RISK SHARING AND EFFECTIVE INCENTIVES IN COLLABORATIVE PROCUREMENT

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There are a number of options available for procurement of construction work. The main differences between the options include the payment mechanisms and risk allocation between the project participants. Payment options include fixed price contracts, cost-reimbursable contracts and target cost contracts. Use of collaborative procurement based on target cost contracts is on the increase in UK construction. Other innovative arrangements for procurement include Early Contractor Involvement (ECI) design and build. The key features and risk allocation inherent in different procurement methods are discussed. The characteristics of ECI contracts are assessed including an evaluation of the payment mechanisms in a major rail project. It is concluded that experience of ECI design and build contracts is still limited. As a consequence, further theoretical research and empirical data analysis are required to collate information which will guide industry in designing effective incentives in collaborative procurement.

Keywords: Contracting, Incentives, Partnering, Procurement, Risk.

INTRODUCTION

There have been in recent years major advances in collaborative procurement in UK construction. All project participants are increasingly working together in a variety of contractual arrangements including partnering, alliances, joint ventures and framework contracts. Building trust is a key ingredient in such arrangements. For clients in central and local government, these changes have been driven mainly by legislation. For clients in the private sector, change has been driven by the cultural shift in attitudes and working practices called for in the Latham and Egan reports (Latham 1994, Egan 1998). To achieve true collaboration, a legally binding contract that aligns the motivations of the parties is essential. Although lump sum and admeasurement contracts are still widely used, the development of the NEC Engineering and Construction Contract has led to widespread use of target cost contracts. The theory of risk sharing and incentives in target cost contracts has been widely reported in the economics literature. This work adopts principally a mathematical modelling approach and specific assumptions regarding the contracting relationship between the client and the contractor. For example, a principal-agent analysis by Weitzman (1980) concludes that an optimal sharing ratio in target cost contract depends on various factors. These factors include the level of project uncertainty, the degree of risk aversion by the parties and the contractor's ability to control costs. Another principal-agent analysis by McAfee and McMillan (1986) suggests that an optimal contract that minimises procurement costs is never a cost-plus

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contract. It may be a fixed-price contract but that such contracts should be used much less frequently. They conclude that an optimal contract is usually an incentive contract and that a client's choice of the sharing ratio determines the contractor's choice of cost-reducing activity. The larger the share of costs paid by the client, the smaller the effort expended to lower production costs.

In target cost contracts, the contractor is reimbursed all the allowable project costs. In addition, he is paid a fee to cover overhead expenses and profit. The contractor and the client will also normally share the difference between the target cost and the actual cost of the project in a pre-agreed proportion. Perry and Barnes (2000) examine the interplay between the fee, the target cost, the sharing fraction and the final contract price. Their analysis shows that some methods of tender evaluation can lead to adverse contractor selection. Consequently, they propose methods of tender evaluation to ensure optimal choice of tender. Based on a case study approach, guidance on selection of appropriate sharing rates is discussed in Broome and Perry (2002). A probabilistic model for structuring incentive fee contracts is discussed in Berends (2000). Meanwhile, Rosenfield and Geltner (1991) suggest that cost-plus and incentive fee contracts have a number of inherent drawbacks and that their use in practice should be limited.

In addition to use of target cost contracts, the concept of Early Contractor Involvement (ECI) design and build has been developed. ECI seeks to integrate the team members around the project. The contractor is appointed early in the life cycle of the project to work with the client and contribute to development of the design and secure improvements in buildability and economy. ECI contracts are normally in two phases. The first phase of design development is paid for on a cost-reimbursable basis. The second phase of detailed design and construction is paid for on a target cost basis. ECI contracts are gaining widespread use in practice although experience of their use practice is still limited. This paper aims to provide a contribution to this gap in knowledge based on a survey of published work and review of a £37m rail project.

RISK IN FIXED PRICE CONTRACTS

A lump sum or fixed price contract may be let on the basis of outline drawings and a performance specification. The contractor submits a single sum for all the works. Payments may be made either on a monthly basis or on achievement of specified milestones or activities. The lump sum contract is suitable when the project performance specifications are clear. Fixed price contracts are widely used for projects of a repetitive nature such as standard buildings or factories. The contractor takes all the risk for changes in quantities or ground conditions. Any client-initiated changes can be costly because their financial implications have to be negotiated and paid for on a reimbursable basis.

Contractor selection in fixed price contracts is normally by competitive tender and the work is in most cases awarded to the lowest bidder. If there are no changes, the client pays the contractor the fixed price irrespective of the total costs incurred by the contractor in executing the work. Should these costs turn out to be higher than the agreed fixed price, the risk of loss making is the responsibility of the contractor. Competitive tendering followed by award of the contract to the lowest bidder is still perceived as the best way of achieving value for money. For example, a recent survey showed that 80% of contracts awarded by local authorities still goes to the lowest bidder (Lynch, 2005).

The contractor in a fixed price contract is motivated to reduce the costs to the lowest practicable level and maximise profit. In bidding for work under fixed price contracts, rational bidding contractors will include a risk premium in their tender. The client pays this risk premium irrespective of whether the risk materialises or not. Under competitive bidding pressure, it is well known in the construction industry that contractors will reduce tender prices to improve their chance of winning work. Should such contractors find that they are losing money and stand to make a loss on the contract, they may resort to cutting project quality and pursuing contractual claims. Fixed price contracts should ideally be used only when the performance specifications are complete and clear, and where the project risks are controllable by the contractor.

COST-REIMBURSABLE CONTRACTS

In cost-reimbursable contracts, the client reimburses the contractor all the allowable costs properly incurred for labour, materials, and plant in carrying out the works. These costs are verified by the employer through a system of open book accounting before payments are made to the contractor. The cost implications of errors, changes, or omissions are the responsibility of the employer. In addition, the employer pays the contractor a fee to cover other costs not included in the allowable costs, overhead expenses and profit. The fee may be fixed fee, it may be a variable fee or it may be a percentage of the actual project costs incurred by the contractor.

Cost-reimbursable contracts have a number of advantages for the client. These include permitting an immediate start to the works. The employer also incurs costs limited only to what is actually incurred. It can also be argued that the client does not have to pay an unusually high-risk premium that may be included in tenders in fixed price contracts. Cost reimbursable contracts are suitable for emergency works and works in existing buildings such as in manufacturing concerns where the contractor may be frequently interrupted by the occupier’s operations. They are also suitable for maintenance work where the exact extent of the work to be undertaken and the resources required are uncertain.

Disadvantages of cost-reimbursable contracts include absence of motivation for the contractor to pursue efficiency by controlling production costs. In fact, if the fee paid to the contractor is in direct proportion to the allowable costs, there could be perverse incentives for the contractor to drive costs upwards. This can be achieved by a contractor padding out costs, for example, by unnecessary testing of materials and works, generous arrangements with suppliers of services, materials and construction equipment or excessive manpower arrangements to avoid redundancy costs.

Use of cost reimbursable contracts poses a number of difficulties for the client. The first is that contractor selection can be difficult particularly for public sector clients. The contractor’s fee can be used as the basis of competitive tender. However, choosing a contractor on this basis does not guarantee lowest total project costs to the client. Clearly, cost-reimbursable contracts are likely to be suitable where there is a high level of project cost uncertainty, minimum project specification and where project risks are controllable by the client. Where a cost-reimbursable contract is adopted, a lack of incentives to maximise productivity and adverse contractor behaviour such padding of costs must be watched and effectively controlled by the client or his project manager.

TARGET COST CONTRACTS

Target cost contracts constitute a refinement of cost-reimbursable contracts. Just as in cost reimbursable contracts, all allowable costs correctly incurred in project execution are monitored through open book accounting and reimbursed to the contractor. The contractor is also paid a fee to cover his overhead expenses and a profit. The main development in target cost contracts is that a project cost target is agreed between the client and the contractor. If the contractor exceeds the cost target set, he pays a penalty on his fee. If he performs the work at a keener price than the target, he receives a bonus on his fee. In target cost contracts, the contractor has financial incentives to keep project costs down and work can start before the design is far advanced.

The total payment by the client to the contractor in a target cost contract is given by the equation:

$$P = C + F + r(T - C) \qquad (1)$$

where

C = actual cost of the project (which is uncertain at the start of the project)

F = fixed fee paid to the contractor

T = project target cost

r = sharing ratio, $0 < r < 1$

F, T and r are fixed at the commencement of the contract. If r = 0, the contract is effectively a cost-reimbursable contract. If r =1, the contract is effectively a fixed price contract. If the actual project cost exceeds the target cost by F/r, the contractor makes a loss on the contract. Target cost contracts contain mechanisms for negotiation and adjustment of the cost target due changes in design or scope of the work. The use of target cost contracts generally and the choice of optimal sharing rate in particular are the main contributions of this paper. For construction of the Channel Tunnel, all underground construction was based on a target cost contract to which a gross profit (fixed fee) of 12% was paid to the contractor. If the cost was under budget, the contractor received 50% of the savings. If the budget was exceeded, the contractor paid 30% of the cost overrun, up to a limit of 6% of the target cost (Biedleman, Fletcher and Veshosky, 1990).

Target cost contracts have been used in defence procurement since the 1960s due to concerns with cost overruns on large defence projects. Tirole (1986) notes that cost overruns in defence programme development costs exceed original predictions by 220% on average and that in some cases costs have exceeded original predictions by as much as 14 times. Cost sharing can be beneficial to the client in such cases if it can bear the consequences of cost overruns more cheaply than the contractor.

Driving down project costs is not the only way the contractor can maximise his payoff. The same objective can be achieved by seeking an inflated target cost during initial negotiation and renegotiations. In an earlier but still pertinent publication, Fisher (1969) presents an empirical analysis of incentive contracts in the defence sector. He concludes that to ensure that incentive contracts motivate contractors to increase efficiency and lower production costs, it is essential that the target cost is a realistic estimate of the expected actual costs. He goes on to state that gains in incentive contracting are likely to come from improved methods of determining target costs rather than through elaborate incentive sharing arrangements. Reasonable target

costs can be determined by improved cost reporting information systems from historical projects, improved cost analysis and estimating capability. Analysis by Tirole (1986) has shown that contractors will put in less effort to reduce actual projects costs if there are opportunities to renegotiate the contract sum.

Rosenfield and Geltner (1991), whilst not advocating that cost-plus and incentive contracting should be ruled out argue based on economic analysis that such contracts have some drawbacks and that they should be limited to very exceptional cases. First, they argue that cost-reimbursable contracts (with or without incentive mechanisms) always tend to cost the client more than fixed price contracts. This is because accounting controls required of the client increase his overhead costs and overlapping design and construction leads to a shifting of the construction expenditure pattern. Earlier payments for construction by the client imply higher expenditure in net present value terms compared to costs incurred under alternative procurement patterns. They further argue that use of incentive contracting may lead to survival of inefficient contractors with low or poor productivity. Such contractors may in the long run win contracts in the industry against efficient contractors- a phenomenon referred to as adverse selection. At a macroeconomic level, they argue that in the construction sector as a whole, use of cost plus and incentive contracts lowers competitive pressures and blunts incentives on construction firms to increase productive efficiency that can in turn increase costs and prices in the industry.

According to Weitzman (1980), the optimal sharing ratio in a target cost contract depends on the project uncertainty, risk aversion and the contractor's ability to control costs. Based on a linear incentive payment schedule and assuming that the client's utility of money function is more linear than that of the contractor, Weitzman (1980) concludes firstly that where the contractor has greater discretionary power to reduce project costs, it should be made to bear a greater share of those costs. Conversely, if there is little that a firm can do or will do to cut costs, it should be freed from the risks – a conclusion which is in accordance with the cardinal principle of risk allocation. An interesting conclusion by Weitzman (1980) is that the sharing ratio ought to be above 50% in most reasonable scenarios and that it should sometimes be well above this to create greater incentive for the contractor to reduce costs. A higher sharing ratio makes the contractor bear more cost uncertainty that requires as compensation a greater fee.

Cost sharing provisions and opportunities to renegotiate target costs are two important features in target cost contracts. Their effects on the contractors cost saving effort are presented in Brumm (1992). His empirical analysis of data obtained from 51 defence contracts uses a multiple indicators, multiple causes statistical model to link contractor cost saving effort and the sharing rate, number of contract modifications, and cost uncertainty. Whilst acknowledging the theoretical limitations of his model and the limited data on which the analysis is based, he concludes that contract modifications significantly reduce the contractor's cost saving efforts but that the contract share rate has no significant effect. Brumm (1992) further concludes that in fact incentive pricing does more to encourage a contractor to propose frequent modifications to the contract with the hope of renegotiating higher target costs, than to hold actual costs down.

Target cost contracts require the client to carry more risk than in traditional procurement. They are designed to encourage collaboration. Clear definitions of costs, fees and equitable methods of target cost adjustment are central to running of successful target cost contracts. Perry and Barnes (2000) in their fundamental analysis

of target cost contracts firstly propose tender evaluation methods that will lead to choosing a contractor whose final price will be lowest. Secondly, they conclude that the contractor's share of cost overrun or underrun should be set at a value that is not less than 50% since a low contractor's share decreases the motivation to reduce the actual project costs.

On setting of share fractions in target cost contracts, Broome and Perry (2002) conclude that the following parameters should be taken into account:

- Alignment of motivations of the parties and the project objectives. For a contractor, the main objective is ultimately profit maximisation and for the client, project objectives should be a combination of cost, time or quality.
- Project constraints such as completion date, physical access or noise levels etc.
- Project risks and uncertainties. The share profiles should reflect the degree of risk inherent in the project.
- Strengths and weaknesses of the parties, in particular the ability of the parties to manage risks inherent in the project and the relative financial strengths of the parties.

INCENTIVES IN A MAJOR RAIL PROJECT

This rail project is being taken forward by a variety of organisations. The Employer has requested that commercial confidentiality be maintained and as a consequence, the project and all the participating organisations will not be named in this paper. The project is estimated to cost £37 million and seeks to reopen 21 km of disused and abandoned railway lines. The procurement strategy utilised a unique concept - Early Contractor Involvement (ECI) Design and Build. The contract comprised two distinct phases. Phase 1 covered the period from the Contract Date to the issue of the Notice to Proceed to Construction by the Employer. The contractor's role during this period was to familiarise himself with the project, review the existing preliminary design and adopt it with the aim of improving it or replace it with an improved alternative design. Other duties included supporting the Project Manager and the Employer to steer the project through Royal Assent, identifying site investigations required and establishing third party relationships required through to Phase 2. Detailed design work could be carried out during this phase but only if instructed by the Project Manager.

Phase 2 covered the period from the issue of the Notice to Proceed to Construction to the issue of the Defects Certificate for the Works. It should be noted the contractor's duties included everything to ensure the full and complete design and construction of the project, including accommodation works. However, a guide to the main duties anticipated in each phase is provided below. The contractor was required to take on the role of Principal Contractor under the CDM Regulations.

The duties of the Contractor during Phase 1 included the following (order not significant):

(a) project familiarisation and mobilisation of staff;

(b) attend partnering workshops and other partnering events;

(c) attend monthly project progress meetings and other group meetings as required;

(d) liase with public utility authorities and agree necessary diversions including costs;

(e) liaison with statutory and non-statutory bodies being consulted;

(f) promote public liaison and consultation;

(g) develop and agree actual cost estimates for submissions;

(h) attend risk workshops and develop and update the Risk Register;

(i) review surveys carried out and/or planned to assess suitability/ deficiency and undertake additional surveys as appropriate;

(j) review previous studies and documents;

(k) prepare the design and construction proposals including attendance at value engineering workshops with the Employer and Project Manager;

(l) obtain approval for departures from standards from appropriate organisations;

(m) obtain approvals from appropriate bodies;

(n) assist others to obtain approvals from appropriate bodies;

(o) develop and adhere to the draft code of construction practice;

(p) prepare quality plans, quality statements and the health and safety plan and update as necessary;

(q) perform function of Principal Contractor under the CDM Regulations;

(r) prepare land acquisition plans and schedules and assist Project Manager with land entry procedures;

(s) incorporate changes to design as a result of the recommendations from the legislature/ Parliament and/or the Employer and develop appropriate mitigation measures;

(t) develop Prices and agree value of changes as a result of any Bill amendments;

(u) develop and agree performance targets and associated Key Performance Indicators for Phase 2;

(v) develop and agree activity schedule for Phase 2

(w) develop the programme for Phase 2 including possession date(s) and section(s) of the site;

(x) develop the Works Information and Site Information for Phase 2;

(y) agree prices for Phase 2.

Throughout Phase 1, no guarantee was given to the Contractor by the Employer that the project would be constructed. The Employer retained the right to terminate the contract at any time due to :

- project economics if the project cost benefit ratio became unfavourable.
- failure to obtain an Act of the relevant statutory body/ Parliament
- change in government policy
- lack of availability of funds to construct the works.

There was explicit provision in the contract that Prices for the works would be agreed at the end of Phase 1. If the Price turned out to be higher than the Employer's Budget Cost, the Employer retained the right to seek competitive tenders for construction of

the scheme under a conventional design and build contract. The Employer would be at liberty to use the design produced by the Contractor for the tender, and if lower prices were obtained, the Employer reserved the right to terminate the contract. On termination of the contract, any documentation, reports, brochures prepared by the contractor for purposes of the project would be handed over to the Promoter. All work undertaken by the contractor during phase 1 was paid for on a cost-reimbursable basis.

Duties of the Contractor during Phase 2 were agreed during Phase 1. They included the following (order not significant):

(a) continuing all duties from Phase 1 as required;

(b) undertake the detailed design of the project;

(c) assist the Project Manager to complete land entry procedures;

(d) update the Prices and Actual Cost Estimates;

(e) maintain and report an open book accounting technique;

(f) carry out all duties associated with the construction of the project including planning, administration, construction, supervision, liaison, self-certification, testing and commissioning, etc;

(g) carry out public information/liaison exercises

(h) perform the function of Principal Contractor under the CDM regulations; and

(i) rectify any defects.

In adopting ECI design and build, the contractor was appointed early and philosophy behind this decision was that:

- the project would benefit from an early stage input of construction expertise to improve buildability, pricing and determination of the optimum scheme;
- innovation would be encouraged at an early stage of scheme development prior to development of detailed design;
- preparation and the construction process would be speeded up;
- the contractor's expertise would be available and could be utilised in developing and implementing the approvals process from relevant authorities.

Phase 2 was paid for on a target cost basis and the agreed contractor's share percentages and share ranges under clause 53 of the NEC Engineering and Construction Contract Option C were as indicated in table 1 below.

Table 1: Share range and contractor's share percentages for the £37 million Rail Project.

Share Range	Contractor's Share Percentage
Up to 100%	15%
100 – 110%	50%
110 – 120%	65%
120 – 130%	75%
Over 130%	100%

The above risk-reward criteria could be criticised on the grounds that the contractor only gets the benefit of 15% of the savings but is penalised quite heavily if he exceeds

the total of the prices. It could be argued that the incentive to identify savings and manage risks following Phase 1 is not significant as the Employer gets 85% of all savings. It should however be noted that design and development in Phase 1 was paid for on cost-reimbursable basis. Such a risk-reward strategy was designed to motivate the contractor to undertake a thorough technical evaluation of the scheme and develop a realistic pricing of the Works during Phase 1. If detailed design of some elements of the scheme was necessary in order to arrive at realistic pricing, the contractor could undertake this following a request to do so, and authorisation from the Project Manager.

It should also be noted that instructions to bidders included a detailed risk register. Each source of risk was numbered uniquely. The project phase when each source of risk was likely to materialise was also stated. A detailed description of each risk was given including a risk management plan. Probabilities of occurrence of each risk were estimated including an assessment of their likely impacts. A clear statement of allocation of risk to the party responsible for management of the risk was included in the register. Although the risk register was not a contractually binding document, it was a dynamic project management tool that was updated regularly at each assessment date.

CONCLUSIONS

The key features of fixed price, cost-reimbursable and target cost contracts have been discussed in this paper with specific reference to risk sharing and incentive effects. In fixed price contracts, the contractor is paid a fixed price to complete the work. The agreed price is normally adjusted to take account of client initiated changes. There is a strong incentive for the contractor to control costs because every pound saved ends up as a pound in extra profits. All risk however rests with the contractor. The contractor must be compensated for carrying this risk and the premium paid will represent on average a high nominal profit rate.

In cost reimbursable contracts, all risk rests with the client and there is no motivation for the contractor to maximise productive efficiency and control project costs. In fact, it can be argued that such contracts have perverse incentives for the contractor to drive costs upwards. Use of cost-reimbursable contracts should be limited to very rare project circumstances.

Target cost contracts are designed to motivate the contractor to minimise production costs. They been widely used in defence procurement in the past and are gaining widespread use in high-risk construction projects. Several authors in both defence and construction procurement have repeatedly called for sharing rates for cost overruns or underruns in such contracts to be set at a value of not less than 50% in order to provide adequate incentives for the contractor to drive down costs. Some authors however take the view that contractors will put in minimal effort where there are opportunities to renegotiate the target cost.

The key features of the ECI design and build contract and risk sharing mechanisms adopted in a major rail project have been discussed. The main duties of the contractor during Phase 1 which included preliminary design and development of a realistic project cost target are given. Phase 1 was paid for on a cost-reimbursable basis. Phase 2 included detailed design and construction and was paid for on a target cost basis. The sharing fractions for various possible actual project cost outturns are discussed. The target cost was developed collaboratively with the contractor on an open book

basis. The client's project manager was able to check proposed plant and labour productivities, types and amounts of resources and estimates of potential subcontractor costs. As a consequence, the client's confidence in the contractor's estimates was greatly enhanced. Any detailed design that was necessary to enable realistic estimating could be undertaken provided this was agreed and sanctioned by the project manager. The contract was clearly designed to strongly motivate the contractor to provide realistic estimates of the target cost. The contractor was rewarded with a share rate of 15% of any cost savings below the target. Since conceptual design and development of the cost target were paid for a cost reimbursable basis, a higher sharing fraction was considered not appropriate, as this would constitute an unreasonably high reward to the contractor. The compensation event procedures in the contract provided a mechanism for adjusting the project cost target. The client's project managers took the view that if there was a significant cost overrun beyond the target cost, the contractor's estimates of cost for the known work and the risks would have been seriously wrong and a substantial proportion of this risk should be therefore borne by the contractor. The share fractions for cost overruns beyond the target were thus set accordingly to reflect this allocation of risk.

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