JOURNAL OF PUBLIC PROCUREMENT, VOLUME 15, ISSUE 4, 405-438 WINTER 2015

PUBLIC INFRASTRUCTURE PROCUREMENT: A REVIEW OF ADVERSARIAL AND NON-ADVERSARIAL CONTRACTING METHODS

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ABSTRACT. Adversarial contracting methods are used for most public infrastructure procurement and timely delivery on budget remains a problem. In the past 20 years, OECD countries have adopted a number of alternative procurement methods that are based on collaborative principles including public private partnerships, long-term outsourcing arrangements and relationship/alliance contracts. We review the theoretical principles that operate for both adversarial and collaborative contracting methods. We identify the characteristics of non-adversarial contracting methods such as the output specification, qualitative selection criteria, the alignment of incentives, discrete allocation of residual control rights, life cycle costing, and risk-weighted value for money measurement that are delivering better procurement outcomes for government.

INTRODUCTION

Most public infrastructure is provided by traditional procurement methods generally based on quantitative selection techniques and adversarial contracting principles. Evidence suggests that this method of contracting is inefficient, and is often delivered late and over-budget (Flyvbjerg, Skamris, & Buhl, 2004; Raisbeck, Duffield, & Xu, 2010; Love, Lopez, Edwards, & Goh, 2012). Furthermore, the adversarial nature of

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the contracts means that disputes over variations, changes to specification, poor documentation and rework or renegotiation may lead to lengthy and costly ex-post negotiations or civil action (Love, Cheung, Irani, & Davis, 2011a). To address the limitations of traditional procurement methods, alternative procurement methods (APM) were introduced at the behest of public sector clients adopting a less adversarial contracting approach in which ownership (of decision-making) and responsibility and risk for design and operation of the service-producing asset passed to the contractor with the state (owner-client) adopting a more passive regulatory role (Kumaraswamy, Love, Dulaimi, & Rahman, 2004). A further reason for the use of APM was the growing complexity of infrastructure services, the pursuit of innovative design and construction outcomes and growing recognition of the importance of risk and life cycle costing to long-term investment. However, non-adversarial contracting may not be appropriate for all forms of infrastructure procurement. They may require longer lead times and increase forecast or predicted construction costs. Thus, it is more beneficial to use APM when projects are long-term and complex, when risks are high and service outcomes can benefit from private sector entrepreneurship, innovation and new technology.

In recent years, non-adversarial procurement has been specifically employed to improve capital-intensive social infrastructure services in corrective services, public administration, health and education. The importance of this development is the shift in emphasis from state ownership of infrastructure assets to that of a buyer of infrastructure services. These contracts are non-adversarial to the extent that the relationship between the contractor and the state is one of long-term relationship management. Evidence suggests that APM is achieving better time and cost performance than adversarial methods and through greater efficiency, is contributing to improved service delivery and lower life cycle costs (Raisbeck, Duffield, & Xu, 2009; Love, Davis, & Chevis, 2011b).

Against this contextual backdrop, adversarial and non-adversarial contracting methods used to procure public infrastructure are reviewed with emphasis being placed on identifying the change drivers that are producing improved infrastructure service outcomes for governments. Adversarial contracts are examined, specifically with ownership in the form of residual control rights, the form of

contract, contractor selection, the form of specification, risk, governing policy framework, contractual relationship, and mechanisms for managing change. Next, collaborative contracting is analysed, using the alliance contract model and the public private partnership (PPP). Comparative performance of these procurement methods is also presented.

ADVERSARIAL CONTRACTS

Traditional contracting is the procurement of public works by governments (as principal) to private contractors who are selected by auction or pre-qualification and negotiation. Traditional procurement of goods and services has a long history as the favoured method for the delivery of public infrastructure. Public procurement by auction was evident in Mesopotamian city states as long ago as 2,600BC, classical Greece and the Roman Empire (Cameron & Neal, 2003; Bernstein, 2008). The ancient Sumerian city-states around 2,400BC possessed civil codes that provided for the regulation of public and private contracts, recognised a party's right to pursue self-interest in a contract and imposed penalties on parties who failed to deliver what they had promised. Traditional contracting and legal institutions that dealt with contractual disputes were also evident in early Roman private law and later European states in the western tradition. The term traditional contract is generally applied to contracts for government procurement of goods and services generally offered by auction with a detailed input specification and lowest price bidder selection criteria.

In fact, the term *traditional* is something of a misnomer, suggesting something of enduring cultural value or significance. Traditional contracting certainly has history on its side, but its uses and abuses over time suggest little of either value or significance. Traditional contracts are adversarial which is determined by the form of contract, allocation of risk, mechanisms for dealing with disputes, the alignment of incentives and responsibility for decision-making. The arrangement for payment of the contractor is also important as it is this mechanism that determines which of the parties carries time and cost risk.

When carrying out work in a fixed price contract, much of the contractor's work is unobservable or either too difficult or costly for the principal to monitor. In an adversarial contract, the incentives that

drive the parties over the term of the contract are mismatched or non-aligned and contractual disputes after the fact are common, absorbing significant management time, and are costly to resolve (Love et al., 2011a). The principal's expectation is to receive the specified goods or services in accordance with the contract documents and delivered on time and within budget. In a competitive bid market, the contractor will bid to win the contract and if successful, the manager's focus will be on ameliorating margins by taking advantage of an incomplete specification, poor documentation, change in scope of works, ambiguity in the contract, and disputes. Resolution of disputes does occur during the life of the contract although many claims may be unresolved long after the works have been completed.

Elements of the Adversarial Contract

Traditional procurement is the default procurement option of government and its typical structure has the *Principal* (owner or client) contracting with the *Main Contractor*, who takes responsibility for, employs and manages sub-contractors to carry out the actual work under the contract. It is a method suited to short term complete contracts for the acquisition of plant and equipment, materials, civil works and construction in which the assets may be fully specified. Traditional contracts may use standard form documentation on projects that can be put to market quickly and incur low transaction costs compared with other methods of procurement. Contractor bidding costs for traditional contracts are, on average, around 30% to 60% less than bids of similar size for public private partnerships and build own transfer transactions (Infrastructure Association of Queensland, 2010). This form of contracting has a number of distinguishing characteristics, which are now analysed and discussed.

Ownership

In a traditional and complete contracts, ownership in the form of residual control rights or the decision-making prerogative is exercised by the principal (Estache, Iimi, & Ruzzier, 2009). Control in project procurement is important as it creates the incentive framework that applies to stakeholders and influences the conduct of both the principal and the contractor over the life of the contract (Forborn and Pejovich, 2001). Under a complete contract, the principal is also

responsible for project risks not specifically allocated to the builder. This is a potential problem if the principal is responsible for post-handover service delivery and life cycle-operating costs such as energy, maintenance and repairs. Moreover, poor build quality may affect service delivery costs or, in the case of health, education and corrective services, adversely influence their reliability and quality (Besley & Ghatak, 2003). Most adversarial contracts of short duration vest ownership and decision-making with the principal. The benefits of this include faster decision-making and lower transaction costs. The disadvantages to the principal include limited risk transfer and less opportunity for design and construction innovation. An adversarial contract is vulnerable to disputes and disagreements over changes to the specification (quality), the scope of the project and information asymmetry that is a consequence on non-aligned incentives between the parties.

The Form of Contract

Traditional contracts generally take the form of short-term complete contracts, which attempt to take into account all variables which are, or may become relevant, over the term of the contract (Selanie, 2005). Short-term construction contracts are generally written as complete contracts with provisions that deal with disputes between the parties, change management and externalities that include risk and decision-making in conditions of uncertainty. Default mechanisms including mediation and arbitration provisions to deal with externalities including *force majeure* events which may frustrate the contract or result in legal action. These events effectively terminate the contractual relationship and may result in judicial proceedings which are a costly and unpredictable solution for both sides.

In the common law system, in an adversarial or fault context, a court may resolve contractual disputes with several remedies including orders for specific performance, termination and/or damages. Contractual relations rarely continue beyond judicial determination of commercial disputes and the appellate process. Traditional incomplete contracts extending over long service intervals raise different issues. These contracts cannot address all of the future contingencies that will arise over terms of 20 years or more and it may well prove costly to try to do so (Hart, 2008). Incomplete

contracts address this by providing mechanisms for managing change, resolving disputes (alternative dispute resolution) and dealing with renegotiation (embedded and real options). Incomplete contracts discourage separation of ownership and management which is important from a contractor's perspective if the contract transfers lifecycle cost risk or imposes strict standards on occupational and operating service delivery. They also provide the contractor strong bargaining power towards completion which can lead to opportunistic behaviours. Nevertheless, the decision to be made by the principal is the trade-off between the disadvantages of less control and the advantage of lower transaction costs by not having to run periodic bids for contracts of shorter duration.

Contractor Selection

Infrastructure contracts are commonly let by competitive auction in the form of an open tender or tender by invitation. Depth in infrastructure bid markets is influenced by the frequency of transactions (the project pipeline) and few contractors will retain the specialist skills needed to bid on complex projects if transaction flow is irregular, or the likelihood of success in large bid fields is small. Similarly, if bidding costs are high, contractors will only bid when the chances of success are reasonable. Controlling bidder depth and bid costs for infrastructure projects is a difficult task for government and schemes to reimburse bid costs, limit bid fields or adding a pre-qualification process may increase hold-up risk, prove costly and may only be of limited value. In the case of projects requiring specialised technology or know-how, the procurement authority may select a preferred contractor from a pre-qualification process and enter into a period of exclusive negotiation for the contract. Contracts let by exclusive negotiation have a greater risk of renegotiation largely as a result of their adversarial nature and limited competitive tension in both the preliminary and handover stages of the project (Rothkopf & Harstad, 1994; Tadelis & Bajari, 2006)

A further characteristic of traditional contracts is the use of lowest price criteria for selection of the contractor. Critics of the lowest cost-based approach argue that the winner of a competitive auction is likely to incur optimism bias in pricing of the work (the winner's curse). Transactional evidence suggests that contractor selection should include a significant level of qualitative criteria which may include the

contractor's experience and capabilities, its track record with successful projects, and the value of risks transferred between the parties and wider benefits that the contractor brings to the project including new technology and innovative work practices (Partnerships Victoria, 2001). An important interplay exists between the mechanism that awards the contract and the incentive structure that constrains the ex post behaviour of the contractor (Bajari & Lewis 2011).

Form of Specification

Adversarial procurement is generally based on an input specification (prescriptive contract documentation) issued by the principal and its advisers that provides a definitive requirement for the work to be performed, the materials to be used and the form (but not the method) of construction. This approach assumes that the principal and its advisers have the best design, construction and service delivery solutions. This is particularly the case with public spending on corrective services, health and education where recent evidence suggests that non-traditional approaches to building design and innovation can deliver improved and innovative services including lower recidivism rates, higher educational standards and improved staff productivity (National Audit Office, 2005). The alternative is the output specification which was introduced with the early *build own operate* (BOT) procurement methods in the 1990s. The output specification defines the principal's service requirements but leaves the 'how to' question to the contractor. The output specification effectively allocates design, construction and life cycle cost risk to the contractor or bidding consortium. The contractor exercises control of the project and has a strong incentive to deliver quality assets that minimise life cycle costs. The contractor also has an incentive to employ new technology and innovative design and construction practices if their effect is to lower construction costs, improve productivity and ensure sustainable service delivery.

Risk

Control over project decision-making carries with it the burden of initial, and operational project risks not specifically assigned to the contractor, such as penalties for late delivery, cost overruns and post-construction warranties. The principal meets the cost of the project, all variations and carries life cycle cost risk. The allocation of risk between principal and contractor may be reconfigured by the form of contract

and state or organisational procurement policies. Gross maximum or fixed price contracts may allocate specific time and cost risk to the contractor and reconfigure the contract's incentive framework. For example, under a fixed price contract, the contractor is, in effect, incentivised to raise the cost of variations and 'cut corners' to find cost savings. These contracts are also prone to renegotiation and dispute. If the contractor has no role in future asset management or service delivery, build quality and low life cycle costs are traded for an expedient construction outcome. Conversely, in a *cost plus* or *managing contractor* arrangement under which the contractor is paid an agreed margin, most construction risk resides with the principal and the contractor is incentivised to extend the contract for as long as possible with the maximum resources.

Remuneration provisions in the contract will also affect incentive frameworks. For example, in a cost plus or managing contractor arrangement, an incentive payment mechanism structured as a share of cost savings may also drive specific behaviours and limit the likelihood that the contractor will let contract run over budget. However, it should be recognised that the two major risks in infrastructure projects are the construction and life cycle cost stages which, for service intervals of twenty or more years for conventional buildings, may be a multiple of the original construction cost (National Audit Office, 2002).

Governing Policy Framework

The procurement of public goods is governed by state procurement policies which may require the unbundling of projects into staged work parcels for construction, design, consulting, project management, and facility management. The services may be provided by different organisations, some may be public and others private. Recent studies suggest that bundling of the design and construction tasks or early contractor engagement in the design phase of a project may improve communications, improve delivery cost and time, and stimulate both innovation and adoption of new technologies (Hart, 2003; National Audit Office, 2005a). Policies may also limit the scope for reconfiguring tender, bid selection and form of contract parameters designed to improve alignment of incentives, reduce the adversarial nature of traditional contracts and encourage the contractor's contribution to improved innovation and lower life cycle costs.

Contractual Relationships

Adversarial relationships place the principal and contractor in competition for the capital available to the project with the likelihood of greater interparty friction. The principal endeavours to deliver the project at, or better than, the budget, and the contractor is working to benefit from changes in project scope or specification, the manner of work and disputes over rework, faulty materials and workmanship, and ambiguity or uncertainty in the interpretation of the contract. The relationship between the principal and contractor is also governed by the form of contract. A fixed price contract passes time and cost risk to the contractor, whereas a managing contractor or cost-plus arrangement ensures the principal retains all project risk. The form of contract also determines the formula for the calculation of the contractor's margin (flat fee or incentive-based) and the form of specification (an input specification limits contractor liability to matters specified in the contract whilst an output specification passes design, construction and possibly operational risk to the contractor).

When a contractor claims greater cost recovery for variations or specification changes than the principal is willing to pay, costly disputes follow together with risk of cost overrun, late delivery and extended post-contractual negotiations to resolve matters in dispute, or judicial proceedings, both of which increase transaction costs. Essentially, the parties to the contract are caught in a conflict between self-interest and their obligations under the contract. The adversarial relationship is not confined to the principal and contractor and where the agency unbundles these services into separate contracts, friction may also apply to the relationships between the contractor and sub-contractors, the designer and consultant. When a contractor has bid competitively to secure the contract, the incentive exists to auction or 'shop' the sub-contract components to the lowest bidder. This friction limits opportunities for collaboration and innovation, and can increase transaction costs and disputes.

Incentive Framework

What incentives operate with adversarial construction contracts? Traditional contracts are used to transfer the major proportion of time and construction cost risk to the contractor. The agency's objective is to ensure delivery to specification, to minimise variations and to

ensure that the project is delivered on time and within budget (Songer & Molenaar, 1997). Under a fixed price contract with time constraints, the contractor will endeavour to meet its obligations under the contract, contest liquidated damages for late delivery, manage and, where possible under contractual obligations, minimise costs. In construction contracts, there is also a risk that contractors will bid strategically and competitively to win the contract and then when work commences 'cut corners' or exploit variations to the specification or scope of works to reduce costs and improve the margin during the term of the contract (Hart, Shleifer, & Vishny, 1997). These practices include poor build quality and building sustainability, non-durable fixtures and finishes, and low-efficiency plant and equipment. The risk is greater with complete and fixed price contracts than for incomplete or cost plus margin contracts (Estache, Iimi, & Ruzzier, 2009).

Change Management

Complete contracts provide little flexibility for dealing with change and externalities outside the conventional alternative dispute resolution and judicial solutions. Disputes in traditional procurement may be resolved by alternative dispute resolution (ADR) procedures, although full recourse to legal sanction is always an option. Settlement of a dispute in a court of law may carry the risk of outcomes beyond contemplation of the parties, including contract termination. Legal action is also adversarial and likely to lead to a breakdown in the relationship of the parties to the contract which may take many years to resolve and is costly. Competing objectives give rise to disputes over costs that are resolved by negotiation and arbitration following completion of the works.

Nevertheless, unless otherwise agreed between the parties, recourse to judicial proceedings to resolve intractable disputes remains an option. In incomplete construction contracts, a significant part of the contractor's performance may not be observable to the principal or it may be non-contractible. This may arise because the performance cannot be verified, or it is a consequence of decision-making by the contractor. Monitoring may be too costly, or uncertainties exist in the scope of works and the specification in relation to the quality or quantity of labour and/or materials used. Unobservable work may take several forms, but is generally

concerned with the quality of materials and standards of workmanship. In an adversarial contract, unless strong incentives induce the contractor to contribute additional investment in time, resources and/or money to improve construction performance and quality, the contractor will under-invest in non-observable works especially when cost saving from 'cutting corners' improves overall return.

Information is not readily available for actual costs incurred by contractors and principals although estimates are provided by Allen Consulting Group (2005) and Thompson (1998). Data published by UK building firm Laing O'Rourke in 2009, suggests the average sum in dispute on completion of short-term construction contracts is 9.5% of aggregate contract value. The time taken to resolve contractual disputes is an average of 7.2 months (Laing O'Rourke Ltd Annual Report, 2010). In adversarial contracts, the sub-optimal alignment of incentives contributes to sub-optimal procurement outcomes as traditional contracts are generally limited to production of the asset rather than its whole service life.

NON-ADVERSARIAL CONTRACTS

In the early 1990s in the wake of a world recession, many countries sought to improve microeconomic performance, reduce public deficits and unemployment, and renew aging infrastructure. These reforms led to wider use of outsourcing of government services, the privatisation of many state business enterprises, and the introduction of new privately-financed procurement methods. In fiscally constrained times, the appeal of private capital was also very attractive. The role of government also began to change from the ownership and production of public services to the purchase of services from private producers. In the years that followed, a number of new methods were adopted that took a very different approach to the relationship between the state as principal and contractor as agent. The more common non-adversarial contracts currently in use include *build operate transfer* (BOT) arrangements and *public private partnerships* (PPPs) and outsourcing arrangements including concessions and franchises. This group of procurement methods are based on a very different set of principles to traditional adversarial procurement and commonly feature the following characteristics:

- long-term incomplete contracts;

- bundled services;
- an output specification;
- a non-adversarial contract structure that encourages long term relationship management to resolve disputes, renegotiate elements of the contract affected by change, and to maintain services;
- significant risk transfer from principal to the contractor;
- a contractor selection process that places equal or greater reliance on qualitative factors than it on quantitative or price criteria; and
- greater alignment of incentives to encourage innovation and efficiency.

Non-adversarial contracting for delivery of state infrastructure services is not new. There is evidence that concessions were widely used in Ancient Greece in the 3rd Century BC for quarrying, maritime transport and mining, the outsourcing of colonial administration in the Aegean and Asia Minor, and private control of the grain import trade. The *Seleucid* monarchs of Persia favoured private provision of roads and postal services and the Romans entered into franchises for the construction of bridges, punts, roads, the delivery of water in towns and cities, and the collection of taxes (Easton, 1970; Lall, 1998). The opportunity existed then, as it does now, for private investment and management to deliver infrastructure services to, and on behalf of, the state when the state's capacity to do so is constrained, or its ability to deliver services efficiently and at optimal cost is impaired. Public failure is a characteristic of state institutions and describes state interventions whose cost exceeds the benefits in welfare terms, and activities that could be produced with greater efficiency and at lower cost by private agents (Andrews, Boyne, & Enticott, 2006). Public failure is, or should be, factored into the economics of public procurement as a risk premium (National Audit Office, 2000). The two most common alternative procurement methods used to deliver infrastructure are alliance contracts and BOT concession (including public private partnerships).

Alliance (Relationship) Contracts

An alliance, a form of relationship contracting, is used for short-term or multi-stage construction and civil works projects. Relationship contracting is based on a collaborative approach to the preparation of the project scope and specification, sub-contractor selection, cost estimation, project management and governance. Alliance contracts can be used to deliver complex and multi-stage projects in which the works specification is incomplete at the time of commissioning the contract.

The Form of Contract

The contract is negotiated between the consultant and the principal together with a target cost estimate (TCE). The contract is designed to create a collaborative contractual framework in which the contractor and its subcontractors and consultants work cooperatively with the principal to deliver the project to specification, on time and within the TCE. The characteristics of an alliance contract may include (Love *et al.,* 2011):

- joint residual control and collaboration on sub-contractor selection;
- sharing of information, innovation and technology;
- an 'open book' project governance and accounting framework;
- a joint approach to project costing (target cost estimate) and negotiation of the contractor's margin;
- aligned incentives driving the conduct of the parties;
- joint selection of the project managers, sub-contractors, consultants and advisers;
- risk of cost overrun borne by both parties and the contractor stands to lose all or part of its margin and corporate overhead;
- cost savings and early completion gains shared between the principal, the contractor and sub-contractors; and
- disputes resolved by ADR methods with limited recourse to judicial proceedings.

Alliance contracts may be implemented quickly, reducing transaction costs by eliminating tender and bid evaluation stages. For

complex projects, project design may proceed concurrently with early costing work with the contractor engaged in all aspects of design and preparation of the specification. This provides opportunity for shared innovation, new technology and wider consultation on matters affecting life cycle costs and service quality (Walker & Rowlinson, 2008). However, the aggressive element of price competition between bidders is reduced when compared with traditional procurement.

Contractor Selection

Contractors are generally pre-selected against qualifying criteria which includes the readiness, experience and track record of the contractor's management team. Additionally, contractor selection also includes the contractor's record of innovation and collaboration and a willingness to work toward joint objectives with an appropriate culture fit with the client. Contractors submit to an audit review process in order to pre-qualify for a panel from which the agency may invite a contractor to submit an expression of interest for a project. The calculation of total project cost, completion time and the contractor's margin are achieved by negotiation without competitive tension. Alliance contracting is a significant move away from traditional adversarial contracting with a focus on transparency, good governance, shared decision-making and aligned incentives (Miller et al., 2009).

Form of Specification

Alliance contracts may be used with complete and incomplete specified projects and are employed widely with projects in which the design and specification is incomplete at the commencement of works. Alliance contracts are also suitable for complex and multi-stage projects delivering civil works, infrastructure (interstate highways, railways), public buildings (Blyth Community College, Northumberland, UK), integrated transport terminals (Heathrow Terminal 5, London), schools (Kingsmead School, Hoylake, UK), defence (Logistics Organisation Offices, Andover, UK), port reclamation (Port of Brisbane) and water treatment (Thames Water, UK) (National Audit Office, 2005b).

Ownership

The alliance model is managed by a project control group generally with equal representation from the principal and contractor. The project control group creates the governance and reporting framework, recruits the project manager and monitors performance. Residual control rights are exercised collaboratively in the best interests of the project. The ownership and decision-making for the project is performed by the project control group. Alliance contracts in Australia are delivered under a national alliance contracting policy and guidance framework (Infrastructure Australia, 2011).

Risk

As a general rule, the TCE and delivery schedule are two of the primary measures of procurement performance. Risk and reward in the form of early completion or cost savings are shared, and penalties for time and cost overruns are carried jointly by the principal and contractor. However, in many contracts, the contractor's financial loss may be limited to project profit and corporate overheads. Few alliance contracts are similar and the agreement for risk sharing will be negotiated between the parties. The cost savings and bonus payments for early completion and improved performance are also shared between the principal, the contractor and the sub-contractors. In most alliance contracts, sub-contractors are paid directly through the project control group and the contractor is paid the cost of construction work and site overheads (Petrie, 2007).

Contractual Relationship

The relationship between principal and contractor is non-adversarial; incentives are aligned in a common purpose and information is shared, minimising the asymmetries that add to transaction costs with adversarial traditional contracts. Alliance contracts are generally designed to simplify monitoring and dispute resolution procedures and, as is the case with other alternative procurement methods, enforcement may employ responsive regulatory principles (Walker & Rowlinson, 2008). This applies a graduated penalty framework for minor breaches of the contract such as direct negotiation and minor financial penalties (or a redeemable points system) which escalates to higher penalties, warning notices and possibly contract suspension for repeated and more serious breaches

(Ayers and Braithwaite, 1992). The attraction of responsive regulation is the focus on relationship management and avoidance of contract failure. Alliance contracts are designed to minimise renegotiation and time lost with disputes over changes to specification or scope of works. The transactional experience suggests that it is these characteristics that are reducing transaction cost and improving value for money outcomes.

Ex Post Service Delivery

Alliance contracts are typically employed for construction work and may be used with long-term contracts when articulated over several stages. Alliance contracts do not generally extend to post-handover service delivery. Where a project requires the contractor to provide post-construction asset management services, a separate management service agreement is entered into (NSW Government, 2008).

Incentive Framework

The incentive framework is significantly different between traditional and alliance contracts with the distinction grounded in the ordering of the incentives. In an adversarial contract, self-interest is in tension with the parties' obligations under the contract. Parties will appropriate benefits from an information advantage and there are no mechanisms for sharing the benefits of innovation and new technology (Walker & Rowlinson, 2008; Miller et al., 2009). In collaborative contracting, the risk and reward sharing formula encourages full disclosure, innovation and a joint approach to resolving problems at the least cost. In semi-collaborative contracts such as public private partnerships, the emphasis is on handover and life cycle service delivery rather than on pre- and post-contract construction asset delivery. The principal is not a buyer of the asset, but is a buyer of the service that it produces. As the state agency is only paying for services delivered to the specification, the sole focus of the contractor is to produce the service to specification (NSW Government, 2009). The contractor may improve the marginal return on investment with better productivity or by investing more in the production process. There is no financial benefit to the contractor in cutting costs while constructing the asset, if the result is an increase in life cycle costs or reduction in service quality.

PPP CONTRACTS

Public private partnerships (PPPs) were a development of the BOT procurement method widely used as a vehicle for project finance in the resources industry in the 1980s. PPPs were adopted in the Australia and UK in 2001 and in other jurisdictions shortly thereafter. In Australia, PPPs were formed by state governments, administered by Treasury agencies and supported by a dedicated PPP unit and a comprehensive policy framework. PPPs were first used in Victoria in 2001, although earlier BOT transactions were undertaken in Sydney (Harbour Tunnel project) and Melbourne (Citylink toll roads).

A uniform national PPP policy was adopted in 2009 and currently, PPPs are used in around 130 countries and are a preferred strategy of the multilateral development agencies to fast track infrastructure in developing nations (World Bank, 2012). In Australia, only projects complying with PPP policy are described as PPPs, although in other jurisdictions, most private investments in infrastructure are described this way (Infrastructure Australia, 2008; KPMG, 2010).

PPPs can be distinguished from other infrastructure procurement methods by the following characteristics (Infrastructure Partnerships Australia, 2010; Regan *et al.,* 2011):

- are implemented within a comprehensive policy framework, which operates independently of state procurement policy. PPPs are negotiated for terms of up to 40 years;
- are evaluated by the agency and modelled on a risk-weighted and life cycle cost basis against a traditional procurement benchmark (the public sector comparator);
- contractors are selected either by competitive tender or by pre-qualification and negotiation. The bids are contested by sole contractors or consortia for larger projects which may include a sponsor, construction contractor, asset and/or facility manager, and possibly sub-contractors and consultants;
- the cost of the asset and service provision is met by the consortium and its lenders. The successful bidder derives income from a unitary or availability charge to the agency or accepts market (patronage) risk;
- the agency only pays for the services it receives and payment is abated and/or penalties applied when the contractor fails to meet

service delivery or quality standards or other key performance indicators;

- PPP contracts are long-term and incomplete. This requires contractual provisions to resolve disputes and deal with change without recourse to legal action;
- The contractor is selected on the basis of the best value for money proposition making use of qualitative (contractor track record and experience, innovation, technology, service outcomes) and quantitative criteria;
- ex post service delivery is based on a relationship management approach with a focus on responsive regulation and a non-adversarial management framework; and
- investment economics favour high debt: equity ratios which contribute to greater transaction costs than traditional procurement methods. These costs concern bid and establishment expenses, long lead times to prepare bid documentation, a lengthy bid process, and the conduct of post-selection negotiations with the principal.

The Form of Contract

The PPP transaction embodies a bundle of contracts that pass effective control of the asset and service delivery to the consortium over the term of the arrangement. Service performance is monitored by a state agency under a comprehensive contract management framework. The contract is essentially incomplete and while regulated internally, it contains mechanisms to deal with changeover service intervals as long as 40 years. The agency pays for service delivery and abates payment when the services do not meet the output specification. The state only pays for the services that it receives at the required standard. The consortium has acquired a franchise to deliver services over the life of the contract that is largely protected from market competition (Partnerships Victoria, 2001, Partnerships Victoria, 2012). The opportunity exists for the contractor to improve productivity and profitability over the term of the contract and take advantage of increases in contract value to revalue and refinance assets and raise the marginal return on investment. The PPP contract is not fully collaborative, but it achieves a level of transactional transparency and cooperation not found in traditional procurement methods.

Contractor Selection

A contractor or consortium is selected from a competitive bidding process which may take the form of an expression of interest pre-qualification followed by a request for tender by invitation. The selection process attempts to maintain competitive tension between several pre-qualified consortia while minimising bid costs which can be very high with this method of procurement (Yescombe, 2007).

Form of Specification

PPPs are bid as an output rather than a detailed input specification although, for complex projects, the output specification may be accompanied by detailed operational standards and requirements. The consortium meets the cost of service delivery and is responsible for the design, construction, commissioning and operation of the assets and the services that it delivers. The consortium carries life cycle cost risk and has an interest in ensuring good build quality (Partnerships Victoria, 2001).

Ownership

The PPP transfers decision-making to the consortium, subject only to the agency sign-off on key matters such as final design and service commissioning. The role of the agency is to monitor construction and manage the relationship with the consortium during construction and following commissioning, during the service delivery term. The contractor has the incentive to improve productivity and efficiency and invest further if the pricing mechanism includes bonus payments for service performance exceeding requirements (Regan *et al*., 2011).

The pricing may be based on a points system with breaches of contract and non-conforming services attracting point deductions and consistently high service quality rewarded with additional points. In a monthly or quarterly period, aggregate points exceeding the performance benchmark attract bonus payments and scores below the benchmark result in abatements or penalties. Points systems such as those used in United Kingdom hospital PPP projects are redeemable either within the review period or for reconciliation with later periods (National Audit Office, 2005c).

Risk

The consortium carries the full risk of service delivery and in some transport projects it may also carry market risk. In the latter transactions, market risk may be mitigated by 'take or pay' provisions in the contract, and other forms of agency guarantee, that ensure minimum revenue levels sufficient to support consortium debt servicing (Partnerships Victoria, 2001).

The principal only pays for the services delivered and therefore carries no operational risk. However, the principal carries residual political risk in the sense that if the consortium fails for any reason, the agency must work with the project financiers to identify a buyer of the contract and/or resume the asset with compensation. In Australia, 12% of projects have failed in the sense that the consortium cannot meet its debt servicing requirements (Regan, 2008a, 2009). The state also carries the electoral risk that the electorate will hold government responsible for poor service quality or service delivery failure (Infrastructure Australia, 2010). There has not been any service delivery failure of PPPs in Australia, although projects have been delivered late (i.e. Ararat Prison Contract II and Southern Cross Station, both in Victoria, Australia).

Governing Policy Framework

PPPS are delivered under the national policy framework with some variations adopted by the states and territories for local conditions. PPPs are not subject to general state procurement policy, although they are subject to the governance and performance monitoring processes in the states and territories. PPPs are not generally available to local government without the consent of local government ministers at state and territory level (Infrastructure Australia, 2008).

Contractual Relationship

The PPP is an incomplete and non-adversarial contract that operates to minimise the risk of interparty friction. Additionally, decision-making resides with the party most concerned about life cycle operation, service quality and the marginal return on investment. The role of the financier and the consortium is particularly important in a PPP because it provides a limited indemnity to the state against project failure: as a limited recourse loan, the financier may appoint

an administrator to the development vehicle in the event of consortium default. The state requires continued service delivery and the financier's requirement is to maintain cash flow and debt servicing. In the event of default under either the PPP or the loan agreements, the financier may subrogate an administrator to manage the PPP contract with a view to finding a new buyer of the contract. A change in control of the ownership of a PPP contractor or consortium requires agency approval (Yescombe, 2007; Infrastructure Australia, 2008; Regan, 2008b).

The financier also applies capital market discipline to the consortium by enforcing contractor compliance with the terms of the contract such as service delivery standards and debt servicing covenants in the loan agreement. In the event of default under either the PPP or the loan agreements, the financier may subrogate an administrator to manage the PPP contract with a view to finding a new buyer of the contract. A change in control of the ownership of a PPP contractor or consortium requires agency approval (Regan, 2009).

Ex Post Service Delivery

As a long-term incomplete contract, PPPs include the *ex post* service delivery stage of service provision. This creates an important connection between building quality, life cycle cost risk and the quality of service provision. If the contractor is responsible for life cycle costs over the term of the contract, it is in the interests of the contractor to ensure that assets are constructed with a view to durability, low maintenance and minimal energy consumption. Unlike an adversarial contract, *ex post* performance under the contract is conducted under responsive regulatory principles within a relationship management framework designed for early resolution of service delivery and compliance issues at the project level (Bajari & Tadelis, 2001; Bajari & Lewis, 2011).

Incentive Framework

A PPP aligns the incentives that drive behaviours for the three principal parties to the contract, the financier, the consortium and the state agency as buyer of the service (Love *et al*., 2011). Each has an interest in sustained high-performance service delivery, the avoidance of protracted and costly disputes, and the resolution of change management issues. The tensions that may exist at the

project level over compliance matters suggest that PPPs may not be a fully collaborative contract, in the same way an alliance contract. Nevertheless, the alignment of risk, incentive and objectives within the PPP arrangement suggest a cooperative approach that is a significant departure from conventional adversarial contracting (Miller *et al*., 2009).

COMPARATIVE PROCUREMENT PERFORMANCE

Reports by the UK National Audit Office in 2001 and 2003 identified late delivery and over-budget performance in around 70% of public projects (National Audit Office, 2001, 2003). Moreover in 2007, a study of traditional contracts and PPPs in Australia found that traditional adversarial contracts for major projects were systematically delivered late and over-budget compared with PPPs (Allen Consulting and University of Melbourne, 2007). Land transport projects, in particular, attracted a high level of *optimism bias* reflected in overestimation of revenues and underestimation of delays, coordination problems, and costs (Standard and Poor's, 2004; McDonald, 2002). The Standard and Poor's 2004 study examined patronage (forecasting) error for over 87 international road projects and identified an average 20% to 30% per cent overestimation. The study also compares evidence for toll and non-tolled roads and builds on the evidence of two earlier firm studies (Standard and Poor's, 2002, Bain, 2003). The problems are significantly greater for non-standard buildings and civil engineering works, and equipment procurement (Mott McDonald, 2002).

There has been a subtle shift away from the use of traditional contracting in an attempt to ensure that infrastructure projects meet pre-defined service deliverables. The National Audit Office in Britain conducted a review of complex projects delivered with traditional and alliance contracting across a number of applications including primary, secondary and tertiary education, airports, property, medical services, water and public buildings. Contracts designed on collaborative contracting principles delivered better quantitative and qualitative pre-construction and construction and handover service outcomes than adversarial contracting benchmarks (National Audit Office; 2005a, 2005b). Despite the shift to collaborative contracting, infrastructure projects are still *not* being delivered on time and to budget. In the UK, for example, the Construction Industry Key Performance Indicators

revealed that 55% of current projects are delivered late, and 37% are not delivered to the intended budget (Construction Excellence, 2011). Similarly, in Australia, Blake Dawson (2011) found that less than 48% of infrastructure projects surveyed were delivered on time, on budget and to the required quality. A fundamental shift in the public sector's ethos to contracting is required in order to address this unending pervasive problem.

Procurement theory views project procurement in all its forms through the lens of the principal-agent relationship (Estache *et al.,* 2009). A difficulty with the principal-agent model is asymmetry of information and unobserved conduct. When the principal selects a contractor in an auction (tender) using criteria weighted in favour of quantitative values such as price, the principal encounters adverse selection problems because it cannot easily measure or verify the contractor's efficiency, embedded technology, willingness to innovate, commitment or propensity for litigation. A principal is also unlikely to know if the contractor will cut corners to improve margins and whether or not the contractor has made errors in constructing its bid. This matters if the principal is carrying life cycle cost risk or if there is a risk of impaired service outcomes. In agency, these problems are usually resolved with incentives designed to improve build quality and a trade-off between a lower procurement cost and increased life cycle costs over the longer term (Laffont & Martimort, 2002). In state procurement contracts, an additional problem can be the limited discretion agencies have to reconfigure selection criteria within rigid policy criteria.

Collaborative contracting is difficult to view through the principal-agent model. In PPPs, the principal is a buyer of services under a long-term supply agreement. The contractor is the producer of services with possession of the assets, decision-making authority and responsibility for lifecycle costs. Because the contractor can improve its investment return from innovation and efficiency in both the construction and management of the asset, it can appropriate the surplus (the marginal return on investment). The principal has no capital at stake, it is buying and only paying for services that meet specification and its objective is to ensure that the service meets requirements. The value for money test is an *ex ante* determination made in a competitive bid context and the relationship between the parties is simply an arm's length supply contract between a vendor

and buyer of a service (Department of Infrastructure and Planning, Queensland, 2008; Infrastructure Australia, 2010; Regan *et al.,* 2011).

Procurement theory suggests that complex procurement contracts deliver better performance when the contractual framework incorporates non-adversarial principles (Bajari & Tadelis, 2001). That is, the relationship of the parties to the contract benefit from cooperation (Bajari & Tadelis, 2001). In this sense, cooperation is the sharing of information, the alignment of objectives and incentives, the encouragement of innovation and productivity by aligning decision-making and responsibility for project outcomes, and the adoption of a responsive and relationship management approach to *ex post* contract administration. This approach is supported by empirical evidence where the performance advantage of PPPs and alliances is well documented. (National Audit Office, 2005a, 2005b; Regan *et al.,* 2011). Complete contracts for short-term construction and civil works can benefit from incentive-based contracts that place the principal and the contractor on a less adversarial footing. Delivery performance may be improved with the integration of the design and construction tasks, early contractor involvement, wider use of output objectives in the project specification to encourage contractor innovation, and specific incentives relating to build quality with a view to reduced lifecycle costing. Where possible, life cycle contracts can lead to significant time and cost savings with complete contracts. However, it does require the redesign of state procurement policy to permit more flexible bidder evaluation criteria.

TECHNOLOGY ENABLED COLLABORATIVE CONTRACTING

A leitmotiv that contributes to the failure to deliver infrastructure projects predictability is 'poor quality information' (Love *et al*., 1999; Andi & Minato, 2003; Love *et al*., 2006; Crotty, 2012). According to Barrett and Barrett (2004) "projects that run over time and budget are often underpinned by faulty documentation that looks professional, but in fact does not properly describe the built solution". Under a traditional contract, complete design documentation is generally not fully available when a project goes to tender (in theory, it should), which explains why few projects are actually completed within the tendered price. This is also the case for non-traditional approaches as design activities are undertaken in a concurrent

manner and preliminary information is released earlier to proceeding tasks (Evbuomwan & Anumba, 1996). This approach is typically adopted to reduce design time and errors as well provide feedback to solve problems that may have manifested earlier in the design process (Arundachawat *et al.,* 2009). Using preliminary information when design tasks are overlapped often leads to information changes, which arise due to evolutions in design. The early release of information may cause unnecessary rework due to redundant data, and an increase the time and effort to prepare for the release of information as checks and quality assurance processes need to be implemented (Eastman, 1980; Love *et al*., 2012).

Information is pivotal to reducing the construction costs as well the whole-life cycle costs of a facility. For this reason, the ability to access in-built information within equipment, systems, and spaces a *Building Information Modelling* (BIM) approach informs design decisions as the project progresses. The Government Construction Client Group (2011) in the UK states "clients should expect all consultants to be familiar with BIM and to be actively developing ways in which processes can be made more cost effective and value adding". It has been estimated that BIM can provide (Centre for Integrated Facility Engineering, 2007):

- 7% reduction in schedule;
- 10% saving in contract value through clash detection;
- 40% elimination of unbudgeted change; and
- 80% reduction in the time taken to generate a cost estimate with cost estimation accuracy within 3%.

Clients, particularly those who will operate and maintain an asset will benefit most from implementing BIM. Essentially, BIM is a process and technological innovation that enables project team collaboration and integration to occur and provides a platform for sharing information. BIM requires a collaborative contracting approach known as Integrated Project Delivery (IPD) to be used to realise its full potential. IPD is defined as "an approach that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to optimize projects results, increase value to the owner, reduce waste, and maximize efficiency through all phase of design, fabrication, construction" (AIA California Council, 2008). The use of

IPD is somewhat akin to the concept of alliances with emphasis being placed upon (Eastman, Teicholz, Sacks, & Liston, 2008; Sacks, Koskela *et al.,* 2010; Love et al., 2012) the following:

- a multi-party contract;
- early involvement of key participants;
- collaborative decision-making;
- sharing of risks and rewards;
- liability waivers among key participants; and
- jointly developed project goals.

All of the above characteristics must be incorporated into a project for IPD to be realized in its 'purist' form. Projects using IPD in Australia do not employ all of these characteristics; instead they use some elements to increase the likelihood project success (Allen Consulting, 2010). While the use of IPD provides the ideal platform to use BIM, it is not a necessity. However, IPD without BIM is better than BIM without IPD.

BIM enables designers to view an asset and its contents from all angles, which can reveal potential problems during the formative stages of the design process. Sections, elevations and 3D views can be created instantly, reducing the need for check plots. Changes to any one of these elements affect all of the others, including materials, costs and construction schedules. With BIM, detailed information about each building component is contained within its modelled element. Primarily, BIM improves coordination among project team members by making design changes, and all their consequences evident and available to all users of a parametric model. The synchronized and collaborative nature of BIM allows for earlier clash detection between the numerous members of the design team. Earlier clash detection therefore shortens the time required for building design and reduces costs associated with rectifying clashes that were undetected during design reviews. In Australian construction projects, for example, it has been estimated that 60% to 90% of all change orders are a result of poor design documentation– a failing that BIM enabled technology can readily address, particularly during the design phase of a project.

CONCLUSION

Traditional and adversarial methods of contracting have been reviewed to provide decision makers with an understanding of reasons and basis for continuing with the tried and tested approaches. The advantages and disadvantages of the traditional approach have been discussed and their use is based in the sharing of risk between principal and contractor. The often ignored advantage of the traditional approach is the fact that it preserves government probity through competition and having the minimum barriers to entry to new participants. Pre-qualification can dilute these characteristics, but applied fairly and sensitively can reduce risk of non-performance for the principal. A major disadvantage identified in this approach is the culture of adversarial relations between the parties and this engenders division rather than cooperation between the parties.

Non-adversarial approaches re-balance risks towards the contractor and the party that can best manage them. Bearing risk does not come without cost and the parties, especially the contractor, must price this additional burden in their tender. The expansion of public tenders to go beyond the delivery of the infrastructure for the principal and include service delivery for a designated period (up to 40 years), has increased the risk profile of the successful bidder. However, the performance and deliverables often measured by the project parameters of time, cost, quality and scope have improved under collaborative contracting. However, they are not infallible and poor decisions often captured in *optimism bias* can result in failure and termination of the service contract and selling off the infrastructure asset. These have occurred on some projects around the World and whilst these failures are regrettable, in most cases the public purse does not suffer. In fact, the public sector may gain an infrastructure asset at a cost less than the replacement cost to be retained or auctioned to a second provider.

The use of BIM and IPD for infrastructure delivery in Australia has been limited to date. However, there are positive predictions as to the influence BIM will have on reducing documentation errors on projects. Poor documentation is a chronic malaise within the construction industry. Yet, accurate contract documents (specification, drawings, schedules and bills of quantities) are an essential pre-requisite to all procurement approaches, whether produced by the principal's agents

(design team) or the contractor. Error-free documents would not only improve contractual relations between the parties (less conflict), but would also improve time, cost and quality parameters. A corollary of good documentation is a reduction in disputes and greater potential for project delivery success.

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