

ARCOM Doctoral Workshop

Contracts and Procurement in the Construction Industry

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Introduction

The ARCOM Doctoral Forums have three aims: they give the opportunity for students writing PhDs to present papers and thus benefit from feedback on the methodological issues raised by their work; they give all delegates an insight into current research; and they provide a chance to meet other researchers working in similar fields. In achieving these aims, they also help ARCOM to strengthen its contribution to the research community.

The focus for this research workshop is on procurement and contract management. This includes PhD topics related to procurement (e.g. purchasing processes, sub-contract procurement, PFI, partnering, framework agreements and innovative approaches to managing construction networks and supply chains) and contract management (e.g. contract administration, claims management, contract drafting, resolution of disputes, conflict management).

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Integration of health and safety planning in construction project management through the development of a best practice "gateway" model

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Effective planning for health and safety is essential if projects are to be delivered on time, without cost overrun, and without experiencing accidents or damaging the health of site personnel (CIOB, 2002). These are not easy objectives as construction sites are busy places where time pressures are always present and the work environment changing (HSE, 2002). In order to achieve a holistic approach to the management of construction, it is important to view health and safety planning as an integral aspect of production planning from the beginning. This embraces the premise that delivery in one area, safety, can actually lead to benefits in other areas, such as time and cost (Hinze & Parker, 1978). Some conceptual work on integration, done in the 1990's focused on integrating health and safety data with Critical Path Method scheduling software (Kartam, 1997). More recently research was conducted in Brazil where an attempt to integrate safety with project long, medium and short term planning was undertaken (Saurin et al, 2004). Both these studies embrace the philosophy of integrated planning, but concentrate exclusively on planning after design. With the relatively new, and increasing, focus on the health and safety responsibilities of clients and designers, it is essential that this philosophy of integration is extended to all project planning.

The problem being investigated in this research is how best to promote the effective integration of health and safety management into project planning, communication and control in all construction activity.

In order to address the problem, the following objectives were set:

- 1. Consult experienced practitioners to investigate current, improved methods of integrating health and safety within construction project management.
- 2. Produce a model of construction project management, integrating health and safety.
- 3. Produce a set of tools to support the model.
- 4. Field test the model and tools in order to improve them.
- 5. Produce a guide to best practice, including a set of 'Key Integrated Safety Management Planning Procedures'.

The research programme is being undertaken in conjunction with an 18 month, £97000 Contract Research Report (CRR) on behalf of the United Kingdom's Health and Safety Executive (HSE), which was carried out in five overlapping phases:

Literature search – Covering guidance on construction project management; health and safety management, including safety management systems; and the Construction Design and Management Regulations (1994). Information on Gateways was also investigated.

Steering Groups – A steering group of senior industry stakeholders was formed to advise on the strategic direction of the research, review progress and outcomes and assist in obtaining access to construction sites and personnel. Several "virtual" steering groups were also formed. This approach allowed individuals to contribute knowledge via email and telephone when geographical location would have otherwise precluded them.

Expert Panels – Expert panels were formed to conduct a series of brainstorming meetings; covering maintenance; construction; and planning and design. These were held to investigate

Critical Success Factors, which were subsequently categorised as "Events" that had to take place at a macro level, or issues requiring "Tools" at a micro level.

Interviews – Interviews were held with industry practitioners, recommended by the Steering Group, to assist in directing the research focus on the development and validation of the model.

Validation interviews – A series of visits to practitioners' offices and sites were made to test each tool by performing mock demonstrations and gaining detailed feedback on how each tool would perform in real-life situations.

The research involves the development of a Gateway model of health and safety processes which map and integrate with other project management processes incorporating strategic decision points (Gateways). The decision to use the OGC model has been based on two main factors. The flexibility of this gateway model allows various procurement routes to be adopted and acknowledges that no matter which method of procurement is chosen, there are various common processes that need to be fulfilled. Specific guides for the procurement of construction projects proved to be too rigid and prescriptive as commented on by Hughes (Hughes, 1991). The other advantage of the OGC model is that it is primarily for general project management purposes, rather than using health and safety specific gateways. Supporting tools will provide the detail necessary to implement the model, thereby adding value to the overall management and control of construction projects. The research aims to build on the existing Office of Government Commerce (OGC) Gateway framework and provide guidance for its implementation along with supporting tools for the management and control of the risks.

The 18 month HSE project has been completed. Findings from this show the Gateway model is structured, systematic, logical, rigorous and transparent. Good leadership will prevent the process becoming bureaucratic; therefore, efforts should be concentrated on managing people rather than managing paperwork. Every tool achieves two goals: it aids general project planning; and it integrates health and safety planning.

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The holistic realisation of PFI infrastructure project objectives

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INTRODUCTION

The aim of this research is to determine a prescriptive improved PFI model in infrastructure civil works, mainly highways in the UK. PFI is a relatively new means of securing investment in the public sector and is just one type of Public Private Partnerships (PPP). PFI is not a form of privatisation but, it is an innovatory way of financing necessary public investment at minimum cost to the taxpayer by involving the resources of the private sector.

Underpinning idea of PFI is the need to cut public borrowing, and its real aim is administrative reform in the public sector and can be considered as an *agent for change*. For PFI, PPP is the means to transfer much of the public sector's role to the private sector. At its core PFI assumes the superiority of the *Competitive Contract Model* in delivering services and this competition will produce more efficient delivery of services that the people at large want.

In the PFI deal the primary requirement of the public sector is efficient long-term service delivery to be provided by the infrastructures constructed by the private sector. Until the end of the concession period the infrastructure asset has no integral value to the public sector. The efficient long-term service delivery can be made subject to competitive forces.

RESEARCH OBJECTIVES

PFI projects are changing the way that infrastructure projects are delivered. The delivery of a service *via the creation of an infrastructure solution* is changing the way project objectives are realised. The long-term duration of the service provision is altering and increasing the parameters by which projects are judged as successful or otherwise.

The research will identify the parameters that are particularly relevant to PFI infrastructure delivery. Furthermore it will evaluate the project delivery by a composite holistic evaluation.

The research is based on answering three questions concerning PFI in road projects. Based on the research questions, three research objectives have been established:

- 1. Establishing the "Critical Success Factors" to assess the current and future capability/maturity/situation;
- 2. Establishing the "Whole-life Cycle" and "Risk Management" models to assess the current and future capability/maturity/situation; and
- 3. Establishing the "*Competitive Advantage*" model to assess the current and future capability/maturity/situation.

RESEARCH PROCESS AND RESEARCH METHODOLOGY

Based on the research objectives a research process has been designed. The progress of the research is outlined here below:

- 1. Extensive literature review has been done and the current literature is being followed;
- 2. Research Design (RD) is developed to answer *what, why* and *how* questions at four levels;
- 3. The Research Framework (RF) is developed to test the theoretical existing PFI application. In this framework the identified PFI Key Concepts, PFI Implementation

- Barriers, PFI Key Drivers, PFI Key Enablers and PFI Implementation Key Issues in road projects will be detailed;
- 4. Data collection from two PFI road projects and semi-structured interviews from other two companies working in large PFI schemes is scheduled to be completed shortly;
- 5. The collected data will be analysed and interpreted in the following months; and
- 6. Following the data analysis and interpretation the framework will be validated in due course and writing-up, which is already started, will continue.

The research is designed to follow the following methodology:

- 1. Grounded phenomenological study;
- 2. Case study analysis of two PFI road projects (unit of analysis is construction project);
- 3. Depending on the findings a "New PFI project application model" will be compared with the "actual model";
- 4. A "Revised Improved Model" will be proposed; and
- 5. Through triangulation the "Revised Improved Model" will be validated and as a result the research questions will improve a "Prescriptive Improved PFI Model" for road construction in the UK.

Performance based specification (PBS)

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Introduction: There is much confusion surrounding the term Performance Based Specification (PBS) – an alternative to traditional prescriptive specification for project inputs. PBS is often used synonymously with performance based design (PBD), performance based contracting (PBC), performance based building (PBB) and performance based serviced building acquisition (PBSBA) and various other acronyms. Within PBS and its derivatives are many other examples of confused terminology which contribute to the slow international acceptance of the PBS principles. However, at some point, performance requirements are commuted to prescriptive in order for the contractor to construct.

Benefits of PBS: The benefits of PBS and its synonyms have been charted by numerous authors who focus on PBS giving clients a building which more exactly meets their needs with better value for money. PBS is reputedly more economic (less waste and reduced design, project management and construction costs) with higher quality; gives better exploitation of supplier's expertise, technological innovation, creativity and flexibility (rather than traditional prescriptive specification in which the inputs are prescribed by the designers – self-certified "experts"); offers improved communication and feedback; is less risky; actively uses whole life costing; will reduce international trade barriers; is less adversarial; improves the health and safety of users and constructors; and finally, reduces build time and lessens paperwork. However, only two research partnerships appear to have used case studies. Kashiwagi and Savicky, (2003) recorded an actual PBS project and benchmarked it for best value and performance. Templemans Plat and Hermans (2001) evaluated PBS on the design element of a project.

Dis-Benefits of PBS: There are fewer acknowledged dis-benefits of PBS but little research to qualify this statement. An examination of outsourcing as a synonym for PBS reveals that there are psychological considerations including trust (the client has to trust the team entire to deliver to the extent where he loses direct control), plus the on-going considerations of managing the interfaces and the client's loss of bargaining power, the possible rise in transaction costs and the possibility that suppliers may behave opportunistically. Direct costs and up-front costs could rise because of the need for training workshops. Since the award of a PBS project is based on the contractor's past performance history, there is concern that PBS could be anti-competitive.

Barriers to PBS: The greatest barrier to PBS is believed to be the fear that performance based products cannot be verified as confidently as traditionally prescribed products – particularly because there is a lack of universal language of measurable metrics. This is compounded by the lack of PBS training (which can increase the up-front costs), the fragmented nature of the construction industry and the "guild" mentality which protects the various trades and professions. Furthermore, the absence of an international framework means implementation of PBS is piecemeal and spasmodic (nationally and internationally), and contributes to non-tariff trade barriers. There is also concern regarding risks and liabilities for some of the contractors involved. The lack of finance for research and development in innovation (including planning systems and IT) is contributing to the lack of suitable tools for use at design stage – another barrier to acceptance.

Discussion: These considerations are usually described from the view of client and constructors: not the product suppliers at the end of this chain of specifications where performance specifications give way to prescriptively-described products. Resistance from various sectors has been noted in the USA where PBS was mandated for government contracts. There was reluctance among US architects, engineers and construction contractors to accept

PBS because they felt it would jeopardise their profits. Consequently, these groups were initially exempted from USA government-wide performance based contracting targets. (Peckinpaugh, 2002) Ultimately, at the end of the supply chain, there is a building which is made from materials which have to be measured, compressed, manufactured, tolerated, proven and paid for according to prescribed specifications – to meet the performance-based specifications of the project, and the regulations, codes and standards of governing legislation. The legislation varies from country to country and national standard are only sometimes formed under an international umbrella such as the International Standards Organisation (ISO) or World Trade Organisation (WTO). Some authors believe that it is possible to procure a building on the same basis as a consumer good is procured – but further research is needed to test this suggestion. Little hard evidence is available from actual case studies: Kashiwagi and Savicky appear to be almost alone in their case study research.

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Procurement strategies for the oil and gas industry: developing new approaches

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The new century brings significant challenges to the oil and gas industry, as it seeks to maintain high levels of investment against a background of volatile oil and gas prices. Despite the numerous constraining issues and problems, the industry has to deal with, exploration and production technologies have continued to improve in leaps and bounds with more land and seabeds being explored for their valued commodity (UKOOA, 2003). However, there appears to have been little development to move away from conventional approaches into a more innovative procurement strategies in the oil and gas industry (Mohammad and Price, Sept 2003). This is perhaps, according to Pedwell *et al.* (1998), because there are relatively few major players, that is project initiators (clients/owners) and implementers (contractors), in the oil and gas sector. Furthermore, clients/owners have been found to have a wide variety of method for selecting contractors.

The construction industry encompasses many sectors, which includes building, civil, mechanical, electrical and heavy engineering. The oil and gas industry, however, places greater reliance on other specialist disciplines or sectors such as geology, maritime and drilling. The oil and gas industry is different in nature to construction industry although the typical stages of a project are design, construction, operation, maintenance and decommissioning. For example, in the oil and gas industry, during the operation stage, focus would be on the actual production of oil and gas for profit as the main income stream, whereas, in the construction industry, the focus would be on how the completed project is being used to provide a service or product. When compare to construction, as mentioned by Wright (1996), most projects in the oil and gas industry have higher capital/investment cost, higher levels of uncertainty/risk due to the exploratory nature, higher technology and more heavy engineering work, increase spasmodic delivery/supply schedule, larger scale/magnitude of projects and larger number of engineering disciplines from exploration to first oil and production to decommissioning.

Further research on the area of procurement in the oil and gas industry is required more now than ever before according to UKOOA (2003). This is because of considerable changes in the oil and gas scenario throughout the world today with clients and contractors looking more for a win-win situation in their procurement arrangements. With the high cost of exploration and production today, profit margins for clients are decreasing. Selecting the right contractor with the right price can be a time consuming and risky business. The volatility of the current oil and gas prices has added to the need to reconsider clients' cost control procedures, in particular procurement strategies. Mohammad and Price (Sept 2003) have found out that the recent development of marginal fields with tight budgets and high risks has resulted in traditional procurement approaches becoming unsuitable leading to the introduction of partnering/alliancing/joint ventures. The decline in production output of matured oil and gas fields in the United Kingdom has subsequently increased the production cost for oil and gas due to the rise of operational and maintenance costs. This has also created the need for further exploration and production with poor combination of higher costs and increased risk.

There is also a desperate need for innovative procurement strategies in the oil and gas industry, as cited by Wright (1996) and in a survey of integrated oil and gas companies in the US (Dittrick, 1999). It stated that project procurement process in the oil and gas industry is a capital-intensive industry. As 90-95 per cent of project costs are paid to contractors and suppliers to ensure project success, it is critical that procurement strategies should incorporate and integrate with the capital project procurement process from start to finish. The strategies

must also submit to a total system of cost and evaluation throughout the procurement process such as whole life costing and must also incorporate what is known as multi cultural complexities. Some form of standardization approach and specification reviews must also be included. Strategic outsourcing, such as in supply chain management, must be in place. A management and incentive programme for all key contractors and suppliers must also exist in order to secure the commitment of contractors and suppliers to the overall success of the project.

However, little appears to have been written on this 'softer issues' of procurement systems/strategies in an industry that generates billions of dollars per day in revenue. This could be due to the complexity and nature of the industry itself. Procurement systems used also appear to be experiences taken from other industries. Throughout the general reading of articles and papers during the literature search, it was obvious that there were gaps in the research and literature on the issue of procurement, whereby little was found or mentioned on the procurement aspects of the industry (Mohammad and Price, Sept 2003). In order of priority, it has been established that cost cutting, cost reduction and risk management appeared quite frequently in recent articles. Cooperation, competitiveness and organizational strategy are the famous keywords in most articles although no linked to procurement system/strategy are directly mentioned.

Finally, at this stage of the research, it is proposed that the selection of the most appropriate procurement strategy in the oil and gas industry according to Mohammad and Price (Nov 2003) should be based on:

- **project risks** with reference to industrial, political and technological constraints;
- Client's involvement in risk allocation, such as their willingness to be involved, trust towards other parties and willingness to take risks;
- Client's characteristics which include strategy, experience and capabilities;
- **project physical characteristics** to meet demanding technological, administrative and legislative requirements;
- **client's long and short-term objectives**, such as **Whole Life Costing** (Mohammad, 1996) which will be taking the construction, operation and maintenance cost route; and
- **multi-cultural complexity** based on geographical, regional practices, political, financial and competitiveness which is an important issue to be addressed in the selection of procurement system in the global market.

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Organisation of Private Sector Actors in Accommodation Service PFI Projects

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In 1992, the UK Government introduced the Private Finance Initiative (PFI) as a government policy to allow and regulate privately financed public projects. However, PFI can be better understood as an innovative procurement method. In the procurement of a PFI project, a public sector client uses innovative mechanisms to enable the private sector entity (ProjectCo) undertaking the project to improve value for money through contract whole life cost (CWLC) minimisation. These mechanisms are: task integration, long-term contract, output-based specification, net present value based competition, risk transfer and incentive contract.

This presentation explores the ProjectCo actors' organisation in PFI project development. It demonstrates that the prevailing organisational structure compromises the ProjectCo actors' ability to engage in CWLC minimisation and, thus, improve value for money for the client and/or increase profit to the ProjectCo. First, the organisational structure limits the ProjectCo actors' opportunities to implement innovative solutions that are expected to lead to CWLC reductions. Second, the structure gives the ProjectCo actors new incentives that are in conflict with their CWLC minimisation incentive. The limited opportunities and alternative incentives mainly arise from: the special purpose vehicle's use of separate design & build; and operation subcontracts to undertake the project; and the debt finance provider's risk-aversion.

This presentation proposes an alternative organisational structure for the ProjectCo actors. Based on *a priori* reasoning the alternative structure solves the problems that result from the use of the prevailing structure. In the alternative structure, the special purpose vehicle subcontracts the execution of the project to a joint venture between the contractor and operator investment companies using an integrated design, build and operate contract and the debt finance provider invests equity in the project.

Optimising the impact of financial incentive mechanisms in Australian commercial building projects

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In the past, the Australian Construction industry has experienced significant problems in project delivery, which have resulted in cost and time overruns and failure to achieve client requirements (AEGIS, 1998, 6). These poor outcomes have been partly due to misalignment of project goals and inappropriate risk allocation between project participants (AEGIS, 1998, 2, 9, 13). The appropriate implementation of performance-based incentive systems in the contractual arrangements in Australian construction projects can impact significantly on the motivation of contract agents and hence project performance, and have been argued to improve the efficiency of the Australian construction industry (Kenley & London, 2000).

Financial incentive mechanisms (as a component of the project delivery strategy), aim to provide contractors with the incentive to align their goals with those of the client, via a financial reward/penalty. Financial incentive mechanisms take many forms in commercial building contracts, including profit/loss sharing in cost plus incentive contracts; bonus/ penalty performance provisions attached to various lump sum and cost reimbursable contracts; and multiple financial incentive mixes.

Although financial incentive mechanisms are used in many commercial building projects in Australia, there has been little research into the performance of these incentives, particularly in relation to motivational principles. This research aims to contribute to current knowledge by investigating the effectiveness of financial incentive mechanisms in the Australian commercial building industry and how their implementation can be optimised to increase the level of contractor motivation and assist in the attainment of client defined project goals.

To achieve this aim, the research objective will be to assess the current performance of the incentive mechanisms in Australian commercial building projects. Such performance will be compared against best practice as represented in an integrated framework based on established motivational literature. This research assumes that the level and direction of effort (motivational force) under financial incentive contracts are influenced by indicative motivational variables that impact on the actual performance in each of the projects. A qualitative case study approach has been chosen as the appropriate method to achieve the objectives of this PhD research. Primary data collection mechanisms include semi structured interviews, supplemented by reviews of contractual documentation and direct observations.

The identification of indicative motivational variables influencing the level and direction of effort under financial incentive contracts will assist in their optimal implementation in future Australian commercial building projects. This can lead to an improvement in project performance, within this problematic industry sector. The research also aims to contribute to the understanding of the complex interrelationships between contractor motivation and client incentive system design.

Bio of Researcher

Tim Rose is a PhD scholar with the CRC for Construction Innovation and the School of Construction Management and Property, QUT, Brisbane, Australia. He holds an undergraduate honours degree in Applied Science (Construction Management) and was previously employed both in the private and public building sectors, most recently the Queensland Department of Public Works. He is currently 10 months into his PhD research into the optimisation of financial

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Non-price criteria in municipal construction procurement

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This is a short summary of a PhD project that deals with non-price criteria in municipal construction procurement. The PhD thesis is a so-called papers model dissertation, which means that it contains four or five papers of publishable quality. The interrelation and joint contribution of these papers will be discussed in an analytical summary in the dissertation. The PhD project, which started in the spring of 2003, is part of the larger multi-disciplinary research project *Procurement for Sustainability in Construction: The Development of Local Government Practices.* This Swedish project is carried out in collaboration between researchers at the Department of Service Management, Chalmers University of Technology and researchers at the Sociology of Law Institute, Lund University.

In many countries the traditional procurement approach, based on detailed specifications and lump sum contracts awarded on lowest-price criteria, is questioned. This approach is thought to produce adversarial relations and defensive strategies, hampering a smooth and constructive handling of changes and of new circumstances, as well as the introduction of innovative and more sustainable technologies. A bias towards short-term thinking is easily reinforced. However, the last decade has seen a great interest in developing collaborative interorganisational relations in general. In the construction industry, new forms of contractual arrangements, conflict resolution and project relations are now objects of both development initiatives and academic research. The link between award criteria in public procurement and innovation in the construction sector has been recognized as a policy issue. The wish to enhance social and environmental sustainability, as is evident in Agenda 21 local government initiatives, partly explains why public clients may look for other criteria than lowest price in contractor selection.

Against this background, this research project focuses on initiatives undertaken by professional public clients, sometimes assisted by legal advisers, to develop models (including criteria and procedures) for handling other award criteria than price in contractor selection. The overall purpose of the multi-disciplinary research project is to investigate how criteria related to environmental, social and economic sustainability are developed and used in models for awarding construction contracts. This PhD project shares this purpose, while drawing primarily on contract economics and especially transaction-cost economics. Economics of innovation and theories of entrepreneurship are also used when analysing the relation between public procurement on the one hand, and innovation and technological development on the other hand.

Empirically, we rely on interviews with both municipal agency personnel and managers at construction companies. The semi-structured interviews are related to actual construction projects and tendering documents from these projects. Eight municipalities and two county councils are included in our sample. These were selected based on statistical data from a European tender database. Between May and October 2003, a pre-study was conducted, including eight interviews with personnel from three of the selected municipalities. During the spring of 2004 we have also collected empirical data from 386 tendering documents. These tendering documents represent construction projects procured by Swedish municipalities in 2003. About half of all Swedish municipalities are represented in this sample, and the data shows a variety of multi-criteria contractor selection practices.

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Based on the general purpose of the research project, a number of more specific research questions that lay the foundation for scientific papers have been identified. Three questions are reviewed briefly in this abstract.

- 1. Why do government agencies use multi-criteria contractor selection and what are the consequences of its use? From a transaction-cost economics perspective it can be argued that multiple award criteria may result in the selection of a contractor that is better attuned to the needs of the buyer. Thus, although transaction costs ex-ante may rise due to evaluations of criteria compliance, transaction costs ex-post may be reduced because of a lower degree of disputes during the course of the project. We also note that both municipal procurement and the use of multiple criteria can be viewed in a dynamic perspective. Contractors continuously learn about evaluation and award practices employed by public clients. Thus, it can be expected that contractors invest in resources and capabilities to increase their competitive advantage.
- 2. How do government agencies take contractors' past performance into consideration when awarding a construction contract? The increasing use of multi-criteria contractor selection has also led to criteria that incorporate contractors' past performance. These criteria are sometimes related to prior projects that the contractor has performed, other times related to references, i.e. prior clients might give their opinion of contractors' performance. The notion of past performance resembles the role that reputation and credibility play in private procurement. A construction company that has performed well in prior project could thereby be rewarded, while a poor performer is not. However, taking contractors' past performance into consideration, in a public procurement context, raises a number of questions. What is past performance? How can a government agency compare contractors' performance? Is it the company or the project staff that should be evaluated? For how long should a construction company suffer because of prior project failures?
- 3. Does multi-criteria contractor selection stimulate innovation and technological development in industry? One critique of the traditional procurement regime based on lowest price awards is its strong focus on price competition among construction companies. At first glance it can be argued that multiple award criteria lead to another type of competition—more focused on quality, environmental friendliness, technology, etc.

The Performance of Constructed Facilities Delivered through PFI

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Background

Capital works through the Private Finance Initiative (PFI) are supposed to demonstrate value for money (VFM). Value for Money (VFM) is a general term used to assess whether or not an organisation has received the maximum benefit from the goods and services it has purchased. It is based on the 'three Es' – economy, efficiency and effectiveness.

In the context of constructed facilities, VFM appraisal compares the economic costs and benefits of alternate procurement methods. VFM has become increasingly used as the grounds upon which claims in favour of PFI programmes are made, as well as a basis for challenging those claims. Both cannot be right, however both can be wrong. There is clearly a need for an objective method of applying VFM criteria for assessing PFI projects both before and during the life of the building.

In order to establish an objective method of evaluating PFI projects on VFM grounds, a conceptual model of VFM will be developed that will exhibit more clearly how the Three E's apply a wide range of possible circumstances. This will be done through the application of systems analysis in order to ensure a coherent set of criteria of evaluation. The research will then progress towards developing a model specific to PFI projects dealing with complex issues through Multi-Criteria decision Analysis (MCDA) for both selection and performance evaluation by the user client.

The aim of the research is to develop an integrated performance index (IPI) model in order to evaluate built facilities obtained through PFI. The model will enable the clients to determine their own priorities but will 'spell out' the logical consequences of how those preferences are ordered.

As a consequence they will be able to make more informed decisions about the VFM they seek from their built facilities.

Objectives:

- 1. To examine current understanding and limitations of VFM based on the three Es. This will be done by reviewing the literature on VFM in the UK and other countries and studies on efficiency and effectiveness in economics, production and accounting publications.
- 2. To investigate the role of systems analysis as a tool for analysing VFM in terms of the three Es. This will be done by exploring the techniques of SA, such as input/output and decision analysis, in order to establish a the logical relationship between the three Es and VFM
- 3. To develop a conceptual model of VFM that relates the level and nature of the decision and exhibits the various permutations in the way the three Es relate to as wide a range of possible circumstances. This will be done by examining a selection of MCDA techniques and comparing their features with those of problems characterised by multiple and conflicting requirements of constructed facilities.

- 4. To explore the role of Multi-Criteria Decision Analysis (MCDA) within the context of systems analysis as a means of handling multiple and conflicting requirements from constructed facilities. This will be done setting out the relationship between the three Es and VFM and how the arrangement of nature of inputs and outputs for systems of different complexity
- 5. To derive an integrated set of performance measures that will enable the overall performance of a constructed facility to be monitored over time. The method has yet to be worked out precisely but is expected to be developed from established methodologies for deriving indexes.

The model should improve the client's ability to evaluated providers on their delivery and to improve the method of securing reliable service level agreements between the parties.