

DEVELOPING A RESEARCH METHOD TO TEST A NEW FIRST-ORDER DECISION MAKING MODEL FOR THE PROCUREMENT OF PUBLIC SECTOR MAJOR INFRASTRUCTURE

Poh Lian Teo¹, Adrian J. Bridge², Jason Gray³ and Marcus C. Jefferies⁴

^{1,2,3} School of Urban Development, Queensland University of Technology, GPO Box 2434, Brisbane, Queensland, 4001, Australia.

² School of Architecture and Built Environment, The University of Newcastle. Callaghan, NSW 2308, Australia.

Given global demand for new infrastructure, governments face substantial challenges in funding new infrastructure and simultaneously delivering Value for Money (VfM). The paper begins with an update on a key development in a new early/first-order procurement decision making model that deploys production cost/benefit theory and theories concerning transaction costs from the New Institutional Economics, in order to identify a procurement mode that is likely to deliver the best ratio of production costs and transaction costs to production benefits, and therefore deliver superior VfM relative to alternative procurement modes. In doing so, the new procurement model is also able to address the uncertainty concerning the relative merits of Public-Private Partnerships (PPP) and non-PPP procurement approaches. The main aim of the paper is to develop competition as a dependent variable/proxy for VfM and a hypothesis (overarching proposition), as well as developing a research method to test the new procurement model. Competition reflects both production costs and benefits (absolute level of competition) and transaction costs (level of realised competition) and is a key proxy for VfM. Using competition as a proxy for VfM, the overarching proposition is given as: When the actual procurement mode matches the predicted (theoretical) procurement mode (informed by the new procurement model), then actual competition is expected to match potential competition (based on actual capacity). To collect data to test this proposition, the research method that is developed in this paper combines a survey and case study approach. More specifically, data collection instruments for the surveys to collect data on actual procurement, actual competition and potential competition are outlined. Finally, plans for analysing this survey data are briefly mentioned, along with noting the planned use of analytical pattern matching in deploying the new procurement model and in order to develop the predicted (theoretical) procurement mode.

Keywords: infrastructure, procurement, research method, value.

INTRODUCTION

Reflecting population growth, migration and demographic changes, the OECD (2006) estimates global demand for new infrastructure at US \$53 trillion between 2007-2030 and in Australia, Infrastructure Partnerships Australia (2010) has summarised estimates of required new infrastructure over the next 10 years from \$455 billion to more than \$770 billion (in 2007 terms). This high demand for new infrastructure in

¹ pauline.teo@student.qut.edu.au

Teo, P L, Bridge, A J, Gray, J and Jefferies, M C (2011) Developing a research method to test a new first-order decision making model for the procurement of public sector major infrastructure *In: Egbu, C. and Lou, E.C.W. (Eds.) Procs 27th Annual ARCOM Conference, 5-7 September 2011, Bristol, UK, Association of Researchers in Construction Management, 715-724.*

many countries, is presenting governments with severe challenges - not only in terms of funding and in the wake of the Global Financial Crisis (GFC) but at the same time, in the delivery of new infrastructure whilst achieving Value for Money (VfM). One response to this challenge has been to develop Public-Private Partnerships (PPP) and leverage private finance. Such that now, PPPs are considered to be a key mode of delivering new infrastructure in many countries, not least of which in Australia (KPMG and Infrastructure Australia 2010). However, the latest report from the National Audit Office in the UK notes amongst its key findings that "There is no clear data to conclude whether the use of PFI has led to demonstrably better or worse value for money than other forms of procurement" (2011: 6). This uncertainty surrounding the relative merits of PPPs versus other/non-PPP procurement modes is being exacerbated, for example again in the UK, by the lack of transparency and accountability in non-PPPs (Thomas 2011). There are grounds to consider that at least part of this situation applies outside of the UK. For example, in their review of all key international PPP evaluative studies and including studies in Australia, Hodge and Greve (2009) conclude that, at best, the case for PPPs is mixed. Seemingly, amongst the most authoritative current advice concerning the circumstances in which to select a PPP over other non-PPP modes remains at a very broad level and is given by the House of Lords Select Committee on Economics Affairs (2010) and based on the UK's substantial experience in delivering privately financed projects. That is, "the projects most suitable for private finance are those where the requirements can be clearly specified at the outset and which are of a size that consortia of private sector companies can take on their balance sheets".

Against this background and uncertainty surrounding the use of PPPs and non-PPPs, it may not be any coincidence that current research and practice on procurement in construction/new infrastructure, is at a largely prescriptive level and lacks scientific maturity. Chang and Ive (2002) observe that since the 1970s there have been around 900 procurement studies and that the multi-attribute utility approach (MAUA) has been a foremost approach amongst these studies. Teo, Bridge and Jefferies (2010) further explain the weaknesses of this current research and practice and which is dominated by variations of the multi-attribute utility approach (MAUA). From a scientific perspective, the key issue with MAUA is that the most appropriate procurement mode is being defined as a subset (that is, the relative merits of alternative procurement modes), or effectively in the same terms as the desired outcomes of the procurement mode and is, therefore, tautological. That is, if cause (read procurement mode) and effect (read performance outcomes from the asset/desired attributes) are defined in the same terms, or if cause or effect are defined as a subset of each other, then the relationship is circular and considered a truism that is not falsifiable. Whilst from a practical view, the major problem with MAUA is that key performance outcomes tend to focus on visible attributes at the start of the operations of the facility and as such revolve around short term production costs/benefits and largely ignore transaction costs. In total, this creates a narrow, or nominal approach to VfM, in so far as, VfM is being framed in terms of whether or not the selected procurement mode delivered the key production/performance outcomes visible at the start of operations. There are some signs that the dominant and Nobel prize winning theory concerning procurement from a microeconomic perspective (Transaction Cost Economics - TCE) and the dominant strategic management theory concerning procurement (Resource-Based Theory - RBT) are beginning to be deployed in construction related sectors (for example, Chang and Ive 2007 on TCE). Much more significantly, however, the chief protagonists concerning

transactions costs and RBT are each pointing towards the integration of both perspectives in order to develop more accurate explanations of key aspects of procurement including the make-or-buy decision (Coase 1991; Williamson 1999; Barney 2002). Bridge and Tisdell (2004) and Bridge (2008) have successfully developed and empirically tested an integration of TCE and RBT concerning the make-or-buy decision. Furthermore, a number of leading scholars in the field of construction management and economics have supported Bridge and Tisdell's approach to integrating TCE and RBT - for example, Walker (2007) and Bröchner (2008; 2011), and Ball (2007: 221) considers that Bridge and Tisdell have developed an "ingenious" approach to drawing together the TCE and RBT literatures. Moreover, Bridge (2008) has also successfully developed and empirically tested TCE on the issue of the nature of the exchange relationship decision. These theories offer the facility to focus on conditions concerning the technological and physical attributes of the project, as well as the capabilities and competencies of government versus the private sector with respect to the project. The project conditions represent what is to be measured, whilst a priori theory guides how these conditions are measured and the manner by which resultant measurements informs procurement selection. Such that, the procurement selection is more likely to incorporate whole-of-life considerations and achieve a more efficient balance between production costs/benefits and transaction costs. Teo, Bridge and Jefferies (2010) have presented an initial schematic of the new first-order procurement decision making model that deploys production cost/benefit theory and theories concerning transaction costs from the New Institutional Economics (including Bridge and Tisdell's approach to integrating TCE and RBT), in order to identify a procurement mode that is likely to deliver the best ratio of production costs and transaction costs to production benefits, and therefore deliver superior VfM relative to alternative procurement modes. In doing so, the new model is also able to address the uncertainty concerning the relative merits of Public-Private Partnerships (PPP) and non-PPP procurement approaches. The aim of this paper is to develop competition as a dependent variable/proxy for VfM and a hypothesis (overarching proposition), as well as developing a research method to test the new procurement model. First though, an update on a key development in the new procurement model is presented the next section.

NEW PROCUREMENT DECISION MAKING MODEL

Figure 1 illustrates a schematic of the new first-order procurement decision making model and which is described by Teo, Bridge and Jefferies (2010). The a priori component incorporating Bridge and Tisdell's integration of TCE and RBT occurs in Stage 1 Task B Make-or-Buy analysis. The decision whether to locate an activity within or outside the firm is known as the make-or-buy decision and it is this decision that determines the extent to which the firm is vertically integrated. In the context of this paper, the firm equates to the government and, therefore, this decision determines the vertical boundaries between the public sector and private sector in infrastructure projects.

In Bridge and Tisdell's integration there are eight theoretical patterns, with each pattern comprising a total of six variables/measurements from TCE and RBT (three variables from each theory). The RBT measurements concern the relative capability and competence of government versus the private sector with respect to the activity and the TCE measurements concern physical and technological attributes of the project. In sum, the eight theoretical patterns reflect four logical reasons to make/internalise (Patterns 1 to 4a) or buy/ externalise (Patterns 4b to 7) an activity. By

applying the RBT and TCE measurements to each activity in the project an actual pattern for each activity is generated and which is then matched with the closest of the eight theoretical patterns. In doing so, this indicates whether the activity should be internalised or externalised to achieve greatest effectiveness and efficiency, including the most efficient allocation of risks. This approach to identifying the party best able to manage risks associated with an activity is a significant departure from current practice. That is, instead of seeking to identify and assess operational risks at an early developmental stage of the project, the focus is on resources held by government versus private sector and relative to each project activity as a means to more fundamentally and more reliably anticipate which party is best placed to manage risks associated with each activity.

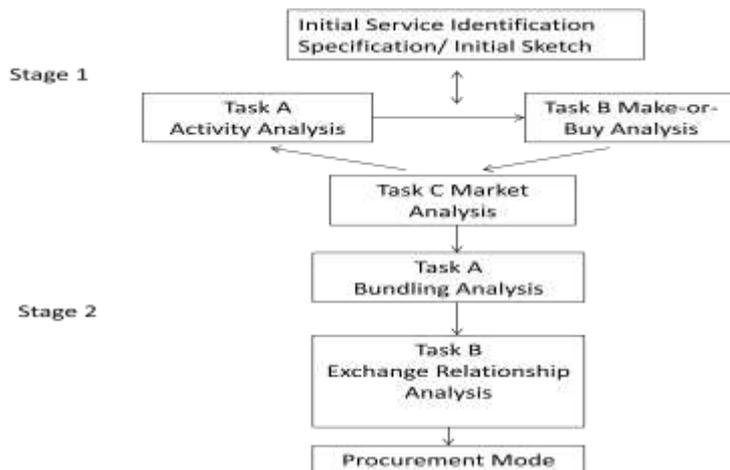


Figure 1: Schematic of new first-order decision making model

The key development in the new model since this was first described by Teo, Bridge and Jefferies (2010) concerns the first three tasks, namely, activity; make-or-buy; and market analysis. Previously, these activities were envisaged in sequence. The new procurement model is now developed in this paper to show these tasks as part of an iterative Stage 1. That is, having completed the first iteration in Stage 1, if any Pattern 7 activities (associated with oligopoly; duopoly; or monopoly market structures) are surfaced and which have been generated on the basis of size or scale of work within the activity concerned, then a second iteration is undertaken involving breaking-up this activity(ies) to correspond with the capacity limits of the next lower tier of firms specialising in this activity. This would then leave only Pattern 7 activities arising out of rare and costly to imitate technology. Iterations within Stage 1 address the "size" issue mentioned by the House of Lords Select Committee on Economics Affairs (2010) as one of the two factors that are observed as key determinants in terms of whether or not a project could be suitable as a PPP. With regard to the other factor mentioned by the House of Lords Select Committee and which concerns predictability, activities assigned as a Pattern 4b activity and the residual Pattern 7 activities from Stage 1 (with a very high potential for hold-up arising from a very high level of asset specificity and very high level of uncertainty/unpredictability) are the focus in Stage 2 Task A Bundling Analysis. Here, Pattern 4b and Pattern 7 activities are excluded from bundling and on the basis that government is better placed to manage potential hold-up in these activities if it directly engages and/or collaborates with the private sector firms supplying these activities.

In summary, the new first-order procurement decision making model addresses key matters concerning risk allocation; size and flexibility/predictability as part of

identifying opportunities to bundle design, construction, operations and maintenance, as well as addressing the nature of the contractual exchange with each private sector party/entity engaged to deliver the project/parts of the project and, in doing so, the new model proposes a mind-set change in current research that revolves around MAUA and the current practice of selecting the procurement mode, as depicted in Figure 2. That is, from an approach which begins with a dominant performance outcome visible at the opening day of an asset (top row of boxes in Figure 2) to a new approach in which the analysis commences with the conditions pertaining to the project (bottom row of boxes in Figure 2) and which opens-up the opportunity to deliver superior VfM and in relative terms - as opposed to VfM in nominal terms.

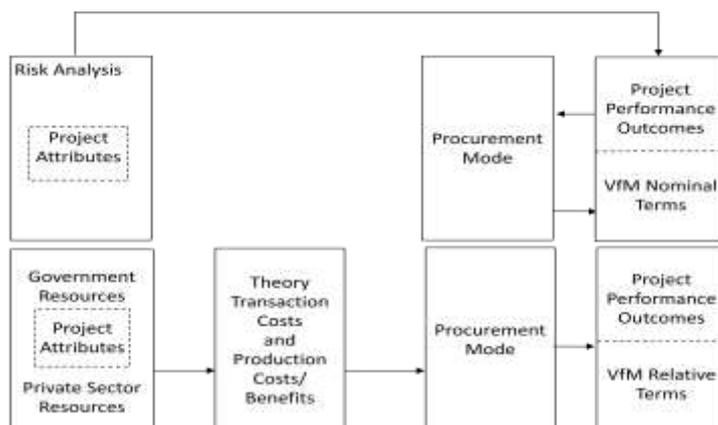


Figure 2: New model and VfM in relative terms

The next section develops competition as a dependent variable/proxy for VfM and a hypothesis (overarching proposition) as steps towards developing a research method to test the new procurement model.

DEVELOPING COMPETITION AS A DEPENDENT VARIABLE

As previously indicated, the House of Lords Select Committee on Economics Affairs (2010) consider competition to be a fundamental driver of value, in terms of recognising size as key determinant of the viability of a PPP. That is, size affects the number of willing suppliers or bidders and this affect is exaggerated in the current economic climate with constraints on credit. The absolute level of competitive tension will not only create downward pressure on prices but also facilitate the crystallisation of innovations that impinge on the time, cost and quality of the project and which will influence the overall performance of the project across its life cycle. More fundamentally, the extent to which actual observed competition matches potential competition (based on actual capacity), or realised competition, is a measure of the success of the selected procurement mode in terms of the level of efficiency achieved in allocating project risks; configuring bundles of externalised activities; and in determining the nature of the external exchange relationship with each externalised bundle/contract. In this way, competition reflects both production costs and benefits (absolute competition) and transaction costs (realised competition) and is a key proxy for VfM. As illustrated in Figure 3, competition is developed as a dependent variable/proxy for VfM in the overarching proposition designed in this paper for testing the new procurement model and which is given as:

When the actual procurement mode matches the predicted procurement mode (informed by the new first-order decision making model), then actual competition is expected to match potential competition (based on actual capacity).

The position that Box A matches Box B and at the same time in the project concerned Box C matches Box D, shows that theory and practice are mutually supportive and that procurement is mobilising full capacity and thus generating maximum competition and enhancing VfM.

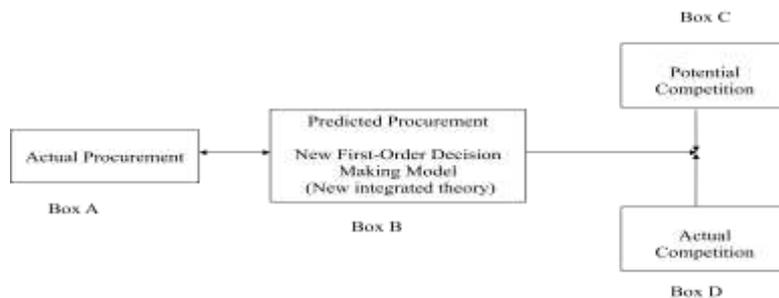


Figure 3: Overarching proposition

This position assumes that tendering policy and practice is meeting the public interest. That is, tendering policy and practice neither gratuitously encourages nor unduly discourages contractors' willingness to bid for public sector projects - as against private sector projects. Alternative positions to that shown in Figure 3 in which government either over-realises competition or under-realises competition, offer opportunities to develop theory and/or practice and explore the effect of tendering on competition.

Over-realised competition: Box D > Box C

In this case, more contactors than expected are expressing a willingness to bid for new public sector infrastructure projects; and notwithstanding the extent to which the overall market is overheated or there exists spare capacity and when:

- Box A (actual procurement) = Box B (predicted procurement) either:
 - Contractors may perceive better than usual odds of bid success and/or better than normal project profit because of the manner by which the project is tendered; or
 - Notwithstanding the manner by which the project is tendered, contractors may be predicting a near term decline in private sector work relative to public sector work.
- Box A (actual procurement) ≠ Box B (predicted procurement) either:
 - This situation needs careful investigation to determine whether theory (new procurement model) can be informed by policy and practice or whether contractors may perceive better than usual odds of bid success and/or better than normal project profit because of the manner by which the project is tendered and/or may perceive better than normal project profit because of the manner by which the project is procured; or
 - Notwithstanding the manner by which the project is tendered, as well as notwithstanding the manner by which the project is procured contractors may be predicting a near term decline in private sector work relative to public sector work.

Under-realised competition: Box D < Box C

In this case, less contactors than expected are expressing a willingness to bid for new public sector infrastructure projects; and notwithstanding the extent to which the overall market is overheated or there exist spare capacity and when:

- Box A (actual procurement) = Box B (predicted procurement) either:
 - Contractors may perceive less than usual odds of bid success and/or less than normal profit because of the manner by which the project is tendered; or
 - Notwithstanding the manner by which the project is tendered, contractors may be predicting a near term decline in public sector work relative to private sector work.
- Box A (actual procurement) ≠ Box B (predicted procurement) either:
 - This situation also needs careful investigation to determine whether this time procurement policy and practice can be informed by theory (new procurement model) or whether contractors perceive less than usual odds of bid success and/or less than normal project profit because of the manner by which the project is tendered; or
 - Notwithstanding the manner by which the project is tendered, as well as notwithstanding the manner by which the project is procured contractors may be predicting a near term decline in public sector work relative to private sector work.

Therefore, under the conditions in which there is an absence of an expected near term decline in either public sector work or private sector work, this research also presents an opportunity to surface the effect of insufficiently strict tendering policy and practice - in the cases in which projects over-realise competition and the effect of overly strict tendering policy and practice - in the cases in which projects under-realise competition. The next section outlines a overall research method using a combination of survey and case study methods designed to generate data to test the overarching proposition and, in doing so, develop and test the new first-order decision making model - as illustrated in Figure 4.

DEVELOPING A RESEARCH METHOD

Information Requested Schedule (Box A: Actual Procurement and Box D: Actual Competition)

The first draft was created on 18th March 2010, and finalised on 26th July 2010 after a further of three drafts. In this process, pilot government respondents' comments were considered and the schedule was refined to reduce confusion concerning terminology and to streamline the questions and scope of the research. A total of ten pilot meetings, including tele-conference meetings were held with government representatives in the five Australian states in the study (NSW; QLD; SA; VIC; and WA). These initial pilot meetings also helped to determine health and road sectors as the focus of the study and projects over \$50million and in which expressions of interest have been established between July 2005 and June 2010. The eventual schedule comprises three main sections namely, project details; project scope and procurement; and tendering approach. The online version of the schedule was designed and developed concurrently, using on-line survey software ("Keysurvey") and which allows respondents to complete the schedule in a password protected survey. After pre-testing the on-line version, the schedule was formally launched on

30th August 2010 and 87 project schedules have been submitted and at the time of writing face-to-face meetings with the government project managers who submitted the schedules are being completed. The objective of the meetings is to fill in the gaps in the submitted schedules and to gather more specific information pertaining to risk analysis and procurement selection guidelines particular to each project and in each state.

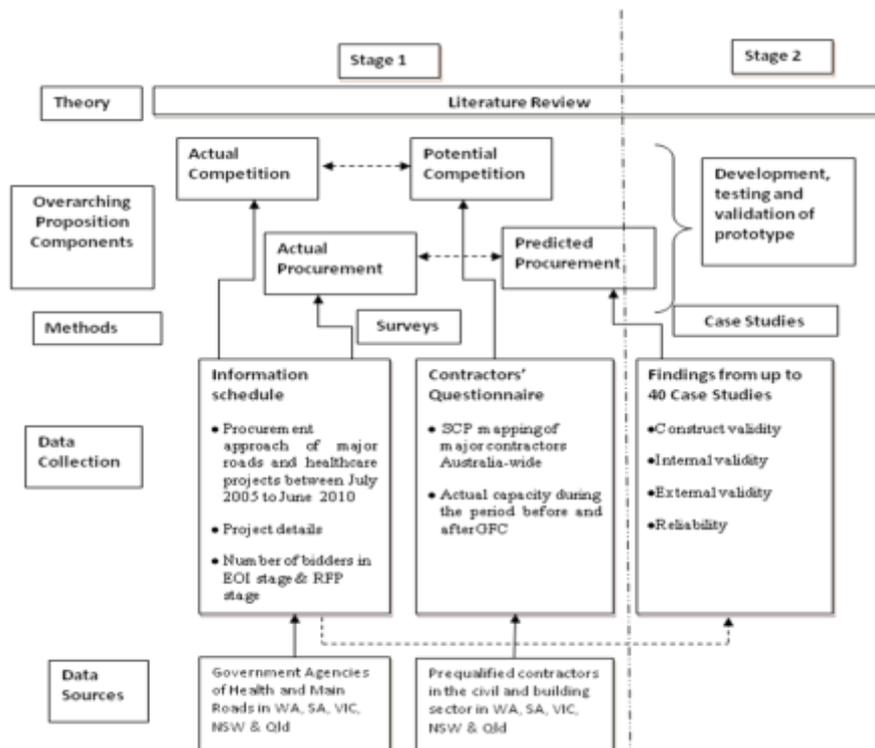


Figure 4: Research methods

Questionnaire (Box C: Potential Competition)

The first draft of the questionnaire was created on 18th March 2010, and following piloting was practically completed on 28th September 2010. After further discussions with government and contracting organisations, the final questionnaire was completed 11th April 2011 and issue commenced 5th May 2011 to 187 contractors capable of delivering projects in excess of \$50million across five states in Australia. In total, 10 versions of the questionnaire were created. Each version has specific wording pertaining to each of the two infrastructure sectors and each of the five states (although each version contains the same questions). Again, an on-line approach was use (Keysurvey – on-line survey software). The questions are designed to map the potential level of competition level in health and road major infrastructure, using sector and Structure-Conduct-Performance (SCP) analyses. The final section of the questionnaire concerns the effects of tendering on bidding. At the time of writing, the process of following-up responses has recently commenced.

Case Studies (Box B: Predicted Procurement)

Data concerning predicted procurement (Box B) is planned to be generated from case studies. The aim is to undertake in the order of 15 case studies selected in order allow analytical generalisation (Yin 2009). That is, one or two health projects and one or two road projects will be selected in each of the five states in the study in Australia. The analytical technique of pattern matching will be used to analyse multiple sources of data in each case study and which is designed to generate the RBT and TCE

patterns and pursuance of deploying the new first-order procurement decision making model.

Planned approach to analysing of data

Once the selected projects have been case studied and the predicted procurement developed for each project by deploying the new procurement model, then the largest construction contact and procurement mode for each project can be identified. Next, using data from the questionnaire a view will be developed concerning the potential competition to this construction contact such that this can then be compared with the actual expressions of interest/actual competition from data in the information requested schedule and which also gives the actual overall approach to procurement (including details concerning the actual approach to procuring the largest construction contact within the project). In each case study, the position/alternative position with respect to the overarching hypothesis can then be identified and the new first-order procurement decision making model developed and tested.

CONCLUSIONS

This paper has presented a key development in a new first-order procurement decision making model and which addresses the "size" issue mentioned by the House of Lords Select Committee on Economics Affairs (2010) in respect of one of the two factors that are observed as key determinants in terms of whether or not a project could be suitable as a PPP. The paper has also developed competition as a dependent variable/proxy for VfM and a hypothesis (overarching proposition), as well as a research method designed to test the new procurement model. In summary, the new model is designed to be used to guide procurement selection at an early stage and before a full business case is developed for the project concerned. In doing so, the model may identify PPPs that may have been otherwise overlooked. The model does not address directly tendering but in testing the model it's envisaged that issues concerning tendering policy and practice will be surfaced in way not seen before. Finally, the questionnaire to contractors will generate data concerning capacity and competition and which straddles both sides of the GFC. Therefore, this will be a unique data set with extreme points and from which future interpolation of capacity and using general economic climate as the guide may be possible. In addition to this, it's envisaged that the SCP map generated from the contractors' questionnaire will be the most comprehensive description of this market in Australia to date and will help inform microeconomic policy and industry reform.

ACKNOWLEDGEMENTS

This research was supported under Australian Research Council's Linkage Projects funding scheme (project number LP0989743).

REFERENCES

- Barney, J.B. (2002), *Gaining and Sustaining Competitive Advantage*, 2nd Edition, Prentice Hall, New Jersey, USA.
- Ball, M. (2007), *Markets and institutions in real estate and construction*, Wiley-Blackwell, Chichester, UK.
- Bridge, A.J. (2008), *The Determinants of the Governance of Air Conditioning Maintenance in Australian Retail Centres*, Unpublished PhD thesis, Queensland University of Technology, Australia.

- Bridge, A.J. and Tisdell, C. (2004), "The determinants of the vertical boundaries of the construction firm", *Construction Management and Economics*, **22**, 807-825.
- Bröchner, J. (2008), "Construction contractors integrating into facilities management", *Facilities*, **26**(1/2), 6-15.
- Bröchner, J. (2011), "Developing construction economics as industry economics", in de Valence, G. (ed.), *Modern construction economics: Theory and Application*, Spon Press, USA.
- Chang, C-Y and Ive, G. (2002), "Rethinking the multi-attribute utility approach based procurement route selection technique", *Construction Management and Economics*, **20**, 275-284.
- Chang, C-Y and Ive, G. (2007), "Reversal of bargaining power in construction projects: meaning, existence and implications", *Construction Management and Economics*, **25**(8), 845-855.
- Coase, R.H. (1991), "The nature of the firm: influence", in Williamson, O.E. and Winter, S.G. (Eds.), *The nature of the firm: Origins, evolution, and development*, Oxford University Press, New York, USA.
- House of Lords Select Committee on Economics Affairs (2010), *Private Finance Projects and Off-Balance Sheet Debt*, HL Paper 63-1.
- OECD (2006), *Infrastructure to 2030: Telecom Land, Transport, Water and Electricity*.
- Hodge, G.A and Greve, C. (2009), "PPPs: The Passage of Time permits a Sober Reflection", *Institute of Economic Affairs*, Blackwell Publishing, Oxford, UK.
- Infrastructure partnerships Australia (2010), *The role of superannuation in building Australia's future*.
- KPMG (2010), *PPP Procurement: Review of barriers to competition and efficiency in the procurement of PPP projects*, KPMG Corporate Finance (Aust) Pty Ltd., Australia.
- National Audit Office (2011), *Lessons from PFI and other projects*, HC 920 Session 2010-2012), The Stationary Office, London, UK.
- Teo, P.L., Bridge, A.J. and Jefferies, M.C. (2010), "Delivering value for money in the procurement of public sector major infrastructure", *Proceedings of the 8th ICCREM*, 1st -3rd December 2010. [Available at: <http://eprints.qut.edu.au/39578/>].
- Thomas, P. (2011), "The evidence for and against PFI", *Infrastructure Journal*, <http://www.ijonline.com/genv2/Secured/printArticle.aspx?ArticleID=67975>. [Date accessed 9 March 2011].
- Walker, A. (2007), *Project Management in Construction*, Blackwell Publishing, UK.
- Williamson, O.E. (1999) "Strategy research: governance and competence perspectives", *Strategic Management Journal*, **20**, 1087-108.
- Yin, R.K. (1994), *Case study research: Design and methods*, Sage Publications, California, USA.