Energy Plant building (<i>Maintenance</i>)</b>		
123. Service Tunnel	129. Hardware to Doors	144. Ventilation
124. Roof Covering (trafficable)	130. Metal Studding Internal Walls	145. Air Conditioning
125. Sheet Cladding External Walls	131. Plasterboard including Paintwork Wall Finishes	146. Fire Protection
126. Steel Windows	132. Ceramic Wall Finishes	147. Electric Light and Power
127. Metal Cored Doors	133. Trowelled Finish to Concrete Floor Finishes	148. Communications (including Voice and Data)
128. Metal Frames to Doors	134. Vinyl Floor Finishes	149. UPS
	135. Ceramic Tiles Floor Finishes	150. Plant including Electricity Generating Plant
	136. Carpet Finishes	
	137. Plasterboard Ceiling Finishes	
	138. False Ceiling Finishes	
	139. Fitments (including Loose and Fixed Furniture)	
	140. Sanitary Fixtures	
	141. Sanitary Plumbing	
	142. Water Supply	
	143. Gas Service	

**Table A-9: Shortlist of *design* activities in Mental Health building in GCUH (Based on ACMM, 2000 and 2001)**

<b>Pathology and Education (<i>Design</i>)</b>		
151. Architectural Design	153. Mechanical Design	158. Maintenance Design (plan/specification of routine and programmed maintenance)
152. Structural Engineering Design	154. Electrical Design	
	155. Hydraulics Design	
	156. Fire Protection Design	
	157. Communications Design	



**Table A-10: Shortlist of *construction* activities in Mental Health building in GCUH (Based on ACMM, 2000 and 2001)**

<b>Pathology and Education building (<i>Construction</i>)</b>		
159. Service Tunnel	174. Hardware to Doors	189. Ventilation
160. Piles and Piers	175. Metal Studding Internal Walls	190. Air Conditioning
161. Foundation Beams	176. Masonry Internal Walls	191. Fire Protection
162. Ground Slabs	177. Plasterboard including Paintwork Wall Finishes	192. Electric Light and Power
163. Portal Frame	178. Vinyl Wall Finishes	193. Communications (including Voice and Data)
164. Insitu Slab Upper Floor	179. Vinyl Floor Finishes	194. UPS
165. Staircases including Landings, Tread and Rises Finishes	180. Ceramic Tiles Floor Finishes	195. Lifts
166. Balustrades and Wall Handrails	181. Carpet Floor Finishes	196. UPS
167. Metal Framed Roof	182. Plasterboard Ceiling Finishes	
168. Roof Covering (non-trafficable)	183. False Ceiling Finishes	
169. Masonry External Walls	184. Fitments (including Loose and Fixed Furniture)	
170. Steel Windows	185. Sanitary Fixtures	
171. Timber Cored Doors	186. Sanitary Plumbing	
172. Metal Cored Doors	187. Water Supply	
173. Metal Frames to Doors	188. Gas Service	

**Table A-11: Shortlist of *operations* activities in Mental Health building in GCUH (Based on ACMM, 2000 and 2001)**

<b>Pathology and Education building (<i>Operations</i>)</b>
197. Catering Services
198. Cleaning
199. Pest Control
200. Waste Management
201. Security
202. Building Services Control (including BMS and Internal Alarmed Doors)

**Table A-12: Shortlist of *maintenance* activities in Mental Health building in GCUH (Based on ACMM, 2000 and 2001)**

<b>Pathology and Education building (<i>Maintenance</i>)</b>		
203. Service Tunnel	217. Hardware to Doors	232. Ventilation
204. Piles and Piers	218. Metal Studding Internal Walls	233. Air Conditioning
205. Ground Slabs	219. Masonry Internal Walls	234. Fire Protection
206. Portal Frame	220. Plasterboard including Paintwork Wall Finishes	235. Electric Light and Power
207. Insitu Slab Upper Floor	221. Vinyl Wall Finishes	236. Communications (including Voice and Data)
208. Staircases including Landings, Tread and Rises Finishes	222. Vinyl Floor Finishes	237. UPS
209. Balustrades and Wall Handrails	223. Ceramic Tiles Floor Finishes	238. Lifts
210. Metal Framed Roof	224. Carpet Floor Finishes	239. UPS
211. Roof Covering (non-trafficable)	225. Plasterboard Ceiling Finishes	
212. Masonry External Walls	226. False Ceiling Finishes	
213. Steel Windows	227. Fitments (including Loose and Fixed Furniture)	
214. Timber Cored Doors	228. Sanitary Fixtures	
215. Metal Cored Doors	229. Sanitary Plumbing	
216. Metal Frames to Doors	230. Water Supply	
	231. Gas Service	

**Table A-13: Shortlist of *design* activities in Pathology and Education building in GCUH (Based on ACMM, 2000 and 2001)**

<b>Pathology and Education (<i>Design</i>)</b>		
240. Architectural Design	242. Mechanical Design (including Refrigeration Design)	251. Maintenance Design (plan/specification of routine and programmed maintenance)
241. Structural Engineering Design	243. Electrical Design	
	244. Hydraulics Design	
	245. Fire Protection Design	
	246. Medical Gases Design	
	247. Communications Design	
	248. Audio Visual Design	
	249. Pathology Module Design	
	250. Acoustics Design	

**Table A-14: Shortlist of *construction* activities in Pathology and Education building in GCUH (Based on ACMM, 2000 and 2001)**

<b>Pathology and Education building (<i>Construction</i>)</b>		
252. Piles and Piers	267. Hardware to Doors	282. Ventilation
253. Foundation Beams	268. Metal Studding Internal Walls	283. Air Conditioning
254. Ground Slabs	269. Plasterboard including Paintwork Wall Finishes	284. Fire Protection
255. Service Tunnel	270. Vinyl Wall Finishes	285. Electric Light and Power
256. Reinforced Concrete Columns	271. Vinyl Floor Finishes	286. Communications (including Voice and Data)
257. Insitu Slab Upper Floors	272. Ceramic Tiles Floor Finishes	287. UPS
258. Staircases including Landings, Tread and Rises Finishes	273. Carpet Finishes	288. Lifts
259. Balustrades and Wall Handrails	274. Plasterboard Ceiling Finishes	289. Pneumatic Tube Systems
260. Metal Framed Roof	275. False Ceiling Finishes	290. UPS
261. Roof Covering (non-trafficable)	276. Fitments (including Loose and Fixed Furniture)	291. Cool Rooms
262. Sheet Cladding External Walls	277. Special Equipment including Mortuary Equipment, Audio Visual equipment, Laboratory Equipment)	292. Medical Gases
263. Steel Windows	278. Sanitary Fixtures	
264. Timber Cored Doors	279. Sanitary Plumbing	
265. Metal Cored Doors	280. Water Supply	
266. Metal Frames to Doors	281. Gas Service	

**Table A-15: Shortlist of *operations* activities in Pathology and Education building in GCUH (Based on 2000 and 2001)**

<b>Pathology and Education building (<i>Operations</i>)</b>
293. Catering Services
294. Cleaning
295. Pest Control
296. Waste Management
297. Security
298. Building Services Control

**Table A-16: Shortlist of *maintenance* activities in Pathology and Education building in GCUH (Based on ACMM, 2000 and 2001)**

<b>Pathology and Education building (<i>Maintenance</i>)</b>		
299. Service Tunnel	307. Hardware to Doors	322. Ventilation
300. Staircases including Landings, Tread and Rises Finishes	308. Metal Studding Internal Walls	323. Air Conditioning
301. Balustrades and Wall Handrails	309. Plasterboard including Paintwork Wall Finishes	324. Fire Protection
302. Roof Covering (non-trafficable)	310. Vinyl Wall Finishes	325. Electric Light and Power
303. Sheet Cladding External Walls	311. Vinyl Floor Finishes	326. Communications (including Voice and Data)
304. Steel Windows	312. Ceramic Tiles Floor Finishes	327. UPS
305. Metal Cored Doors	313. Carpet Finishes	328. Lifts
306. Metal Frames to Doors	314. Plasterboard Ceiling Finishes	329. Pneumatic Tube Systems
	315. False Ceiling Finishes	330. UPS
	316. Fitments (including Loose and Fixed Furniture)	331. Cool Rooms
	317. Special Equipment including Mortuary Equipment, Audio Visual equipment, Laboratory Equipment)	332. Medical Gases
	318. Sanitary Fixtures	
	319. Sanitary Plumbing	
	320. Water Supply	
	321. Gas Service	

**Table A-17: Shortlist of design activities in Clinical Services and IPU (West and South) building in GCUH (Based on ACMM, 2000 and 2001)**

<b>Clinical Services and IPU (West and South) building (<i>Design</i>)</b>		
333. Architectural Design	335. Mechanical Design (including Refrigeration Design)	343. Maintenance Design (plan/ specification of routine and programmed maintenance)
334. Structural Engineering Design	336. Electrical Design	
	337. Hydraulics Design	
	338. Fire Protection Design	
	339. Medical Gases Design	
	340. Communications Design	
	341. Audio Visual Design	
	342. Acoustics Design	

**Table A-18: Shortlist of *construction* activities in Clinical Services and IPU (West and South) building in GCUH (Based on ACMM, 2000 and 2001)**

<b>Clinical Services and IPU (West and South) building (<i>Construction</i>)</b>		
344. Piles and Piers	366. Plasterboard including Paintwork Wall Finishes	390. Gantry Cranes
345. Foundation Beams	367. Vinyl Wall Finishes	391. Patient Monitoring Systems
346. Ground Slabs	368. Ceramic Wall Finishes	392. Patient Protection Systems
347. Service Tunnel	369. Vinyl Floor Finishes	393. Security System
348. Reinforced Concrete Columns	370. Ceramic Tiles Floor Finishes	394. Lightning Protection
349. Insitu Slab and Beam Upper Floors	371. Carpet Floor Finishes	395. Static Earthing
350. Precast Staircases including Landings, Tread and Rises Finishes	372. Plasterboard Ceiling Finishes	396. Conditioned and Converted Power
351. Balustrades and Wall Handrails	373. False Ceiling Finishes	397. UPS
352. Ramps	374. Timber Boarded Ceiling Finishes	398. Screened Rooms Coll Rooms
353. Concrete Roof (including a Portal Frame on top Roof)	375. Fitments (including Loose and Fixed Furniture)	399. Refrigeration Plant
354. Roof Covering (trafficable)	376. Special Equipment including Audio Visual Equipment)	400. Stairwell Pressurisation Systems
355. Curtain Walls (including Windows and Doors)	377. Sanitary Fixtures	401. Compressed Air Systems
356. Timber Cored Doors	378. Sanitary Plumbing	402. Vacuum Systems
357. Metal Cored Doors	379. Water Supply	403. Medical Oxygen Systems
358. Automatic Doors	380. Gas Service	404. Medical Air Systems
359. Rollar Shutter Doors	381. Ventilation	405. Medical Gases
360. Metal Frames to Doors	382. Air Conditioning	406. Waste Disposal Systems
361. Hardware to Doors	383. Fire Protection	407. Cooling Towers
362. Metal Studding Internal Walls	384. Electric Light and Power	408. Helipad
363. Insitu Concrete Internal Walls	385. Communications (including Voice and Data)	
364. Masonry Internal Walls	386. UPS	
365. Operable Screens	387. Goods Lifts	
	388. Passenger Lifts	
	389. Pneumatic Tube Systems	

**Table A-19: Shortlist of *operations* activities in Clinical Services and IPU (West and South) building in GCUH (Based on ACMM, 2000 and 2001)**

<b>Pathology and Education building (<i>Operations</i>)</b>	
409. Catering Services	412. Waste Management
410. Cleaning	413. Security Building Services Control (including BMS)
411. Pest Control	

**Table A-20: Shortlist of *maintenance* activities in Clinical Services and IPU (West and South) building in GCUH (Based on ACMM, 2000 and 2001)**

<b>Clinical Services and IPU (West and South) building (<i>Maintenance</i>)</b>		
414. Precast Staircases including Landings, Tread and Rises Finishes	429. Plasterboard including Paintwork Wall Finishes	453. Gantry Cranes
415. Balustrades and Wall Handrails	430. Vinyl Wall Finishes	454. Patient Monitoring Systems
416. Ramps	431. Ceramic Wall Finishes	455. Patient Protection Systems
417. Roof Covering (trafficable)	432. Vinyl Floor Finishes	456. Security System
418. Curtain Walls (including Windows and Doors)	433. Ceramic Tiles Floor Finishes	457. Lightning Protection
419. Timber Cored Doors	434. Carpet Floor Finishes	458. Static Earthing
420. Metal Cored Doors	435. Plasterboard Ceiling Finishes	459. Conditioned and Converted Power
421. Automatic Doors	436. False Ceiling Finishes	460. UPS
422. Rollar Shutter Doors	437. Timber Boarded Ceiling Finishes	461. Screened Rooms Coll Rooms
423. Metal Frames to Doors	438. Fitments (including Loose and Fixed Furniture)	462. Refrigeration Plant
424. Hardware to Doors	439. Special Equipment including Audio Visual Equipment)	463. Stairwell Pressurisation Systems
425. Metal Studding Internal Walls	440. Sanitary Fixtures	464. Compressed Air Systems
426. Insitu Concrete Internal Walls	441. Sanitary Plumbing	465. Vacuum Systems
427. Masonry Internal Walls	442. Water Supply	466. Medical Oxygen Systems
428. Operable Screens	443. Gas Service	467. Medical Air Systems
	444. Ventilation	468. Medical Gases
	445. Air Conditioning	469. Waste Disposal Systems
	446. Fire Protection	470. Cooling Towers
	447. Electric Light and Power	471. Helipad
	448. Communications (including Voice and Data)	
	449. UPS	
	450. Goods Lifts	
	451. Passenger Lifts	
	452. Pneumatic Tube Systems	

**Table A-21: Shortlist of *design* activities in Carpark in GCUH (Based on ACMM, 2000 and 2001)**

<b>Carpark (<i>Design</i>)</b>		
472. Architectural Design	474. Mechanical Design	479. Maintenance Design (plan/specification of routine and programmed maintenance)
473. Structural Engineering Design	475. Electrical Design	
	476. Hydraulics Design	
	477. Fire Protection Design	
	478. Communications Design	

**Table A-22: Shortlist of *construction* activities in Carpark in GCUH (Based on ACMM, 2000 and 2001)**

<b>Carpark (<i>Construction</i>)</b>		
480. Piles and Piers	496. Hardware to Doors	512. Ventilation
481. Foundation Beams	497. Metal Studding Internal Walls	513. Air Conditioning
482. Ground Slabs	498. Masonry Walls	514. Fire Protection
483. Service Tunnel	499. Plasterboard including Paintwork Wall Finishes	515. Electric Light and Power
484. Concrete Columns	500. Ceramic Wall Finishes	516. Communications (including Voice and Data)
485. Insitu Slab and Beam Upper Floors Construction	501. Granolithic Floor Finishes	517. Lifts
486. Metal Framed Roof Constriction (including Roof Cladding and Metal Decking)	502. Ceramic Tiles Floor Finishes	518. UPS
487. Precast Stairs	503. Carpet Finishes	519. Automatic Gates
488. Balustrades	504. Exposed Concrete Ceiling Finishes	520. Ticket Machines
489. Handrails	505. Plasterboard Ceiling Finishes	521. Railings
490. Sheet Cladding External Walls	506. False Ceiling Finishes	522. Line markings
491. Metal Grills and Screens	507. Fitments (including Loose and Fixed Furniture)	
492. Roller Grilles	508. Sanitary Fixtures	
493. Steel Windows	509. Sanitary Plumbing	
494. Metal Cored Doors	510. Water Supply	
495. Metal Frames to Doors	511. Gas Service	

**Table A-23: Shortlist of *operations* activities in Carpark in GCUH (Based on ACMM, 2000 and 2001)**

<b>Carpark (<i>Operations</i>)</b>
523. Cleaning
524. Pest control
525. Waste management
526. Security

**Table A-24: Shortlist of *maintenance* activities in Carpark in GCUH (Based on ACMM, 2000 and 2001)**

<b>Carpark (<i>Maintenance</i>)</b>		
527. Metal Framed Roof Construction (including Roof Cladding and Metal Decking)	536. Hardware to Doors	552. Ventilation
528. Balustrades	537. Metal Studding Internal Walls	553. Air Conditioning
529. Handrails	538. Masonry Walls	554. Fire Protection
530. Sheet Cladding External Walls	539. Plasterboard including Paintwork Wall Finishes	555. Electric Light and Power
531. Meatal Grills and Screens	540. Ceramic Wall Finishes	556. Communications (including Voice and Data)
532. Roller Grilles	541. Granolithic Floor Finishes	557. Lifts
533. Steel Windows	542. Ceramic Tiles Floor Finishes	558. UPS
534. Metal Cored Doors	543. Carpet Finishes	559. Automatic Gates
535. Metal Frames to Doors	544. Exposed Concrete Ceiling Finishes	560. Ticket Machines
	545. Plasterboard Ceiling Finishes	561. Railings
	546. False Ceiling Finishes	562. Line markings
	547. Fitments (including Loose and Fixed Furniture)	
	548. Sanitary Fixtures	
	549. Sanitary Plumbing	
	550. Water Supply	
	551. Gas Service	

**Table A-25: Shortlist of *design* activities in Initial Works in GCUH (Based on ACMM, 2000 and 2001)**

<b>Initial (<i>Design</i>)</b>		
563. Structural Engineering Design	565. Electrical Design	567. Drainage Design
564. Mechanical Design	566. Hydraulics Design	568. Maintenance Design (plan/ specification of routine and programmed maintenance)

**Table A-26: Shortlist of *construction* activities in Initial Works in GCUH (Based on ACMM, 2000 and 2001)**

<b>Initial (<i>Construction</i>)</b>		
569. Demolition	573. Utilities Diversions	577. External Gas
570. Site Clearance	574. External Drainage	578. External Fire Protection
571. Reduced Level Excavation	575. External Sewage	579. External Electric Light and Power
572. Service Tunnel Excavation and Concreate Walls and Cover and Services (to perimeter of buildings)	576. External Water Supply	580. External Communications



**Table A-27 Shortlist of *maintenance* activities in Initial Works in GCUH (Based on ACMM, 2000 and 2001)**

<b>Initial (Maintenance)</b>		
581. Service Tunnel Services (to perimeter of buildings)	582. External Drainage	585. External Gas
	583. External Sewage	586. External Fire Protection
	584. External Water Supply	587. External Electric Light and Power
		588. External Communications

**Table A-28: Shortlist of *design* activities in External Works in GCUH (Based on ACMM, 2000 and 2001)**

<b>External Works (Design)</b>		
589. Structural Engineering Design	591. Electrical Design	600. Maintenance Design (plan/specification of routine and programmed maintenance)
590. Mechanical Design	592. Hydraulics Design	
	593. Drainage Design	
	594. Geometric design	
	595. Road design	
	596. Pavement design	
	597. Landscaping Design	
	598. Lighting design	
	599. Bridge Design	

**Table A-29: Shortlist of *construction* activities in External Works in GCUH (Based on ACMM, 2000 and 2001)**

<b>External Works (Construction)</b>		
601. Roads, Footpaths and Paved and Parking Areas	603. Outbuildings (including Storage and Shelter for Medical Gases)	605. External Steel Bridges
602. Boundary Walls, Fencing and Gates	604. Covered Ways (New Station to Hospital)	606. Landscaping

**Table A-30: Shortlist of *Operations* activities in External Works in GCUH (Based on ACMM, 2000 and 2001)**

<b>Carpark (Operations)</b>
607. Cleaning
608. Security

**Table A-31: Shortlist of *maintenance* activities in External Works in GCUH (Based on ACMM, 2000 and 2001)**

<b>External Works (<i>Maintenance</i>)</b>		
609. Roads, Footpaths and Paved and Parking Areas	611. Outbuildings (including Storage and Shelter for Medical Gases)	613. External Steel Bridges
610. Boundary Walls, Fencing and Gates	612. Covered Ways (New Station to Hospital)	614. Landscaping

# Theoretical Exposition

## B-1 Microeconomic Theories and Theoretical Pluralism

The Tool employs various schools of microeconomic thought to develop a procurement strategy. This procurement strategy amounts to the efficient management of microeconomic risk in the externalisation of key DCOM activities arising from the project details. The various schools of microeconomic thought employed by the Tool, emanate from the modern era in the history of economics, beginning with Adam Smith and classical economics in the late 18<sup>th</sup> century.

More specifically, the Tool uses microeconomic theories that correspond with today's dominant and orthodox economic thought including assumptions concerning technical possibilities (incorporating diminishing returns to scale) and the rational choice of individual agents based on their preferences (constrained by their initial resources and by technological possibilities). Fundamentally, this mainstream economic thought assumes that resources are scarce, such that it is necessary to choose between competing alternatives. This creates the concept of opportunity cost (or trade-off), as selecting one alternative implies forgoing another alternative. As such, this mainstream thought frames the study of choice, as affected by incentives and resources, to explain and help guide decision-making.

Contemporary mainstream microeconomics builds mainly on neoclassical economics that began to develop in the late 19<sup>th</sup> century. Among other things, neoclassical economics acknowledges the existence of market failure. More recently, a self-styled new institutional economics (NIE) has developed in the US and Europe. While NIE works largely within neoclassicism, scholars on this school of thought expand the reach of conventional neoclassicism by relaxing one or more of the assumptions in neoclassical economics (Samuels, 1995). For example, scholars within the NIE school embrace decision-making under risk and uncertainty, in contrast to classical decision-making under certainty.

The Tool selects microeconomic theories either from, or consistent with this mainstream economic thought, ranging from classical economics to the NIE, and including a prominent theory from the capabilities perspective (in the field of strategic management). This suite of theory is summarised in Table B.1.

In its use of the theories noted in Table B-1, the Tool adopts the doctrine of theoretical pluralism. Theoretical pluralism approves of a plurality of irreconcilable theories for a given set of phenomena not as a transitory state but as an enduring state. This stands in contrast to theoretical monism, which posits that there exists only one theory for any set of phenomena and that the aim of science is to find the unique and true theory. By adopting theoretical pluralism, the User employs the idea that the total understanding of a given set of phenomena (in this case procurement) can be enhanced by the coexistence and deployment of more than one theory. This idea is based on the view that any single theory inevitably only gives a partial account by virtue of its assumptions. A pluralistic approach reflects a certain pragmatism, as it is questionable whether grand unifying theories are possible, and particularly in the social sciences (Elster 1989). An attempt to combine the assumptions of alternative theories does not unify theories if the logic of the respective theories needs to be changed and potentially weakened. Also, from a pragmatic perspective, pluralists accept the limitations of scientific procedures that may lack sufficient scrutiny to single out any one unique

theory. In summary, theoretical pluralism is consistent with Lakatos' (1977; 1978) notion of the progressiveness of Scientific Research Programs. That said, pluralists do not accept any combination of theories. Theories with contradictory, or rival claims, cannot be simultaneously entertained. That is, an acceptance of one theory implies a rejection of the other theories. To distinguish a complementary theory from a rival theory, the theories need to offer a better account of a known fact, *or issue* (noted in the first column of Table B-1), under different conditions and/or account for some novel issue under similar conditions (Groenwegen and Vromen, 1996).

**Table B-1: Map of microeconomics theories in the Tool (Source: Austroads, 2020)**

Theory applied to issue/decision in step in Tool	Economic Thought	Cognitive Focus	Theory	Leading Scholar (Nobel Prize for Economics)
Step 1. Activity Analysis	Classical Economics	Production Costs	Division of Labour/ Specialisation	Adam Smith
	NIE	Governance	Transaction Costs Economics	Oliver Williamson (Nobel Prize 2009)
Step 2. Project Specific-or- Network Analysis	Classical Economics	Production Costs	Economics of Scale	Adam Smith
Step 3. Risk (Make-or-Buy) Analysis	NIE	Governance	Transaction Costs Economics	Oliver Williamson (Nobel Prize 2009)
	NIE	Organisational	Transaction Costs	Ronald Coase (Nobel Prize 1991)
	Strategic Management	Competence and Capabilities	Resource-Based Theory	Jay Barney
Step 4. Contract Packaging (Bundling) Analysis	Classical Economics	Production Costs	Economies of Scope	John Panzar and Robert Willig
	NIE	Governance	Transaction Costs Economics	Oliver Williamson (Nobel Prize 2009)
	NIE	Property Rights	Transaction Costs	Ronald Coase (Nobel Prize 1991)
	Strategic Management	Competence and Capabilities	Resource-Based Theory	Jay Barney
Step 5. Competitive-or- Collaborative Contracting (Exchange Relationship) Analysis	NIE	Governance	Transaction Costs Economics	Oliver Williamson (Nobel Prize 2009)
	Neoclassical Economics	Agency	Principal-Agent Theory	Oliver Hart (Nobel Prize 2016)
	Strategic Management	Competence and Capabilities	Resource-Based Theory	Jay Barney

In the next section, a summary of the rationale for applying Transaction Costs Economics (TCE) and Resource-Based Theory (RBT), along with the development of the integration of these theories and comments on the relationship of the Tool with Argyres and Zenger (2012) is given.

The next section draws from Bridge and Tisdell (2004). More recently, it was pleasing to read scholars in construction economics citing Bridge and Tisdell (2004) and arriving at the same conclusion as Bridge and Tisdell (2004) on the merits of theoretical pluralism and, more specifically, the integration of TCE and competence-based theories (such as RBT) as the "way forward" (Abdul-Aziz and Zaini, 2022: 191).

## B-2 The Make-or Buy Decision (Step 3 in the Tool)

The theory of the firm explains why firms emerge in a specialized economy and the forces determining their size (Coase, 1937). This involves a theoretical investigation into the firm's existence, its boundaries and internal organisation. Step 3 of the Tool focuses on the determinants of the firm's vertical boundaries, or the make-or-buy decision. Coase presented his transaction cost thesis in his 1937 article 'The Nature of the Firm'. Although it was not until the mid-1980s, at which time Williamson completed his operationalisation of Coase's thesis, that the approach proceeded to gain prominence. From a microeconomic perspective and in terms of empirical work, TCE has established itself as the most prominent contemporary approach to the theory of the firm. However, Williamson emphasised the limitations of TCE and urges researchers to take a pluralistic stance in the development of the theory of the firm. He considered that, "awaiting a unified theory, we should be accepting of pluralism" (2000: 595). In terms of pluralism, Williamson (1999: 1106) saw, "the relation between competence and governance as both rival and complementary".

In summary, both Coase and Williamson saw the firm and market as alternative modes of bringing about the same result. These scholars also acknowledged that this assumption generates an important weakness. Specifically, neither the approach taken by Coase nor Williamson can account for vertical integration in pursuance of production benefits beyond the market. Although Coase's thesis is able to explain why firms exist and the extent to which they may expand, it is yet to be operationalised to comprehensively explain and predict which firm will establish itself and what activities it will internalize. Williamson's TCE can explain and predict these phenomena, within a restricted range of conditions pertaining to hold-up.<sup>9</sup> To address this weakness and embrace differences in production across both the firm *and* the market, Williamson and Coase both point to the need to incorporate into the analysis greater attention to the firm's inherent idiosyncrasies.

The competence perspective is most associated with RBT, that is widely considered to be the current dominant perspective in strategic management. The RBT holds the fundamental strategic management position that the reason for the existence of the firm is the search for, and sustainability of, economic rents. The firm's resources may include assets, capabilities, competencies, organizational processes, firm attributes, information, and knowledge controlled by the firm (Barney, 1991, 2002). Hence, RBT's primarily concerns idiosyncratic and costly to copy resources whose internalisation and exploitation may provide the firm with a competitive advantage.

As a steppingstone towards this integration of TCE and RBT on the make-or-buy decision, Bridge and Tisdell (2004) present a capability and competence spectrum that classifies a range of conditions in relation to the focal firm and the market and, in doing so, pick-up on different competitive levels, as well as those circumstances pertaining to hold-up. This capability and competence spectrum is based on the efficient boundaries problem (Williamson, 1985), the capabilities approach to vertical integration (Barney, 2002) and the structure-conduct-performance (SCP) model. Building on Bridge and Tisdell's (2004) capability and competence spectrum, the Table 2.3 "microeconomic risks of high prices and costly variations: risk patterns" is developed.

Table 2.3 amounts to an integrative framework of vertical integration that shows the conditions in which we can expect the logic of the alternative theories and dimensions to dominate. Specifically, Table 2.3 indicates that the capabilities logic and RBT dimensions dominate in Patterns 1, 2, 7 and 8 – under conditions of firm/market heterogeneity (organisation/economic and/or technical heterogeneity) – whereas, in relation to Patterns 3 and 6, a combined transaction costs and capabilities logic dominate under conditions of heterogeneity (organisational/economic only). Here, this logic is more accurately reflected by certain dimensions from both RBT and TCE. The logic of TCE and its dimensions dominate in Patterns 4 and 5a, under conditions of firm/market homogeneity (both organisational and technical homogeneity) *and* potentially harmful opportunistic behaviour. The logic of TCE and its dimensions also dominate in Pattern 5b, under conditions of firm/market

---

<sup>9</sup> The timing of contract execution is important because of the "fundamental transformation" of bargaining power that occurs at contract execution (Williamson, 1985). That is, suppliers gain more power at contract execution as the project sees many bidders transforming into a single supplier, in a bilateral exchange with government. Suppliers can leverage this power to bargain for additional profit and/or better terms/conditions on the occurrence of a change in the works. This is known as hold-up and its likelihood increases in the presence of unpredictability.

heterogeneity (technical homogeneity only) *and* in conjunction with time-critical supply *and* potentially harmful opportunistic behaviour.

Each cell in Table 2.3 is considered from the perspective of the focal firm. Therefore, each pattern represents an activity, *vis-à-vis* the focal firm, that differs in cost and benefit attributes and that are reflected by a pattern of RBT and TCE dimensions. Since Table 2.3 indicates externalisation at patterns 5a to 8, these patterns comprise activities that are downstream and in the focal firm's supply chain.

The TCE dimensions are assessed at level of the activity's transaction that is seen/procured by buyers i.e., measured with the assumption that make or buy are alternative modes of procurement. In TCE, the activity's Asset Specificity dimension could be assessed as low by the buyer (because it could be standard good or standard service). However, if this activity were assessed from the supplier's perspective as the focal firm/buyer of this activity, then it is possible that the Asset Specificity dimension, and RBT dimensions could be assessed as high (because of investments made by this supplying firm in the good or service concerned).

Argyres and Zenger (2012: 1646) highlight that in TCE, "assets and activities begin in a rather generic or homogeneous state", but through investment are transformed into unique assets. Pre-investment, there exists information symmetry and a level playing field competition-wise across the firm and suppliers in TCE. In other words, there exists initial firm-market production homogeneity and effectively competitive neutrality, *vis-à-vis* the development of the new asset (Barney and Perera, 2014). Hence, prototypical TCE captures the conditions in which both assets and firms are similar prior to an upcoming transformative investment.

In their development of a less orthodox approach to TCE, Argyres and Zenger explore the conditions in which assets are different and firms are different. They do this by relaxing the TCE's position concerning the characteristics of a firm's transactions that are assumed as exogenous. They argue that at any point in time, both assets and firms are likely to be heterogeneous (with different features and characteristics). They envisage a strategic factor market in which different assets possessed by sellers are exchanged based on heterogeneous valuations by different buyers. In this unorthodox hold-up scenario, the potential for appropriating quasi-rents arises when the supplier discovers the value that its existing asset adds to the prospective buying firm. Here, Argyres and Zenger see the buying firm moving early to insource the existing unique asset (that does not involve a transformative investment by the buying firm) to avoid *ex post* hold-up by the supplier. With regards to uncertainty and frequency, we presume that Argyres and Zenger have in mind these variables playing the same role in their heterogeneous valuations hold-up scenario as they do in the prototypical hold-up scenario.

In both the prototypical hold-up scenario, associated with a transformative investment, and in the unorthodox hold-up scenario, associated with heterogeneous valuations, Argyres and Zenger see TCE explaining why a firm *must* insource an asset i.e., to avoid hold-up and protect potential value arising from the focal asset. In both scenarios, they see the insourcing decision occurring at a point in time ("*time 1*") before the focal asset contributes to any differential capabilities across the firm and market. In *time 1*, therefore, they consider capabilities logic (including RBT) as being moot.

Argyres and Zenger (2012) develop a two-by-two matrix to represent the two key conditions concerning assets and firms associated with internalisation. Along the x-axis, they locate the asset condition ranging from inherently similar (Condition 1A) on the left to inherently different on the right (Condition 1B). Along the y-axis, they develop a corollary of the condition concerning asset heterogeneity i.e., heterogeneity amongst firms, in which buying firms value assets differently based on the asset's complementarity with bundles of existing assets owned by buying firms (Condition 2A) that they position above non-complementarity bundles of existing assets owned by buying firms (Condition 2B). Using their two-by-two matrix, Argyres and Zenger see internalisation of new assets (the prototypical hold-up scenario associated with new assets and Argyres and Zenger's unorthodox heterogeneous valuations hold-up associated with existing assets) occurring only in the top-right quadrant i.e., Condition 1B and Condition 2A.

However, Bridge (2008b) presents evidence that shows hold-up can occur for reasons other than prototypical hold-up associated with new assets and Argyres and Zenger's unorthodox heterogeneous valuations associated with existing assets. That is, time critical hold-up can also explain and predict internalisation of both new assets and existing assets that are not complementary to existing bundles of assets. The evidence that Bridge (2008) presents also show internalisation can occur for reasons other than any kind of hold-up i.e., insourcing new assets in pursuance of above normal rents associated with either a temporary competitive advantage or a sustainable competitive advantage, and internalising existing assets in pursuance of normal returns associated with competitive parity. This evidence of internalisation for reasons other than hold-up represents the reverse of Argyres and Zenger's articulation of causality vis-à-vis capabilities and show that the prospect of gains from differential organisational and/or production capabilities can determine vertical integration.

The risk patterns in Table 2.3, which are supported by the evidence from Bridge (2008b), are positioned in Argyres and Zenger's two-by-two matrix and shown in Table B-2.

**Table B-2. Risk Patterns and Argyres and Zenger's matrix (based on Argyres and Zenger, 2012)**

<b>Conditions</b>	<b>Condition 1A (<math>C_{1A}</math>) Similar Focal Asset by Supplying Firm</b>	<b>Condition 1B (<math>C_{1B}</math>) Different Focal Asset by Supplying Firm</b>
<p><b>Condition 2A (<math>C_{2A}</math>)</b> The focal asset exhibits high <b>complementarity</b> with bundles of existing similar and/or different assets within the buying firm</p>	<p><b>Pattern 3 → Internalise (Competitive Parity/Normal Rents)</b> Existing similar asset (<i>time 2</i>)</p>	<p><b>Pattern 1 → Internalise (Sustainable Competitive Advantage/Above Normal Rents)</b> Existing <i>different</i> asset (<i>time 1</i>) → Investment → New different asset (<i>time 2</i>)</p> <p><b>Pattern 2 (Internalise) (Temporary Competitive Advantage/Above Normal Rents)</b> Existing different asset (<i>time 2</i>)</p>
<p><b>Condition 2A/B</b> The focal asset exhibits <b>moderate to low complementarity</b> with bundles of existing similar and/or different assets within the buying firm</p>	<p><b>Pattern 4 → Internalise (Prototypical Hold-Up)</b> Existing <i>similar</i> asset (<i>time 1</i>) → Investment (Sunk Cost) → New different asset (<i>time 2</i>)</p> <p><b>Pattern 4 → Internalise (Time-Critical Hold-Up)</b> Existing <i>similar</i> asset (<i>time 2</i>)</p> <p><b>Pattern 5a → Externalise (Prototypical Hold-Up)</b> Existing <i>similar</i> asset (<i>time 1</i>) → Investment → New different asset (<i>time 2</i>)</p>	
<p><b>Condition 2B (<math>C_{2B}</math>)</b> The focal asset exhibits <b>low complementarity</b> with bundles of existing similar and/or different assets within the buying firm</p>	<p><b>Pattern 5b → Externalise (Time-Critical Hold-up)</b> Existing similar asset (<i>time 2</i>)</p> <p><b>Pattern 6 → Externalise (Superior Market Production – Mainly Organisational Advantages)</b> Existing similar asset (<i>time 2</i>)</p>	<p><b>Pattern 7 → Externalise (Very High Superior Market Production – Mainly Technical Advantages)</b> Existing similar asset (<i>time 2</i>)</p> <p><b>Pattern 8 → Externalise (Extremely High Superior Market Production Organisational and/or Technical Advantages)</b> Existing similar asset (<i>time 2</i>)</p>

Risk Patterns 4 (Prototypical Hold-Up) and Risk Pattern 5a (Prototypical Hold-Up) are assessed at *time 1* and so these risk patterns are typically moot in the procurement of new built infrastructure. This is because, sadly, it is very rare that the Client seeks to acquire new/experimental technology, associated Risk Patterns 4 and 5a, in their procurement of new built infrastructure. In the vast majority of cases the Client procures new built infrastructure activities in *time 2*, and when any transformative investment associated with Pattern 4 or Pattern 5a, has contributed to either a Pattern 1 or 2 activity in *time 2* (vis-à-vis the initial Prototypical Hold-Up Pattern 4) or a Pattern 7 or 8 activity in *time 2* (vis-à-vis the initial Prototypical Hold-Up Pattern 5a).

The theory of bundling underpinning Step 4 is summarised in the next section, which draws from Teo and Bridge (2017).



## B-3 The Bundling Decision (Step 4 in the Tool)

Bundling pertains to property rights. These are theoretical constructs concerning how a resource is used and owned, including the right to earn income from goods or services. In the context of the Tool, resources refers to activities associated with the DCOM of a new infrastructure project. The objective of bundling is to derive efficiencies from a range of property rights arising from these activities. Fundamentally, efficiency gains from bundling are determined by the potential for economies of scope that increase when activities display complementarity and the potential for synergy. That is, there is potential for relative improvements in cost and benefits when these activities are delivered in one contract and overseen by one supplier or consortium (De Bettignies and Ross, 2004).

Hart (2003) developed an approach that operationalises incentives for positive investment arising from economies of scope and property rights/bundling. Hart sees this kind of economic behaviour turning on whether it is easier to write contracts on building provision (where the building can be well specified, but the service requirements less so) or whether it is easier to write contracts on service provision (where the service requirements and effective performance measures can be well specified, but the building less so). Hart notes that these factors, in turn, drive the relative quantum of gains from either positive investment (by the buyer and supplier) or gains from negative investment (by the supplier only).

More recently, Iossa and Martimort (2015) developed a model of procurement in a multitask environment. This model is mostly consistent with Hart and again considers bundling to be the main feature of PPPs. Based on their model, and in conjunction with the property-rights approach, Iossa and Martimort developed a rationale for bundling that appeals to the principal-agent literature (including acknowledgement of Hart, 2003). Their model sees bundling as inducing the supplier/consortia to internalise the positive externality generated by its quality-enhancing effort on the fraction of costs that the supplier/consortium bears at the operational stage; thus, the stronger the positive externality, the greater the benefit of bundling. However, Iossa and Martimort are chary on the issue of transferring risks that create the potential for hold-up. For example, they consider that the hold-up problem is less severe under PPP, compared with traditional procurement, when there is a positive externality between the building and managing stages. This can be questioned when the possibility of hold-up lurks very strongly in PPPs (Chang, 2013).

The question of bundling should then account equally for both the possibility of negative opportunistic behaviour on the part of the supplier, and its potential to internalise positive externalities. Iossa and Martimort do acknowledge their model's limitation in being restricted to speculative advice in terms of which sectors only are suitable to bundling. They consider the gains from bundling are greater for generic facilities such as leisure centres, accommodation and public housing, than for specific facilities such as prisons, hospitals and schools. Iossa and Martimort's speculations seem unconvincing in light of the empirical evidence on the incidence of PPPs in hospitals and prisons. They also run counter to Hart's (2003) estimate of the suitability of PPPs for facilities such as hospitals—an estimate that was also based on the principal agent theory in conjunction with property rights theory. That said, Hart's speculations also appear to be unconvincing, as it is difficult to imagine all types of hospitals being suited to a PPP. Furthermore, although Hart has operationalised the theory of bundling that turns on whether it is easier to write contracts on building or service provision, again this approach only serves to develop prescriptions concerning sectors. Thus, as it previously stood, bundling theory was not sufficiently micro-analytic to serve as an implementable theory to contribute to the determining a project's procurement strategy. This is now rectified in the approach developed in Step 4 of the Tool.

A key development in the Tool concerning TCE on the make-or-buy decision and the nature of the exchange decision is briefly noted in the next section.

## B-4 The Exchange Relationship Decision (Step 5 in the Tool)

TCE's contractual schema envisages that internalisation is chosen as a last resort, to deliver a highly relational exchange that attenuates the possibility of hold-up in the presence of higher levels of asset specificity and uncertainty. However, now it can be seen that internalisation can be chosen for purposes other than to avoid hold-up, then relational exchange may not necessarily be part of the rationale for internalisation and, therefore, may not always be an observable consequence of internalisation. Indeed, it is logical to expect just as much a wide range of exchange relationships within the firm as might be found between firms. This leads to relaxing an implied heuristic embedded in TCE's contractual schema i.e., the requirement that TCE should account simultaneously for the make-or-buy decision *and* the nature of the exchange relationship decision. As such, the Tool treats the make-or-buy decision and the nature of the exchange relationship as two genuinely separate and sequential decisions.

Moreover, the Tool sees the nature of exchange as a discrete-relational continuum – as part of the three dimensions in the *trust-commitment-relationship trinity* (Bridge, 2008b). This trinity of trust, commitment and relationship is inspired by Williamson (1985) and Gounaris (2005) and suggests a more sophisticated continuous approach to capturing the nature of the exchange – as opposed to Macneil's three-way stereotypical classification of contractual exchange (that was endorsed by Williamson). For example, Kaufmann and Stern (1988) develop a continuous approach to measuring the nature of the exchange.

A summary of the theory underpinning the approach to validation is given in the next section and which again draws from Teo and Bridge (2017).

## B-5 Validation

With lower levels of competition in the market, there is a lack of incentive for bidders to innovate to reduce prices and/or deliver benefits that government perceives valuable. Empirical studies in the construction industry provide evidence of a correlation between a greater level of competition (or higher number of bidders) and a reduction in the price of the lowest bid. Surveys on critical success factors for PPP conducted in many countries (including Australia, the UK and Hong Kong) similarly identify competition as one of the key VfM drivers in PPPs (for example, Cheung et al., 2009). In ascertaining the boundary between effective and ineffective competition, Selten (1973) is among the first to show that five competitors represent the dividing line between 'few' and 'many' when modelled as moves in a non-cooperative game pertaining to a bidding scenario. In other words, four or fewer firms demonstrating their willingness to bid for a project creates tight oligopoly conditions, associated pricing constraints, and ineffective competition (for example, Beattie et al., 2003). Consistent with this, the European Union stipulated a minimum of five tenderers to ensure sufficient competition in the procurement of construction projects and which led to an average of 5.4 offers (Strand et al., 2011:6). In brief, five bidders can be considered the lower limit of effective competition.

In terms of the upper limit of competition—when viewed from the lens of improvements to production costs and/or benefits—Gupta (2002) examined 1740 highway construction projects in the US over a five-year period. The empirical results indicate that while the price of winning bids decreases as the number of bids increases, the effect on price becomes insignificant when the number of bidders reaches a maximum. Gupta determines this competitive threshold to be approximately eight bidders in an open tender. Also highly relevant, Skitmore (2002) analysed ten data sets (representing 1234 projects) in a different sector, and mainly from the building industries in various countries, including the US, UK and Belgium. Skitmore's findings are consistent with Gupta's, where the regression curves show the price of the lowest bid decreases until about eight bidders, and remains constant as the number of bidders increases. Furthermore, Pereira (2002) analysed 1035 bids (2000–2001) and showed that below five competitors, the winning bid price is 5% to 15% greater than the agency's estimate; with increasing competitors, the contract price has a clear downward trend and starts to stabilise around 8 competitors. In summary, there is very strong

evidence to show that a range of 5 to around 8 bidders is optimal in pursuance of improvements to production costs and/or production benefits arising from the effects of pre-contract competition.

Negative opportunistic behaviour, or hold-up, is not uncommon—either in the construction industry or in the more specific context of PPPs (Chang, 2013). After Williamson (1985), hold-up follows non-trivial disturbances in the works and in a construction context, variations to the works, can occur frequently. Furthermore, Henjeweale et al. (2011) found significant potential for variations in PPPs. In long-term contacts, such as PPPs, the incidence and resolution of variations are particularly costly for government. That is, the resolution of variations revolves around bi-lateral trade with the supplier who begins negotiations in a monopoly supply position. Hence, not only is there a lack of competition and downward pressure on negotiation of the production cost component of the variation, there is also the potential for the supplier to appropriate gains from the quasi-rent or switching cost component of the variation (hold-up). Thus, variations are potentially a source of additional profits for suppliers (including contractors) and can be very lucrative, in particular for a PPP consortium who can achieve super-normal profits from the variation (for example, Turner, 2004; Rooke et al., 2004; Zheng et al., 2008). Thus, the prospect of variation flows, which can be assessed from the contract documents and other related factors, can greatly motivate suppliers and not least PPP consortia to bid for a project including reducing bid profit in anticipation of at least recovering this profit in post-contract variations (for example, Crowley and Hancher, 1995; Ho and Liu, 2004; Lo et al., 2007). Indeed, hold-up behaviour has been observed as acute in PPPs and found to profoundly undermine PPPs delivering Value for Money (Henjeweale et al., 2011; Robinson and Scott, 2009; House of Lords, 2010; Winch and Schmidt, 2016). More specifically, the House of Lords (2010) found a lack of clarity in specifying a project's requirements to be the key source of variations and Henjeweale et al. (2011: 838) observe the specification of project requirements in business case, “dictate the operational performance” of PPPs.

In summary, based on the above empirical evidence concerning pre- and post-contract market failure, it can be said that when a project achieves between 5 and 8 bidders, it has demonstrated it is sufficiently attractive to generate the optimum level of competition vis-à-vis reductions in production costs and improvements in production benefits, and thus avoid pre-contract market failure. At the same time, this project is not overly attractive to generate excessive bids or competition—again, beyond that required in achieving the upper limit in improvements to production costs and benefits. And as variation flows arising from a lack of clarity in specifying the project's requirements can greatly increase the attractiveness of the project to PPP bidders, it can also be said that there is an indication that the project is sufficiently clearly specified in pursuance of avoiding post-contract market failure—associated with an absence of excessive competition. Since competition in the range of 5 to 8 bids provides an indication that the project has avoided pre- and post-contract market failure, we have a measure that is wholly consistent with value for money.

# Development and Empirical Testing

The Tool was developed and empirically tested in a PhD study by Teo (2014) that was funded by an Australian Research Council (ARC) grant.<sup>10</sup> The data for this PhD study comprised four case studies of Australian public sector major health and road projects and a nationwide survey of civil engineering contractors and building contractors. The four case studies are summarised in Table C-1.

**Table C-1: Case studies in ARC grant (Source: Bridge and Bianchi, 2014 and Teo, 2014)**

Case study	Road Case #1	Road Case #2	Health Case #1	Health Case #2
Sector	Road	Road	Health	Health
EoI	Optimal EoI (8 EoI)	Sub-optimal (low – 2 EoI)	Optimal (5 EoI)	Sub-optimal (high – 15EoI)
Capital value in categories	\$50-100 million	\$250-500 million	\$250-500 million	\$250-500 million
Actual procurement mode	Traditional Construct Only	Alliancing	Public Private Partnership	Managing contractor
Actual payment terms	Fixed-price lump sum	Guaranteed construction sum with pain-share/gain-share	Fixed monthly payment	Target outturn cost with pain-share/gain-share

In the ARC grant, the Tool identified a PPP approach in Health Case #2 and it is considered this would have delivered significant improvements in value for money in contrast to the Managing Contractor approach actually used. The key lessons learned across Health Case Studies #1 and #2 is the potential for operational and maintenance efficiency to be delivered through the design of high technology services through the facility's Building Management System (BMS). Hence, large hospitals with a BMS promote the bundling of DCM or DC&OM in terms of operational and maintenance benefits and therefore the use of PPPs. The other key lesson from the health case studies is the imperative to fully develop and specify user requirements in pursuance of minimising transaction costs and avoiding costly post-contract variations and at same time maximising contestability. Hence, these case studies promote the development of the articulation of the performance specification mindful of long-term goals. These cases did not promote the imperative of early contractor involvement and negotiation of the budget for the construction works. These cases did promote the involvement of the contractor at the stage at which the client agency has developed and defined their requirements. Such that a price could be established efficiency and in competition with other contractors.

The Tool developed a multiple contract approach to Road Case #2 and again, it is considered this would have delivered appreciable value for money improvement in contrast to the single Alliance contract approach used. The key lessons learned across Road Case Studies #1 and #2 is the potential to separate sections of roads that have different levels of uncertainty associated with

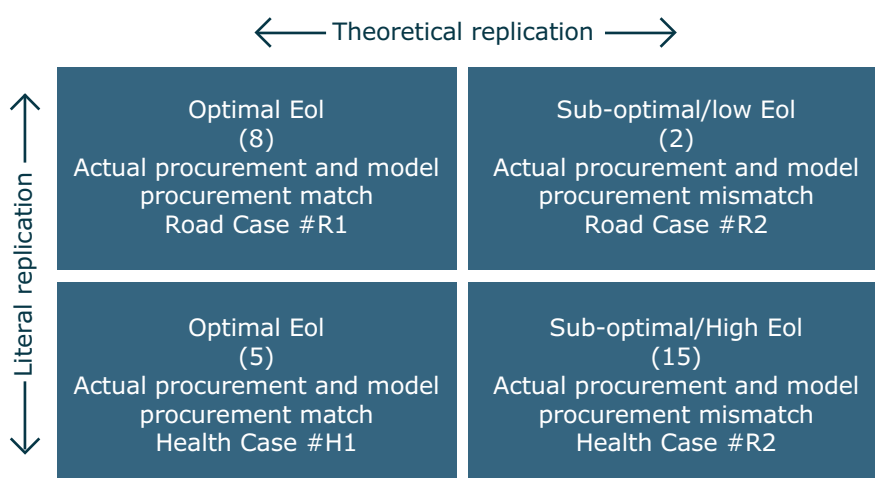
<sup>10</sup> The ARC grant "ARC Major Infrastructure Procurement" was led by Associate Professor Adrian Bridge (QUT) and was a collaborative project between QUT and three other universities plus 11 government and industry organisations (including all five Australian mainland state treasury departments). Further details of the development and empirical testing of the Tool in this research project can be found in the grant's final report on pages 11 to 23 at: <https://eprints.qut.edu.au/76520/>.

ground conditions; proximity to adjoining existing roads; and third party works that may affect the timeline. Because of these factors in Road #2, there were sections in this project that were highly unpredictable. More precisely, uncertain ground conditions in driven tunnel work; complexity of works alongside and across existing highways, as well as cut and cover tunnel work subject to progress of rail alignment work by others. However, around 50% of the remaining sections of Road Case #2 was relatively straightforward road on grade and elevated structures. In this case, the Tool confirmed the efficiency of treating the procurement of operations and maintenance of this new piece of road as part of a network approach given economies of scale and learning economies; along with marginal cost associated with an emergency response. As such, there was no viable DCM or DCO or DCOM bundle and the Tool then developed four contracts, comprising:

- Contract #1: Design of the driven tunnel including fire safety design using a bespoke consultancy agreement with credible threats for non-performance
- Contract #2: Design of the remaining part of project using a standard consultancy agreement
- Contract #3: Construction of the tunnels both cut and cover and driven tunnel using a bespoke agreement including pain share/gain share regime, and
- Contract #4: Construction of the remaining part of the project using a standard construction contract.

The Tool also noted that subject to competitive bidding, Contract #1 and #2 could have been awarded to the same consultancy but as separate contracts/agreements and similarly subject to competitive bidding, Contract #3 and #4 could have been awarded to the same contractor but again with separate contracts /agreements. As an alternative to a separate design Contract #2 and separate construction Contract #4, these contracts could have been combined into a Design and Construct approach (with whole-life performance specifications) again with standard contract. However, the extremely specialist nature of design in Contract #1 (a Pattern 8 activity) indicated that it would be more efficient for government to directly engage the consultant concerned to monitor progress directly and avoid potential-hold being compounded and worsened as part of a Design and Construct approach. The Tool would also have seen the contractor in Contract #3 displaying flexibility in the works and timing at the junctions of the different sections of road between Contract #3 and Contract #4.

Figure C-1 summarises the very strong support for the validating hypothesis from the four case studies. The hypothesis is further supported by the nationwide survey of civil and building contractors, which indicated that the approach identified by the Tool in Health Case #2 was likely to have seen a reduced number of EoI downwards towards the optimum 5-8 EoI band. The approach in Road Case#2, on the other hand, was likely to have seen an increase in EoI upwards towards the optimum 5-8 EoI band.



**Figure C.1: Empirical Support for the Tool in its initial testing (Source: Bridge and Bianchi, 2014 and Teo, 2014)**

The Tool has also been successfully trialled on TSRC and GCUH and which are the project applications in this user guide.

More, recently, OECD successfully piloted the Tool on two major public sector roads in Norway (OECD, 2021).

# References

- Abdul-Aziz, A. R., & Zaini, A. B. A. (2022). Applications of mainstream economic theories to the construction industry: transaction costs. In: Ofori, G. (Ed.), *Research Companion to Construction Economics*. Edward Elgar Publishing. 178-198.
- Argyres, N. S., & Zenger, T. R. (2012). Capabilities, transaction costs, and firm boundaries. *Organization Science*, 23(6), 1643-1657.
- Austroroads. (2020). *Procurement Decision Tool: A Case Study of the Toowoomba Second Range Crossing*. No. AP-R624-20.
- Barney, J.B. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99-120.
- Barney, J.B. (2002). *Gaining and Sustaining Competitive Advantage*, 2<sup>nd</sup> Edn. New Jersey. Prentice Hall.
- Barney, J. B., & Peteraf, M. A. (2014). Comment on Hashai and Buckley: Transactions costs, capabilities, and corporate advantage considerations in theories of the multinational enterprise. *Global Strategy Journal*, 4(1), 70-73.
- Beattie, V., Goodacre, A., & Fearnley, S. (2003). And then there were four: a study of UK audit market concentration—causes, consequences and the scope for market adjustment. *Journal of Financial Regulation and Compliance*, 11(3), 250–265.
- Besanko, D., Dranove, D., & Shanley, M. (2010). *Economics of Strategy*. 5<sup>th</sup> ed. New York: John Wiley & Sons.
- Bridge, A. (2008a). Market structures in air conditioning maintenance activity. In *Proceedings of the 24th Annual ARCOM Conference* (579-586). ARCOM, Association of Researchers in Construction Management.
- Bridge, A. J. (2008b). *The Determinants of the Governance of Air Conditioning Maintenance in Australian Retail Centres*. Doctoral dissertation, Queensland University of Technology.
- Bridge, A. J., & Tisdell, C. (2004). The determinants of the vertical boundaries of the construction firm. *Construction Management and Economics*, 22(8), 807-825.
- Bridge, A., & Bianchi, R. (2014). *Reforming the Procurement of Construction and Financing of Australian Infrastructure: Advancing Capacity, Competition and Investment*, available at: <https://eprints.qut.edu.au/76520/>
- Coase, R. H. (1937). The nature of the firm. *Economica*, 4(16), 386-405.
- Chang, C. Y. (2013). Understanding the hold-up problem in the management of megaprojects: The case of the Channel Tunnel Rail Link project. *International Journal of Project Management*, 31(4), 628-637.
- Cheung, E., Chan, A. P., & Kajewski, S. (2009). Enhancing value for money in public private partnership projects: Findings from a survey conducted in Hong Kong and Australia compared to findings from previous research in the UK. *Journal of Financial Management of Property and Construction*.
- Crowley, L. G., & Hancher, D. E. (1995). Risk assessment of competitive procurement. *Journal of Construction Engineering and Management*, 121(2), 230-237.
- De Bettignies, J. E., & Ross, T. W. (2004). The economics of public-private partnerships. *Canadian Public Policy/Analyse de Politiques*, 135-154.
- Elster, J. (1989). *Nuts and Bolts for the Social Sciences*. Cambridge: Cambridge University Press.
- Emerson, S. (2014). *Industry Briefing on Toowoomba Second Range Crossing*. Accessed via: <https://statements.qld.gov.au/statements/74966>

- Groenewegen, J., & Vromen, J.J. (1996). A case for theoretical pluralism. In: Groenewegen, J. (Ed.), *Transaction Cost Economics and Beyond*. Dordrecht: Kluwer Academic Publishers. 365-380.
- Gupta, S. (2002). Competition and collusion in a government procurement auction market. *Atlantic Economic Journal*, 30(1), 13-25.
- HM Treasury. (2008). *Infrastructure Procurement: Delivering Long-term Value*, London: Office of Public Sector Information.
- Hart, O. (2003). Incomplete contracts and public ownership: Remarks, and an application to public-private partnerships. *The Economic Journal*, 113(486), C69-C76.
- Henjewe, C., Sun, M., & Fewings, P. (2011). Critical parameters influencing value for money variations in PFI projects in the healthcare and transport sectors. *Construction Management and Economics*, 29(8), 825-839.
- Ho, S. P., & Liu, L. Y. (2004). Analytical model for analyzing construction claims and opportunistic bidding. *Journal of Construction Engineering and Management*, 130(1), 94-104.
- House of Lords. (2010). *Private Finance Projects and Off-Balance Sheet Debt*. 1<sup>st</sup> Report of Session 2009-10. Great Britain Parliament. T.S. Office, London.
- House of Representatives Committees Standing Committee. (2022). *Inquiry into Procurement Practices for Government-Funded Infrastructure*. Accessed via: [https://www.aph.gov.au/Parliamentary\\_Business/Committees/House/ITC/Gov-fundedInfrastructure/Submissions](https://www.aph.gov.au/Parliamentary_Business/Committees/House/ITC/Gov-fundedInfrastructure/Submissions)
- Infrastructure Australia. (2021). *2021 Australian Infrastructure Plan*. Accessed via: <https://www.infrastructureaustralia.gov.au/publications/2021-australian-infrastructure-plan>.
- Iossa, E., & Martimort, D. (2015). The simple microeconomics of public-private partnerships. *Journal of Public Economic Theory*, 17(1), 4-48.
- Ive, G., & Chang, C. Y. (2007). The principle of inconsistent trinity in the selection of procurement systems. *Construction Management and Economics*, 25(7), 677-690.
- KPMG and University College London (2010) *Operating Healthcare Infrastructure*. London, UK.
- Kennedy, J., Pantelias, A., Makovšek, D., Grewe, K., & Sindall, J. (2018). *Risk Pricing in Infrastructure Delivery*. International Transport Forum, Paris. Accessed via: [Risk Pricing in Infrastructure Delivery | ITF \(itf-oecd.org\)](https://www.itf-oecd.org/risk-pricing-in-infrastructure-delivery).
- Kinnunen, N., Bridge, A., Carroli, L., Franz, J., Verhoeven, P., Sunindijo, R., & Zhang, L. (2022). Australian Research Council (ARC) Linkage Projects (LP160100259), *Innovative Procurement Theories to Optimise Educational Outcomes Per Total Cost of School Facilities: Activity 1. Value Rating Study and Tool*. 2020. Available via: <https://research.qut.edu.au/arcvio/studies/study-1-value-rating-tool/>
- Lakatos, I. (1977). *Proofs and Refutations*. Cambridge: Cambridge University Press.
- Lakatos, I. (1978). The methodology of scientific research programmes. In: *Philosophical Papers*, Worrall, J., & Currie, G. (Eds). Cambridge: Cambridge University Press.
- Lend Lease. (2014). Australian Construction Achievement Award Stage 1 Entry Gold Coast University Hospital. Accessed via: <https://acaa.net.au/wp-content/uploads/2020/02/Gold-Coast-University-Hospital-%E2%80%93-Queensland.pdf>
- Lo, W., Lin, C. L., & Yan, M. R. (2007). Contractor's opportunistic bidding behavior and equilibrium price level in the construction market. *Journal of Construction Engineering and Management*, 133(6), 409-416.
- National Audit Office. (2004). *Improving Procurement: Progress by the Office of Government Commerce in Improving Departments Capability to Procure Cost-Effectively*.
- National Audit Office. (2011). *Lessons from PFI and Other Projects* (HC 920 Session 2010-2012). London.
- OECD. (2021). *Procurement Strategy in Major Infrastructure Projects: Piloting a New Approach in Norway*. OECD Public Government Papers No. 06. Accessed via: [www.oecd.org/publications/procurement-strategy-in-major-infrastructure-projects-38996343-en.htm#:~:text=The%20OECD%20has%20trialled%20a%20new%20evidence-%20based,effectiveness%20of%20public%20procurement%20of%20infrastructure%20and%20beyond](https://www.oecd.org/publications/procurement-strategy-in-major-infrastructure-projects-38996343-en.htm#:~:text=The%20OECD%20has%20trialled%20a%20new%20evidence-%20based,effectiveness%20of%20public%20procurement%20of%20infrastructure%20and%20beyond)
- Pereira, G.P.C. (2002). *The Construction Market for Public Works as an Audit Tool: A Probabilistic Approach*. Master Thesis, Federal University of Pernambuco.

- Productivity Commission. (2014). *Public infrastructure, inquiry report No. 71*, Canberra. Accessed via: <https://www.pc.gov.au/inquiries/completed/infrastructure/report/infrastructure-volume2.pdf>.
- Projects Queensland. (2014). *Toowoomba Second Range Crossing: Expression of Interest*. Australian Government and Queensland Government.
- Queensland Audit Office. (2014). *Hospital Infrastructure Projects. Report 2: 2014-15*. Accessed via: [www.qao.qld.gov.au/sites/default/files/reports/rtp\\_hospital\\_infrastructure\\_projects.pdf](http://www.qao.qld.gov.au/sites/default/files/reports/rtp_hospital_infrastructure_projects.pdf)
- Robinson, H. S., & Scott, J. (2009). Service delivery and performance monitoring in PFI/PPP projects. *Construction Management and Economics*, 27(2), 181-197.
- Rooke, J., Seymour, D., & Fellows, R. (2004). Planning for claims: an ethnography of industry culture. *Construction Management and Economics*, 22(6), 655-662.
- Samuels, W.J. (1995). The present state of institutional economics. *Cambridge Journal of Economics*, 19, 569-590.
- Selten, B. (1973). A simple model of imperfect competition, where 4 are few and 6 are many. *International Journal of Game Theory*, 2(1), 141-201.
- Skitmore, M. (2002). Raftery curve construction for tender price forecasts. *Construction Management and Economics*, 20(1), 83-89.
- Teo, P. (2014). *The Effect of Procurement on Competition and Flexibility: Determining the Suitability of Public-Private Partnerships in Major Infrastructure Projects*, Doctoral dissertation, Queensland University of Technology, available at: <https://eprints.qut.edu.au/72914/>
- Teo, P., & Bridge, A. J. (2017). Crafting an efficient bundle of property rights to determine the suitability of a Public-Private Partnership: A new theoretical framework. *International Journal of Project Management*, 35(3), 269-279.
- Turner, J. R. (2004). Farsighted project contract management: incomplete in its entirety. *Construction Management and Economics*, 22(1), 75-83.
- The Australian Institute of Quantity Surveyors. (2000). *Australian Cost Management Manual – Volume 1*, Canberra.
- The Australian Institute of Quantity Surveyors. (2001). *Australian Cost Management Manual – Volume 2*, Canberra.
- Williamson, O.E. (1985). *The Economic Institutions of Capitalism*. New York: The Free Press.
- Williamson, O. E. (1999). Strategy research: governance and competence perspectives. *Strategic Management Journal*, 20(12), 1087-1108.
- Williamson, O. E. (2000). The new institutional economics: taking stock, looking ahead. *Journal of Economic Literature*, 38(3), 595-613.
- Winch, G., & Schmidt, S. (2016). Public-private partnerships: a review of the UK private finance initiative. In: Jefferies, & M.C., Rowlinson, S. (Eds.), *New Forms of Procurement: Public Private Partnerships and Relational Contracting in the 21st Century*. London: Taylor and Francis. 35-50.
- Zheng, J., Roehrich, J. K., & Lewis, M. A. (2008). The dynamics of contractual and relational governance: Evidence from long-term public-private procurement arrangements. *Journal of Purchasing and Supply Management*, 14(1), 43-54.



