DESIGN AND ADOPTION OF INNOVATIVE PROCUREMENT SYSTEMS IN INFRASTRUCTURE DELIVERY

Ron Watermeyer[1]

[1] *Visiting Adjunct Professor, School or Construction Economics and Management, University of the Witwatersrand, Johannesburg, South Africa*

Director, Infrastructure Options, (Pty)Ltd. Randburg, South Africa

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Abstract

Procurement systems needs to be designed around a set of objectives. An objective that is common to both the public and private sector is value for money. Whenever procurement outcomes fail to deliver value for money, or are perceived to have failed to do so, those responsible for the procurement are held to account.

Value for money may generally be regarded as the optimal use of resources to achieve intended outcomes. It needs to be assessed during the planning, implementation and close out phases with a focus on economy, efficiency and effectiveness, respectively. Objectives and expected outcomes framed during the planning phase frames the value for money proposition that needs to be implemented. During the close out of a project the projected outcomes are compared against the actual outcomes. This confirms the "effectiveness" of the project in delivering value for money. Any deficit between what was planned and what was achieved puts value for money for a project at risk.

It is well understood that optimism bias and strategic misrepresentation may compromise the projected project outcomes and be the root cause for failing to obtain value for money on projects. A key question is what proactive action can be taken during implementation (efficiency) to minimise any gaps between achieved and projected outcomes irrespective?

This paper examines the fundamental differences between the general goods, general services and delivery of infrastructure. It thereafter reviews the approaches to the soliciting of tenders and the awarding of contracts and the conditions of contract which are most likely to enable value for money to be delivered during implementation. It also examines the question of procurement strategy and tactics and issues of governance and project management, all of which can improve efficiencies during implementation and as such contribute to the achievement of the value for money proposition established during the planning phase of projects. It also describes the culture change that is necessary to deliver value for money during implementation.

Keywords: value for money, procurement, delivery management, infrastructure

INTRODUCTION

Procurement is *the process which creates, manages* and fulfils contracts (ISO 10845-1:2010). A system is a set of interrelated or interacting elements (ISO 9000:2005). It is an established way of doing things that provides order and a platform for the methodical planning of a way of proceeding. Systems are underpinned by processes (sets of interrelating activities which transform inputs into outputs (ISO 9000:2005)), procedures (specified ways to carry out an activity or process (ISO 9000:2005)) and methods (documented, systematically-ordered collections of rules or approaches (ISO 10845-1:2010)).

A procurement system comprises (Watermeyer, 2011a):

- rules and guidelines governing procedures and methods;
- procurement documents which include terms and conditions, procedures and requirements;
- governance and quality arrangements to manage and control procurement; and
- organisational policies which deal with issues such as:
    - the usage and application of particular procurement procedures;
    - requirements for recording, reporting and management of risk;
    - procedures for dealing with specific procurement issues;
    - the usage of procurement to promote social and developmental objectives; and
    - the assignment of responsibilities for the performance of activities associated with the various processes .

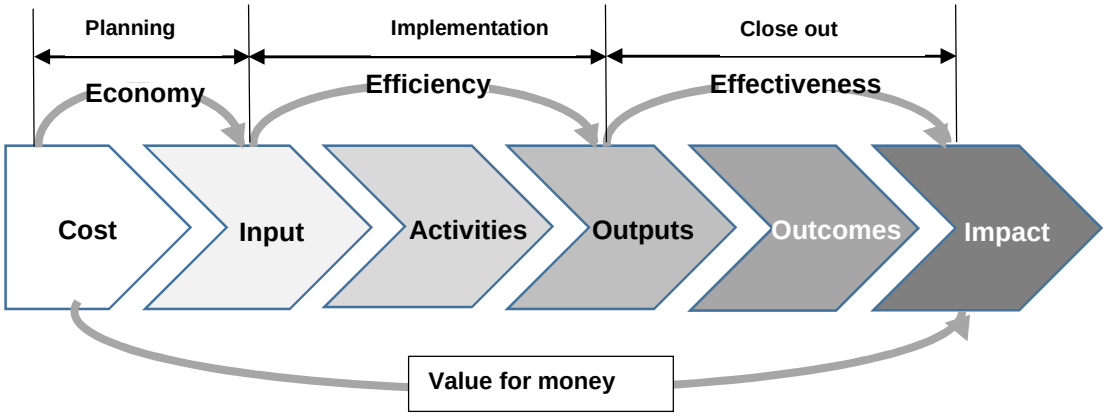
Different components of a procurement system are designed around specific objectives. Graellis (2011) identifies 9 such goals, namely competition, integrity, transparency, efficiency of the procurement systems, customer satisfaction, best value for money, wealth distribution, risk avoidance and uniformity of rules. Some of these objective are closely related, some are instrumental to one another, while some are in open conflict and not all of them are desirable. Furthermore, some of these objectives relate only to public procurement system.

An objective that is common to both the public and private sector is value for money. Taxpayers, shareholders, financiers and project sponsors all have a desire to see value for money being realised in the procurement of infrastructure. Whenever procurement outcomes fail, or are perceived to have failed, to achieve, those responsible for the procurement are held to account

This paper examines the components of procurement system for the delivery of infrastructure (fixed assets which are acquired, constructed or which results from construction operations) that is better able to deliver value for money whilst minimising the scope for corruption.

VALUE FOR MONEY IN THE CONTEXT OF INFRASTRUCTURE DELIVERY

The concept of value for money needs to be understood in the context of infrastructure delivery. Value for money may generally be regarded as the optimal use of resources to achieve intended outcomes. The UK National Audit office currently define it as “the optimum combination of whole-life cost and quality (or fitness for purpose) to meet the user’s requirement.” Underlying value for money is an explicit commitment to ensure that the best results possible are obtained from the money spent or maximum benefit is derived from the resources available. It is a means for developing a better understanding (and better articulation) of costs and results so that more informed, evidence-based choices can be made. Value for money needs to be assessed during the delivery cycle using the so-called three “Es” − economy, efficiency and effectiveness at the end of the planning, implementation and close out stages of a project, respectively (see Figure 1). An overarching fourth “E” also needs to be considered when delivering infrastructure, namely equity (Watermeyer, 2013).



Cost	Sum of money required to fund the intervention
Input	Inputs cover all the materially significant financial, human and material resources used for a development intervention
Activities	Activities are used to deliver outputs
Outputs	Outputs relate to products, capital assets and services which result from a development intervention. Outputs are limited to the specific, direct deliverable of the intervention.
Outcomes	Outcomes are the likely or realised short-term/medium-term effects of the outputs of any intervention. Outcomes are used to identify (a) what will change, (b) who will benefit and (c) how it will contribute to poverty reduction and/or the Millennium Development Goals
Impact	Longer-term effects are produced, directly or indirectly, by a development intervention. Impact refers to higher level identified achievements that the intervention will contribute towards

Figure 1: Results chain framework (after Watermeyer, 2013)

Infrastructure delivery needs to be managed and controlled in a logical, methodical and auditable manner. The starting point in the development of any delivery management system is to identify the information which needs to be developed and accepted by the client or implementer at a particular point in the delivery process to enable a project to be advanced i.e. at a control point (or gate). The stages in the delivery of construction works can then be defined as the activities that need to take place between such points. These stages enable the work flow (sequence of connected activities) toward the attainment of an end of stage deliverable to be developed and culminate in gates (control points) which can be used to provide assurance that the proposed works remains within agreed mandates, aligns with the purpose for which it was conceived, and can progress successfully from one stage to the next (Watermeyer, 2012a). The results chain framework illustrated in Figure 1 needs to be linked to the stages of infrastructure delivery. Figure 2 links the three basic “Es” associated with value for money to the typical stages of the life cycle for the delivery of infrastructure.

The critical starting point in delivering value for money through projects is to screen and select projects during the project initiation stage which are aligned with strategic needs or business opportunities (see stage 0 in Figure 3). Objectives and expected outcomes for given inputs as well as parameters such as the time lines, cost and levels of uncertainty need to be formulated and documented at the end of the planning phase (stage 4). This frames the value for money proposition that needs to be implemented at the point in time that a decision is taken to proceed with the implementation of a project. It establishes “economy” and identifies opportunities for “equity” when design concepts or solutions have been sufficiently developed to establish the feasibility of the works or to select a particular conceptual approach to pursue. It is also the point where the scope of a project is frozen. Should the works not prove to be viable as conceptualised (e.g. insufficient budget, unacceptable risk profile, geotechnical / environmental / community constraints, poor return on investment etc.), the project is either consciously modified in order to satisfy “economy” considerations before proceeding with implementation or is terminated as indicated in Figure 2.

During the close out of a project (stage 9) the projected outcomes are compared against the actual outcomes. This confirms the “effectiveness” of the project in delivering value for money. This typically involves the comparing of the scope, schedule and cost plan and, where relevant, the performance as documented at the start and the end of the implementation phases, respectively. Value for money will

occur when what is achieved equals or exceeds what was expected. Any deficit between what was planned and what was achieved puts value for money for a project at risk. An assumption can, however, be made that if the implementer exercises due care and reasonableness during implementation, value for money will be achieved. Put differently, if due care and reasonableness is exercised during implementation and what is achieved is nevertheless less than what was expected, the difference lies not in the efficiency of implementation but in the inherent project risks materialising or shortcomings in framing the value for money proposition at the start of the project. It is a well-researched fact that risk is inherent in all projects and not all risks can be accurately forecasted or controlled during project planning and implementation (Loosemore *et al*, 2006).

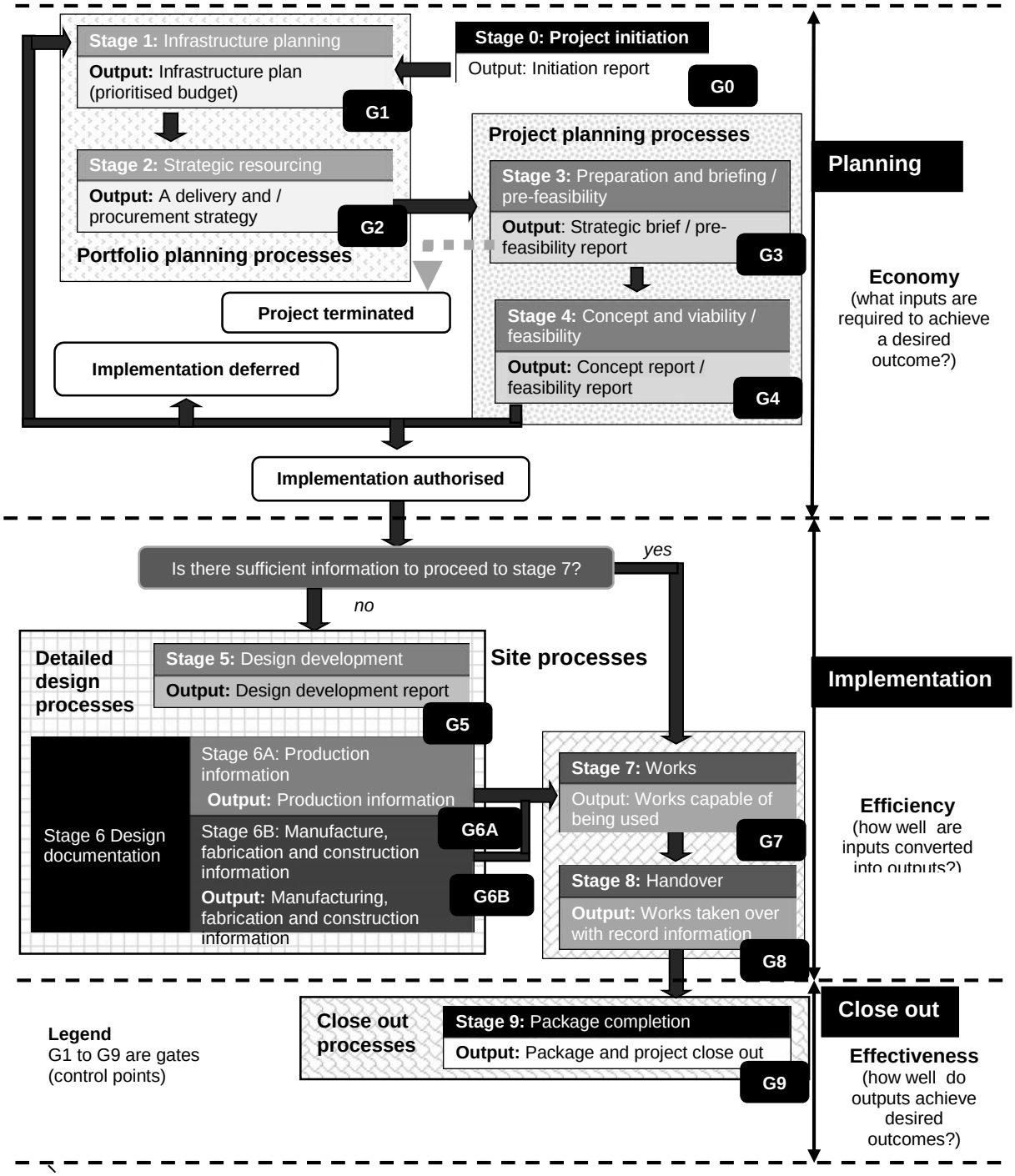


Figure 2: Value for money in the context of the typical stages of infrastructure delivery (after Watermeyer, 2014)

REASONS FOR INFRASTRUCTURE PROJECTS FAILING TO DELIVER VALUE FOR MONEY

The value for money proposition at the time that a decision is taken to proceed with the implementation of an infrastructure project is based on sets of assumptions and the available data. It is therefore important to understand the context within which the value for money proposition is established, particularly that relating to cost.

The degree of project definition as measured by the percentage of design completed at the end of stage 4 can be estimated from the fee apportionments for stages contained in the guideline fees such as those published by the South African councils for the architectural and engineering professions and the Royal Architectural Institute of Canada (Watermeyer, 2014). It is somewhere between about 12 and 40%, depending upon the nature of the works that are being designed and the level of effort and detail put into the end of stage 4 deliverables as some of the work which is normally included in the stage 5 deliverables may be included in the stage 4 deliverables. As an illustrative example, the US Department of Energy uses the classification of estimates indicated in Table 1 to enable the quality of the cost estimate to be appropriately considered through the evolution of a project. Class 3, 2 and 1 estimates typically occur towards the end of Stages 4, 5 and 6, respectively. As a result, the decision to proceed with a project may be based on a class 3 estimate with a -20 to + 30% accuracy where the degree of project definition is between 10 and 40%.

Table 1: Generic Cost Estimate Classifications and Primary Characteristics (US Department of Energy, 2011)

	Primary characteristic	**Secondary characteristic**		
Estimate Class	**Degree of project definition (expressed as % of complete definition)**	**Typical purpose of estimate**	**Methodology**	**Expected accuracy range (typical variation in low and high ranges)***
Class 5	0% to 2%	Concept screening	Capacity factored parametric models judgment or analogy	-20 to – 50% +30 to +100%
Class 4	1% to 15%	Study or Feasibility	Equipment factored or parametric models	-15 to -30% +20 to +50%
Class 3	10% to 40%	Budget, Authorization, or Control	Semi-detailed unit costs with assembly level line items	-10 to -20% +10 to +30%
Class 2	30% to 70%	Control or Bid/Tender	Detailed unit costs with forced detailed take off	-5 to -15% +5 to +20%
Class 1	70% to 100%	Check Estimate or Bid/Tender	Detailed unit cost with detailed take-off	-3 to -10% +3 to +15%

* The state of process technology and the availability of applicable reference cost data affect the range markedly. The ± value represents the typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for given scope.

The value for money proposition upon which the "economy" of a project is based during the planning phase, which ends with a decision being made to proceed with a project at the end of stage 4, may need to be viewed with some caution as it may be tainted by (Flyvbjerg *et al,* 2003):

- optimism bias - the human mind's cognitive bias in presenting the future in a positive light; and
- strategic misrepresentation – behaviour that deliberately underestimates costs and overestimates benefits for strategic advantage usually in response to incentives during the budget process.

Implementation sits between the bookends of "economy" and "effectiveness" in the results chain framework shown in Figure 1 i.e. between Stages 4 and 9. It needs to be executed "efficiently" in order to minimise time delays, scope creep and unproductive costs and to mitigate the effects of uncertainty on objectives (risks) so as to maintain the value for money proposition formulated at the outset of the project.

Optimism bias and strategic misrepresentation are in the main confined to the planning (economy) stages of a project which ends with a decision being made to proceed with a project and relate to the quality of the information upon which a decision is made. The key question that begs asking is what proactive action can be taken during implementation (efficiency) to minimise any gaps between achieved and projected outcomes irrespective of whether or not optimism bias and strategic misrepresentation is present at the time that a decision was taken to implement a project?

DIFFERENCES IN THE PROCUREMENT OF GENERAL GOODS AND SERVICES AND THE DELIVERY OF INFRASTRUCTURE

The starting point in the design of a procurement system for infrastructure delivery which is better able to deliver value for money is to recognise that there are differences between procurement processes for general goods and services and that for the delivery of infrastructure (Watermeyer *et al*, 2013). Procurement that is unrelated to the delivery of infrastructure typically relates to goods and services that are standard, well-defined and readily scoped and specified. Once purchased, goods invariably need to be taken into storage prior to being issued to employees. Services most often involve routine, repetitive services with well understood interim and final deliverables which do not require strategic inputs or require decisions to be made regarding the fitness for purpose of the service outputs.

In contrast, procurement relating to the construction, supply, renovation, rehabilitation or alteration of infrastructure (delivery of infrastructure) covers a wide and diverse range of goods and services, which are required to provide or alter the condition of fixed assets on a site. Accordingly, the procurement process for the delivery of infrastructure involves the initial and subsequent recurring updating of planning processes at a portfolio level flowing out of an assessment of public sector service delivery requirements or business needs. Thereafter it involves planning at a project level and the procurement and management of a network of suppliers, including subcontractors to produce a product on a site (see Figure 3). There is no need to store and issue materials or equipment unless these are issued to employees responsible for the maintenance or operation of infrastructure, or are issued free of charge to contractors for incorporation into the works.

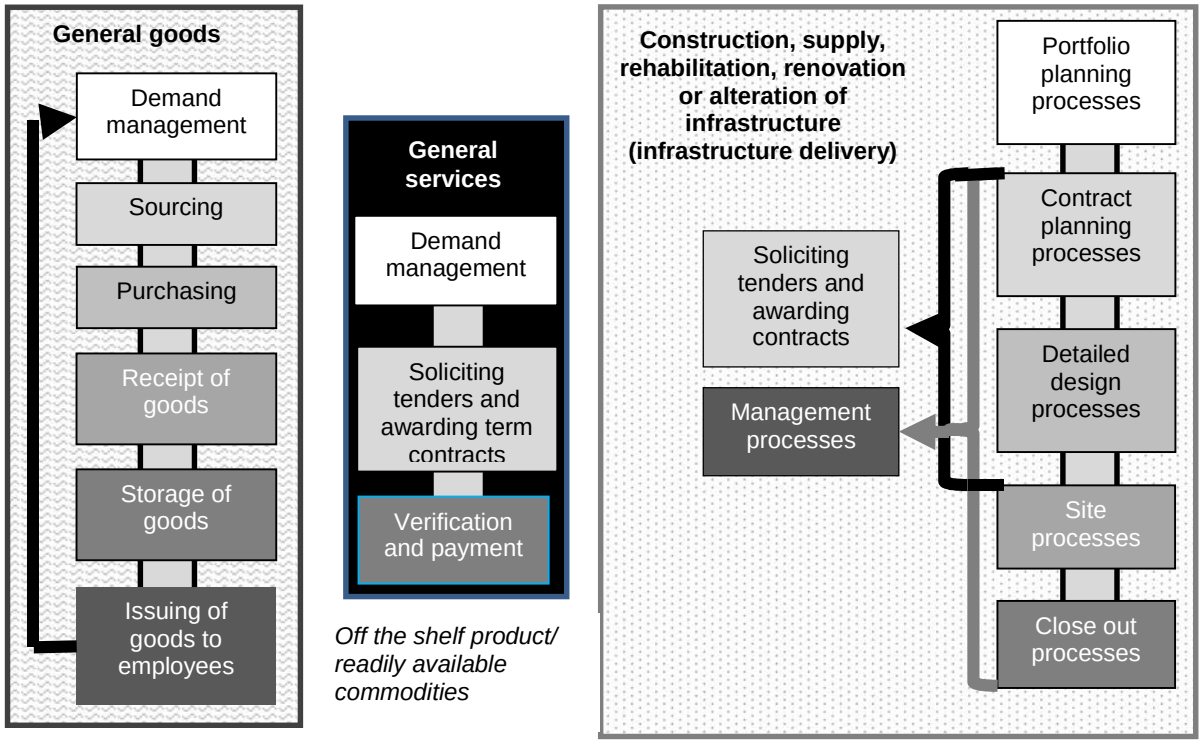


Figure 3: Differences between the procurement of general goods, general services and delivery of infrastructure (after Watermeyer *et al*, 2013)

There are also differences in the approach to the procurement. General goods and services typically deal with direct acquisitions which involve standard, well defined and scoped services, off-the-shelf items and readily available commodities. The business need is commonly achieved through the production of a specification, which then forms a requisition for the procurement of goods or services. An immediate choice can generally be made in terms of the cost of goods or services satisfying specified requirements. Limited management inputs are required in administering the contracts.

Infrastructure delivery differs in that there cannot be the direct acquisition of infrastructure. Each project has a supply chain which needs to be managed and programmed to ensure that the project is completed within budget, to the required quality and in the time available. Many risks relate to the "unforeseen" which may occur during the performance of the contract. This could for example include unusual weather conditions, changes in owner or end user requirements, ground conditions being different to what was expected, market failure to provide materials, sector wide strikes, community unrest or accidental damage to existing infrastructure. Unlike general goods and services, there can be significant changes in the contract price from the time that a contract is awarded to the time that a contract is completed. Key persons responsible for managing a contract, particularly in complex works, have a major impact on the outcome of these changes. The procurement of plant and equipment within infrastructure projects is also different as requirements are frequently established in terms of desired performance. As a result, a range of goods and services (or combinations thereof), with different characteristics, reliability, availability of spares, costs, time for delivery, etc., may satisfy such requirements.

RULES AND GUIDELINES GOVERNING PROCEDURES AND METHODS

It is common practice to regulate public procurement through some form of legislation. This can take place through the embedding of procurement rules in legislation or the establishment of high level requirements in legislation and requiring procurement to be executed in terms of a national or international standards (Watermeyer, 2004 and 2011b). Such systems are commonly designed around competition and transparency objectives. The promotion of competition is seen as a way to guarantee that goods and services are procured under the best market conditions. Competition as such is seen as an instrument for ensuring value for money. Guaranteeing free and open competition has become a general legal principle and a main objective in pursuing public interest (Graellis, 2011). Transparency which can be regarded as the timely, easily understood access to information, is seen to guarantee fair, equitable and non-discriminatory procedures. It is seen to protect the integrity of the process and the interest of the organization, stakeholders and the public.

The United Nations Commission on International Trade Law's (UNCITRAL) Model Law on Public Procurement (2011) contains procedures and principles aimed at achieving value for money and avoiding abuses in the procurement process. The text promotes objectivity, fairness, participation and competition and integrity towards these goals. Transparency is also a key principle, allowing visible compliance with the procedures and principles to be confirmed. These model laws envisage that regulations are required to enable the laws to be implemented and that detailed operating procedures be developed to facilitate implementation.

The ISO 10845 family of standards are designed around both primary and secondary procurement objectives, namely that the procurement system is fair, equitable, transparent, competitive and cost effective and that it may incorporate measures to promote objectives associated with a secondary procurement policy subject to qualified tenderers not being excluded and deliverables or evaluation criteria being measurable, quantifiable and monitored for compliance. These systems are substantively the same as those contained in section 217 of the Constitution of the Republic of South Africa, 1996.

The adoption of ISO 10845 family of standards offers a solid foundation for a procurement system as it provides a framework for best practice and obviates the need for the developing of detailed operating procedures. This family of standards establishes:

- processes, procedures and methods as well as rules for the application of a wide range of methods and procedures (see Tables 2 and 3) that are used in soliciting tenders and awarding contracts;

Table 2: Standard procurement procedures (after ISO 10845-1)

Procedure			Description
1	Negotiation procedure		A tender offer is solicited from a single tenderer.
2	Competitive selection procedure		Any procurement procedure in which the contract is normally awarded to the contractor who submits the lowest financial offer or obtains the highest number of tender evaluation points.
	A	Nominated procedure	Tenderers that satisfy prescribed criteria are entered into an electronic database and are invited to submit tender offers based on search criteria and, if relevant, their position on the database, whereupon they are repositioned on the database.
	B	Open procedure	Tenderers may submit tender offers in response to an advertisement to do so.
	C	Qualified procedure	A call for expressions of interest is advertised and thereafter only those tenderers who have expressed interest, satisfy objective criteria and who are selected to submit tender offers, are invited to do so.
	D	Quotation procedure	Tender offers are solicited from not less than three tenderers in any manner the procuring entity chooses, subject to the procedures being fair, equitable, transparent, competitive and cost-effective.
	E	Proposal procedure using the two-envelope system	Tenderers submit technical and financial proposals in two envelopes. The financial proposal is only opened should the technical proposal be found to satisfy requirements.
	F	Proposal procedure using the two-stage system	Non-financial proposals are called for. Tender offers are then invited from those tenderers that submit acceptable proposals based on revised procurement documents. Alternatively, a contract is negotiated with the tenderer scoring the highest number of evaluation points.
	G	Shopping procedure	Written or verbal offers are solicited from three sources. The goods are purchased from the source providing the lowest financial offer once it is confirmed in writing.
3	Competitive negotiation procedure		A procurement procedure which reduces the number of tenderers competing for the contract through a series of negotiations until the remaining tenderers are invited to submit final offers.
	A	Restricted competitive negotiations	A call for expressions of interest is advertised and thereafter only those tenderers who have expressed interest, satisfy objective criteria and who are selected to submit tender offers, are invited to do so. The employer evaluates the offers and determines who may enter into competitive negotiations.
	B	Open competitive negotiations	Tenderers may submit tender offers in response to an advertisement by the employer to do so. The employer evaluates the offers and determines who may enter into competitive negotiations.
4	Electronic auction procedure		Tender submissions are initially evaluated using stated methods and criteria. All tenderers who submit responsive tenders are invited simultaneously by electronic means to submit new evaluation parameters and have their evaluation scored, without having their identity made known to other tenderers. Tenderers may amend their offers up until such time as the auction is closed.

Table 3: Standard tender evaluation methods (after ISO 10845)

Method	Procedure
Method 1: Financial offer	Tender offers are ranked from the most favourable to the least favourable comparative offer. The highest ranked tenderer is recommended for the award of the contract.
Method 2: Financial offer and quality	Quality criteria are scored in the evaluation of tender offers. All offers failing to score the minimum number of points for quality are eliminated. Financial offers are scored and combined with points for quality in terms of a disclosed weighting. The tenderer with the highest number of tender evaluation points is recommended for the award of the contract.
Method 3: Financial offer and preferences	Tenderers who claim a preference and satisfy the preferencing criteria are assigned a preference score. Financial offers are scored and combined with points for preference in terms of a disclosed weighting. The tenderer with the highest number of tender evaluation points is recommended for the award of the contract.
Method 4: Financial offer, quality and preferences	Quality, preferences and financial offers are scored as for methods 2 and 3. All three of these scores are combined in terms of a disclosed weighting. The tenderer with the highest number of tender evaluation points is recommended for the award of the contract.

- formats for the compilation of calls for expressions of interest, tender and contract documents, and the general principles for compiling procurement documents for a range of different contract types, at main and subcontract levels, based on the principle that each subject within a procurement document can only be addressed once and in only one component document (see Table 4);

Table 4: Procurement documents (after ISO 10845)

Component	Division	Function and broad outline of contents
Expression of interest		
E1: Submission procedures	E1.1: Notice and invitation to submit an expression of interest	Alerts respondents to submit their credentials in order to be admitted to an electronic database or to be invited to submit tenders should they satisfy the stated criteria.
	E1.2: Submission data	Establishes the rules from the time a call for an expression of interest is advertised to the time that any submission is evaluated.
E2: Returnable documents	E2.1: List of returnable documents	Ensures that everything the employer requires a respondent to include in his submission is included in, or returned with, such a submission.
	E2.2: Submission schedules	Contains documents that the respondent is required to complete for the purpose of evaluating submissions.
E3: Indicative scope of work#	E3: Indicative scope of work	Indicates to respondents what the contract is likely to entail so that they can make an informed decision as to whether or not they wish to respond and, if so, to structure their submission around the likely demands of the project.
Tender document		
T1: Tendering procedures	T1.1Tender notice and invitation to tender	Alerts tenderers to the nature of the goods, services and engineering and construction works required by the employer and should contain sufficient information to enable them to respond appropriately.
	T1.2 Tender data	Establishes the rules from the time that tenders are invited to the time that a tender is awarded.
T2: Returnable documents	T2.1 List of returnable documents	Ensures that everything the employer requires a tenderer to submit with his tender is included in, or returned with, his tender submission.
	T2.2 Returnable schedules	Contains documents that the tenderer is required to complete for the purpose of evaluating tenders and other schedules which upon acceptance become part of the subsequent contract.
Contract documentation		
C1: Agreements and contract data	C1.1 Form of offer and acceptance	Formalizes the legal process of offer and acceptance
	C1.2 Contract data	Identifies the applicable conditions of contract and associated contract-specific data that collectively describe the risks, liabilities and obligations of the contracting parties and the procedures for the administration of the contract.
C2: Pricing data	C2.1 Pricing assumptions	Provides the criteria and assumptions which it is assumed (in the contract) that the tenderer has taken into account when developing his prices, or target in the case of target and cost reimbursable contracts.
	C2.2 Pricing schedules / Activity schedule / Bill of quantities	Records the contractor's prices for providing goods, services or engineering and construction works which are described in the scope of work section of the contract.
C3: Scope of Work	Scope of work	Specifies and describes the goods, services, or engineering and construction works which shall be provided and any other requirements and constraints relating to the manner in which the contract work shall be performed
C4: Site information#	Site information	Describes the site as at the time of tender to enable the tenderer to price his tender and to decide upon his method of working and programming and risks.

if applicable

- what is required for a respondent to submit a compliant submission in response to a call for an expression of interest, how the evaluation criteria are made known to respondents and the manner in which the procuring entity conducts such processes;

- what a tenderer is required to do to submit a compliant tender in response to an invitation to do so, how the evaluation criteria are made known to tenderers and the manner in which the procuring entity conducts the process of offer and acceptance and provides the necessary feedback to tenderers on the outcomes of the process; and

- key performance indicators (KPIs) relating to the engagement of enterprises, joint venture partners, local resources and local labour in contracts are needed in order to implement targeted procurement procedures (see Table 5).

Table 5: Targeting strategies

Method	Description
Evaluation points	Give a weighting to social and economic (development) policy objectives along with the usual commercial criteria, such as quality, which are scored at the short listing stage or the admission to a data base
	Give a weighting to social and economic policy objectives along with price and where relevant, quality, during the evaluation of tenders
Incentives for KPI's	Make incentive payments to contractors should they achieve a specified target (key performance indicator) associated with a social or economic goal in the performance of a contract
Mandatory subcontracting	Require contractors to invite competitive tenders from targeted enterprises for specified portions of the works in terms of a specified procedure and specific forms of subcontract. Upon the award of the contract, the subcontractor becomes a domestic subcontractor
Contractual obligations	Make policy objectives a contractual condition, e.g. • A fixed percentage of the work is required to be subcontracted out to enterprises that have prescribed characteristics, or a joint venture shall be entered into • Parts of the works are to be executed using employment intensive methods.

The ISO 10845 family of standards establishes a way of doing things that provides order and a platform for the methodical planning of a way of proceeding. These standards collectively provide a platform to achieve fair competition, reduce the possibilities for abuse and improve predictability in procurement outcomes and in so doing facilitate the attainment of value for money during the solicitation processes including that relating to "equity". This family of standards does not, however, provide standard forms of contract (a contract between two parties with standard terms that do not allow for negotiation) as such documents can be drafted around significantly different objectives and principles e.g. master – servant relationship or collaboration between two experts, risk sharing or risk transfer, independent or integrated design, short term relationships based on one sided gain or long-term relationships focused on maximising efficiency and shared value, etc.

There are, however, two international families of standard contracts, namely those published by the International Federation of Consulting Engineers (FIDIC) and the Institution of Civil Engineers (NEC3). These standard forms of contract cover a range of contract types, contracting strategies (design by employer, design and construct, develop and construct and management contracts) and pricing strategies (see Table 6).

The FIDIC and NEC3 forms of contract cover engineering and construction works and professional services. The NEC3 forms of contract, however, also cover supply, term service and framework contracts. The FIDIC forms of contract are based on the traditional approach to drafting and administering contracts, assessing variations to the contract and effecting payment to contractors in terms of standard price-based pricing strategies (lump sum or bill of quantities). The NEC3 forms of contract on the other hand, facilitate the implementation of sound project and risk management principles and practices in a flexible manner. They also offer a wide range of price-based (activity schedule, price list and bill of quantities) and cost-based pricing strategies (time based contract, cost reimbursable contract, target contract and management contract) and options to manage risk. They are drafted on a relational contracting basis, based on the belief that collaboration and teamwork across the whole supply chain optimises the likely project outcomes and are therefore based on "discussion at

the time" rather than "argument later." They contains clear procedures with defined time limits for actions to be taken, and provide for effective control of change, speedy agreement of time, quality and cost impacts of change, improved forecasting of end costs and end dates. They assess compensation events (events for which the employer is at risk) which entitle the contractor to more money on the basis of cost, as defined in terms of the contract, uplifted by any percentages for overheads and profit or fees agreed at the time when the contract is concluded for work already done, or a forecast for the work not yet done (Watermeyer, 2012b). The wide range of options, which can be tailored for particular circumstance, enable the selection of pricing structures that align payments to results and permit a more balanced sharing of performance risk. They are also well aligned to the Society of Construction and Law's Delay and Disruption Protocol (Watermeyer, 2014). The NEC3 family of contracts has according great potential to realise value for money during the execution of a contract.

Table 6: Price-based and cost-based pricing strategies for engineering and construction contracts (Watermeyer, 2012b)

Pricing strategy	Description
Price based	
Lump sum	Contract in which a contractor is paid a lump sum to perform the works. (Interim payments which reflect the progress made towards the completion of the works may be made)
Bill of quantities	Contract in which a bill of quantities lists the items of work and the estimated / measured quantities and rates associated with each item to allow contractors to be paid, at regular intervals, an amount equal to the agreed rate for the work multiplied by the quantity of work actually completed
Price list / price schedule	Contract in which a contractor is paid the price for each lump sum item in the Price List / Schedule that has been completed and, where a quantity is stated in the Price List / Schedule, an amount calculated by multiplying the quantity which the contractor has completed by the rate
Activity schedule	Contract in which the contractor breaks the scope of work down into activities which are linked to a programme, method statements and resources and prices each activity as a lump sum, which he is paid on completion of the activity. The total of the activity prices is the lump sum price for the contract work.
Cost based	
Cost reimbursable	Contract in which the contractor is paid for his actual expenditure plus a percentage or fee
Target cost	Cost reimbursable contract in which a target price is estimated and on completion of the works the difference between the target price and the actual cost is apportioned between the employer and contractor on an agreed basis
Management contract	Contract in which the contractor is paid the amounts paid to subcontractors plus a percentage fee

PROCUREMENT STRATEGY AND TACTICS

Strategy in infrastructure delivery may be considered as the skilful planning and management of the delivery process. It involves a carefully devised plan of action which needs to be implemented. It is all about taking appropriate decisions in relation to available options and prevailing circumstances in order to achieve optimal outcomes. Procurement strategy (see Figure 4) reflects the choices made in determining what is to be delivered through a particular contract, the procurement and contracting arrangements and how secondary (or developmental) procurement objectives are to be promoted during the implementation phase of an infrastructure project (Watermeyer, 2012b).

As indicated in Table 1, the decision to proceed with an infrastructure project is typically taken when between 10 and 40% of the design is complete. It is therefore important to adopt procurement strategies in the implementation of project which enable projects to be delivered on time and within budget. It is also important to integrate design with construction through strategies such as early contractor involvement, design and construct or develop and construct and to manage contracts proactively so that wastage is minimised and the risks associated with budget and schedule overruns are managed.

Procurement tactics are required to implement procurement strategies. Such tactics relate to the setting up of the procurement documents to solicit tender offers and to enter into contracts i.e. the formulation of submission data, tender data, contract data, the pricing and the scope of work associated with a contract or order issued in terms of a framework contract (see Table 4). Choices are informed by a number of considerations such as the selection of a contractor who is most likely to deliver best value

through the performance of the contract, life cycle costs, the availability of spares, operation and maintenance requirements, the nature of the desired relationship with the contractor, the manner in which delays and disruptions are to be managed, the allocation of risk to the party that is best able to bear it, risk mitigation measures etc. Procurement strategy and tactics have the potential to contribute to "efficiency" during implementation and to reduce the gap between achieved and projected outcomes. On the other hand, the inability to manage risk, interference and scope creep will result in what is planned not being achieved.

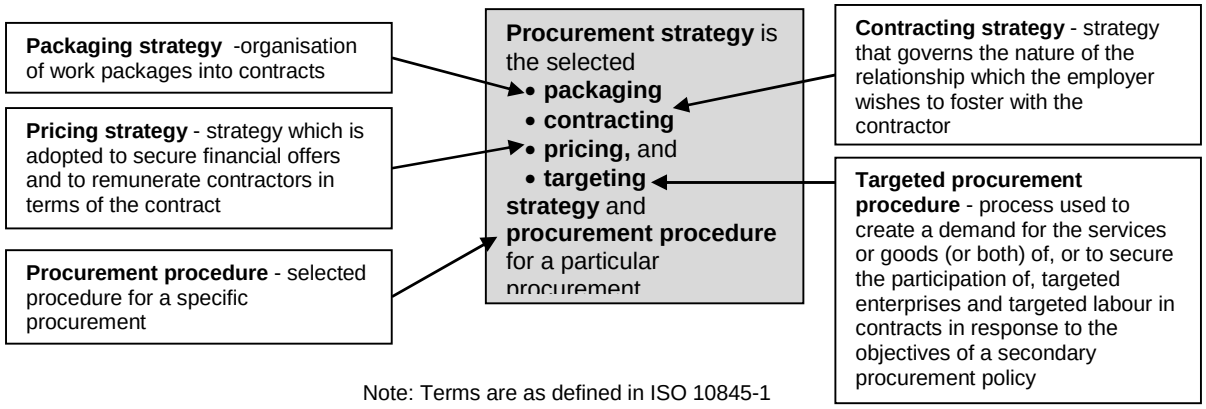


Figure 4: Components of a procurement strategy (Watermeyer, 2012b)

The range of options provided in the ISO 10845 family of standards and the NEC3 family of contracts provides a solid platform for the development of procurement strategies for the delivery of a portfolio of projects or a single contract. They also provide a wide range of tactics which can be incorporate in procurement documents associated with a particular procurement.

A strategic and tactical approach to procurement can be used not only to manage risk but also to incentivise performance. Such an approach can also be linked to collaborative working through framework agreements (Watermeyer, 2012).

A strategic approach to procurement above the project level to balance competing objectives and priorities rather than viewing each project in isolation, should be undertaken during stage 2 (strategic resourcing) shown in Figure 2. If left to the contract level, the opportunity for trade-offs will be lost and are likely to have a lesser impact on project outcomes.

PROJECT MANAGEMENT AND GOVERNANCE

Management can be defined (BS13500) as "*the act of bringing people together to accomplish goals and objectives using available resources in an efficient, effective and risk aware manner*" and governance as "*the system by which the whole organisation is directed, controlled and held accountable to achieve its core purpose over the long term*." Management is about "getting the job done" whereas governance is about "ensuring that the right purpose is pursued in the right way". Governance is the framework by which an organization is directed, controlled and held accountable to achieve its core purpose over the long term. Project governance which includes those areas of organizational governance that are specifically related to project activities, provides a comprehensive, consistent method of controlling the project and ensuring its success.

ISO 21500 (2012) describes project management as "*the application of methods, tools, techniques and competencies to a project which can be applied to a project as a whole or to an individual phase or to both*." This standard identifies process groups (initiating, planning, implementation, controlling and closing) and subject groups (integration, stakeholder, scope, resource, time, cost, risk, quality, procurement and communication).

The indicative impact of a number of key factors over the life cycle of a project is illustrated in Figure 5. The implementation of infrastructure projects need to be carefully managed. There is also a need to put in place controls within the procurement and delivery management process to provide all those involved

in all levels of management with access to information to perform their work and those involved in the governance system to take decisions regarding their readiness to bear the risk (effect of uncertainty on objectives) after risk treatment in order to achieve objectives.

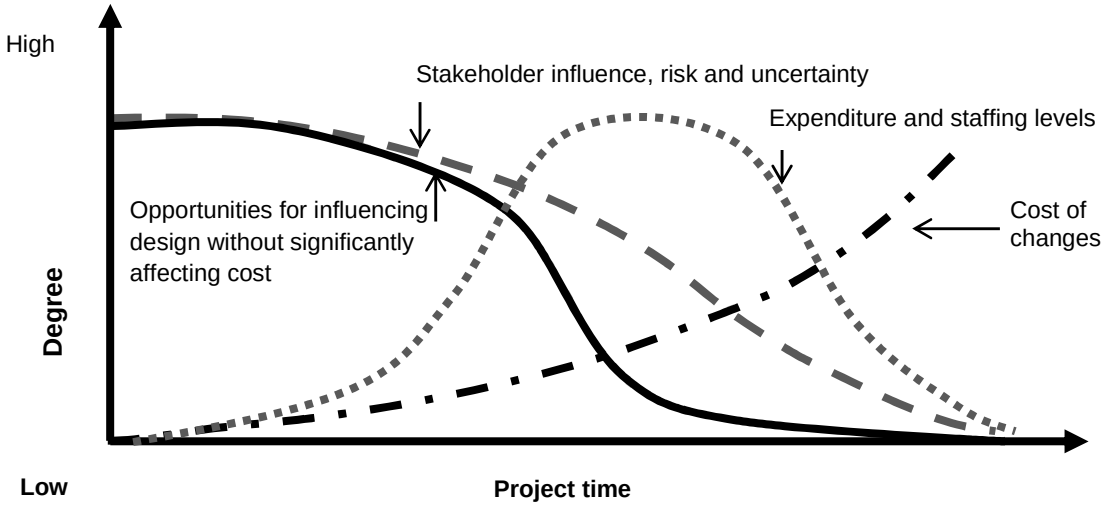


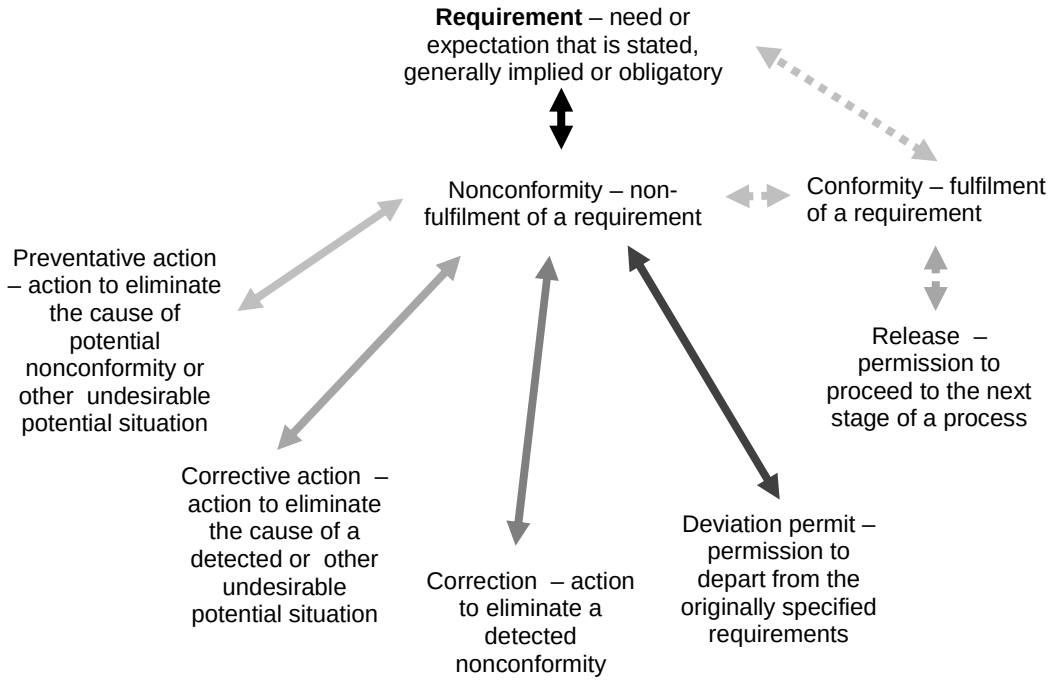
Figure 5: Indicative impact of key variables on the delivery of infrastructure over time

Those engaged in infrastructure delivery needs to determine and manage numerous interrelated and interacting processes. To do so effectively, it is necessary that processes be identified and appropriately defined and documented to ensure the effective planning, operation and control of such processes. Furthermore, responsibilities for activities need to be assigned, procedures need to be implemented, and measures need to be put in place to ensure effective control so that the required results are obtained. As such a control framework needs to be developed to link processes and activities to a series of control points around which decisions can be based on the documented outputs of a process.

The starting point is to determine and document the work flow for processes associated with infrastructure procurement and delivery management as well as their sequence and interaction. Thereafter, procedures associated with the performance of activities need to be documented and responsibilities assigned to persons with competence (demonstrated ability to apply knowledge and skills) to perform such activities. Controls (check points within a process or a gate) also need to be put in place to ensure both the operation and control of these processes to ensure the effectiveness of these processes based on the conceptual thinking presented in Figure 6. Resources and information need to be made available to support the operation and monitoring of these processes. Finally records which provide evidence of conformity to requirements need to be identified, stored, protected and retained in a readily retrievable manner.

The stages and gates indicated in Figure 2 provide a control framework for delivery management which facilitates not only the management of quality but also provides the basis for auditing. This control framework provides the basis for ensuring that projects progress in such a manner that they remain within agreed mandates, align with the purpose for which they were conceived and can progress successfully from one gate to another (Watermeyer *et al*, 2013).

ISO 10845 describes six generic processes and the activities associated with each process. It does not, however, provide a control framework for the implementation of this standard. Figure 6 outlines a control framework for procurement which is aligned with the provisions of ISO 10845.



NOTE Audits are used to determine the extent to which requirements are fulfilled

Figure 5: Concepts relating to conformity based on ISO 9000, *Quality management systems – fundamentals and vocabulary*

THE UNIVERSITY OF THE WITWATERSRAND WIT'S CAPITAL PROGRAMME (2008-2013)

The University of the Witwatersrand, Johannesburg, embarked upon a major capital expansion programme on its various campuses during 2007. Those responsible for implementing the programme adopted procurement procedures and methods which formed the basis for the ISO 10845 standards and made use of the NEC3 family of contracts. They pursued a strategic approach to procurement and developed control frameworks along the lines of that described in this paper, based on the philosophy of collaboration, shared risk and integrated project teams. They adopted a range of packaging strategies including framework agreements with early contractor involvement, used contracting strategies including design by employer, design and construct and develop and construct and engaged in procurement procedures ranging from open tenders to restricted competitive negotiations. They also embarked upon the development of control frameworks along the lines of that described in this paper.

Laryea and Watermeyer (2014) fully describes the outcomes of the delivery of the portfolio of projects over a period of 6 years (2008-2013) comprising more than 40 projects with a budget of around R1,5 billion Rand (approximately 150m USD). The average difference the final amount paid to contracts at the completion of the project and the price when the contractor was instructed to execute the contract has been less than 6% including scope creep. Most projects were delivered on time and within budget. This is not the norm in South Africa or for that matter in developing countries. For example, Hawkins and McKittrick (2012) in their report on the pilot countries in Construction Sector Transparency Initiative (CoST) programme found that in the 145 projects sampled in eight countries, 31% exhibited poor management of time and cost with at least 55% being over budget and 8% being more than 100% over budget.

The design of the procurement system and the approach to managing projects at the University of the Witwatersrand facilitated the culture change outlined in Table 7 which played a major role in the successful project outcomes.

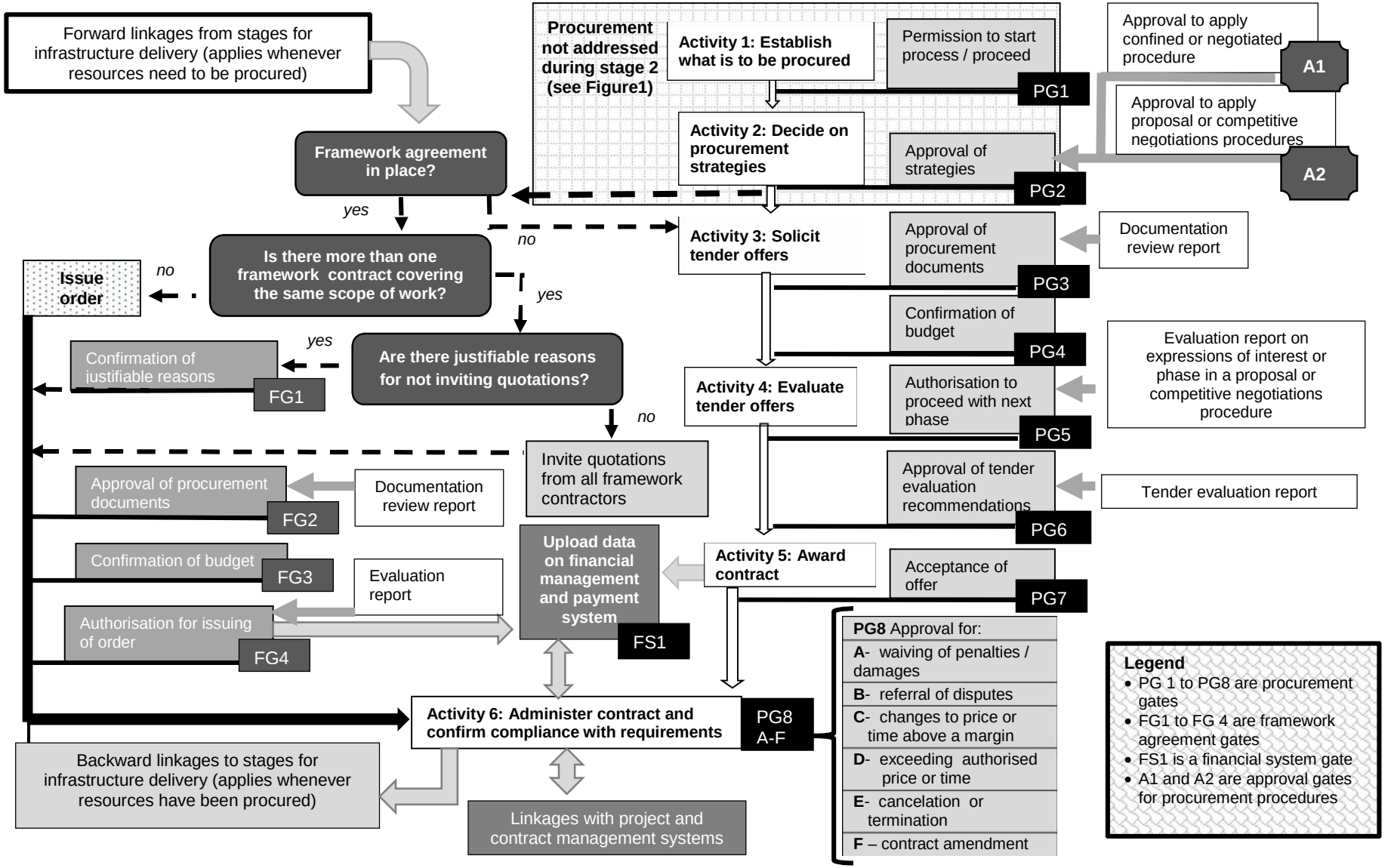


Figure 6: Control framework for a procurement system based on ISO 10845

Table 7: Culture change required to improve project outcomes (Watermeyer, 2012a)

From	To
Master-servant relationship of adversity ("them and us")	Collaboration towards shared goals (integrated project team approach)
Fragmentation of design and construct	Integration of design and construct
Constructability and cost model determined by the design team and quantity surveyor / cost consultant only	Constructability and cost model developed with contractor's insights
Short-term "*hit-and-run*" relationships focused on one-sided gain	Long-term relationships focused on maximising efficiency and shared value
Risks are allowed to take their course	Active risk management and mitigation
Develop the project in response to a stakeholder wish list	Deliver the optimal project within the budget available
"Pay as you go" delivery culture	Discipline of continuous budget control
Pay for what is designed	Deliver infrastructure within an agreed budget
Rigid, bespoke, ill defined and disjointed procurement system	Flexible, predictable, integrated, documented and auditable procurement system
Poorly structured procurement documents based on bespoke or local standards and forms of contract with reliance placed on local knowledge	Structured procurement documents based on international / national standards and forms of contract with minimal customisation / amendments and clear and unambiguous requirements
Meetings focused on past - what has been done, who is responsible, claims. etc.	Meetings focused on "How can we finish project within time and budget available?"
Project management focussed on contract administration	Decisions converge on the achievement of the client's objectives
Standard delivery stages prescribe the contracting arrangements and are unrelated to a portfolio of projects	Delivery is managed and controlled through stages which permit the full range of contracting arrangements and commence at a portfolio level
Ill defined end of stage deliverables and acceptance procedures	Well defined end of stage deliverables and acceptance procedures which enable informed decisions to be made
Design and construction developed in isolation from operation and asset management considerations	Design and construction aligned with operation and asset management requirements
Procurement strategy focussed on selection of form of contract as all other choices are predetermined	Selected packaging, contracting, pricing and targeting strategy and procurement procedure aligned with project objectives
One project one contract	Works packaged appropriately to achieve objectives and efficiencies
Project delivery take place within predetermined parameters without any conscious thought to objectives	Projects deliver on documented primary and secondary (developmental) objectives in a measureable and quantifiable manner

CONCLUSIONS

Much can be done to minimise the gap between achieved and projected outcomes during the implementation of an infrastructure project in order to realise value for money. The starting point is to recognise that there are significant differences between the procurement system for general goods and services and that for infrastructure.

A procurement system that is most likely to deliver value for money during implementation is one which is based on:

- the adoption of procurement standards such as the ISO 10845 family of standards for soliciting tenders and awarding contracts, which are based on fair, equitable, transparent, competitive and cost effective system objective, permit the promotion of socio-economic objectives and provide a wide range of methods and procedures; and

- standard forms of contract such as the NEC3 family of contract which facilitate collaborative working, offer an open book approach to the cost of change and the application of pricing structures that align payments to results, provide cost based and price based pricing strategies and are sufficiently flexible to provide a balanced sharing of performance risk on a project by project basis.

The adoptions of a standard such as ISO 10845 and forms of contract such as the NEC3 may not necessarily enable value for money to be achieved. Procurement systems should be linked to a strategic approach to procurement. Procurement strategy should be developed preferably at a portfolio level. Procurement tactics need to be implemented at a contract level. Good governance and project management linked to suitable control frameworks for infrastructure delivery and procurement can also make a significant contribution to the effectiveness of project implementation.

The design and adoption of an innovative procurement system needs to be underpinned by a culture change in order to deliver optimal outcomes.

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