COMPETITIVE BIDDING FOR OUTCOME BASED CONTRACTS – PRICE TO WIN?

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ABSTRACT

The suppliers of long-life assets such as submarines and airplanes no longer simply sell these assets but provide advanced engineering services. In other words companies that traditionally designed and manufactured long-life products now compete through the provision of a service, such as asset availability.

These companies face a high level of uncertainty due to the novelty of the process and the long-term nature of services. However, regardless of these uncertainties the service provider needs to estimate the cost and expected profits for such provision. The pricing decision of these service contracts is influenced by multiple factors and considerations and as a minimum the supplying contractor needs to yield suitable profit to sustain their business. From current research it is known that the estimated company profit is often optimistic. This places pressure on both the customer and the service provider. From our research we found examples of reductions in profits for those providing services. For example a company, which moved to performance-based road maintenance contracts, only yielded less than 50% of their expected profit. So, how can providers of long-life, high-value assets estimate the costs for delivering an expected outcome and account for the uncertainties? One of the challenges is measuring such uncertainties and taking account of them in the pricing decision.

In this paper we present our research to date on the provision of a framework and a five-step process for modelling the influencing uncertainties and the impact of these uncertainties on the price bid. We will present the background need for such analysis and then provide an overview of our approach and findings to date. Finally, using an exemplar service we will demonstrate how using our approach highlights the probability of winning the contract, the probability of making a profit and the expected profit value for particular price bids.

Keywords: Outcome based contracts, uncertainty modelling, price to win.

1 INTRODUCTION

Many Manufacturing industries have moved from selling products to providing product service systems (PSS), where the product/asset is offered with support arrangements such as maintenance or a guaranteed availability. These types of contracts are not new. For example, in Sub Saharan Africa and Latin America, Performance-based Management and Maintenance of Roads (PBMMR) have been adopted since the late 1980's, the first being in British Columbia Canada. The focus of the PBMMR was aimed at reducing the costs of the roads and increasing the quality of the roads (Zietlow, 2011). Although roads are not complex assets, the PBMMR moved from providing cost plus (i.e. the cost of the activity plus an agreed profit) for roads to the providers being paid for the 'quality' of the road 'in-use'.

The same principles apply in complex high-value-manufacturing (HVM) assets such as trains and planes. Examples of such high-value assets include the recently announce Bombardier £1.3 billion GBP deal with Transport *for* London to provide new trains, depot and maintenance for the London CrossRail project (Bombardier, 2014). Other examples include businesses contracting for availability or being paid to provide capability and performance such as the Rolls Royce £865M contract with the UK Ministry of Defence (MoD), (Rolls Royce, 2010) and BAE Systems £446M Typhoon contract (2012). Within the UK defence sector the, the MoD spent £19.9 billion with UK Industry in 2013 on both products and services (MoD Contracts, 2014), with the annual spend on support being £7.5 billion (Jones et al, 2014).

As described by Zietlow (2011) and Selviaridis & Norrman (2014) PBCs result in the contractor holding a much higher risk than previous cost plus contracts. Under these conditions companies 'bidding' under competition for these support contracts need to estimate their cost as well as ascertain an appropriate price bid. As part of this process, the bidding company needs to understand the uncertainties and risks involved with the contract as well as determine an appropriate price bid to win the contract over any competitors.

In this paper we provide a summary of our framework for 'Managing Uncertainty in Contract Bidding' (Newnes and Goh, 2013). The aim of our approach is to assist industry in their pricing decisions for high-value contracts under competition. Our step-by-step approach is used to model the uncertainties to demonstrate the impact these may have on the price bid. To date the framework has been evaluated through a number of industrial workshops. The underpinning academic analysis can be found in Kreye et al (2014).

In the remainder of this paper section 2 presents our proposed framework and the five-step process used to identify and model the uncertainties in the bidding stage. We provide an exemplar study to demonstrate the application of our approach in section 3. The exemplar has its groundings in a real scenario demonstrating that the customer had an unrealistic expectation of price for the service they were contracting for. In section 4 we conclude the paper and provide an insight into our future research activities, in particular modelling the intangible attributes such as trust, within our framework.

2 FRAMEWORK AND FIVE-STEP PROCESS

Figure 1, depicts the four factors identified, which can have an influence on a companies bidding strategy. The Internal company processes include for example the design of the service provision and the cost estimate for delivering the proposed service. The service contract conditions include attributes such as any offset arrangements required as part of the contract as well as the core requirements for the service. The final two influencing factors include the customer. Uncertainties, which may arise here, include for example affordability of the service to the customer, their declared/estimated budget limitations as well as the influence of stakeholders. In defence the MoD may be awarding the contract but other stakeholders include the actual end-users of the service such as the Royal Air Force. The final influence is that of competitors and how the bidding company is placed in comparison to them, for example in terms of the service provision and price. To apply the framework in a bidding situation a five-step process is used. First the relevant uncertainties for the particular bidding situation are identified. Information on each of the identified uncertainties is collected, processed and the uncertainties are then modelled. Finally a decision matrix is created to assist the decision-maker in determining the price to bid.

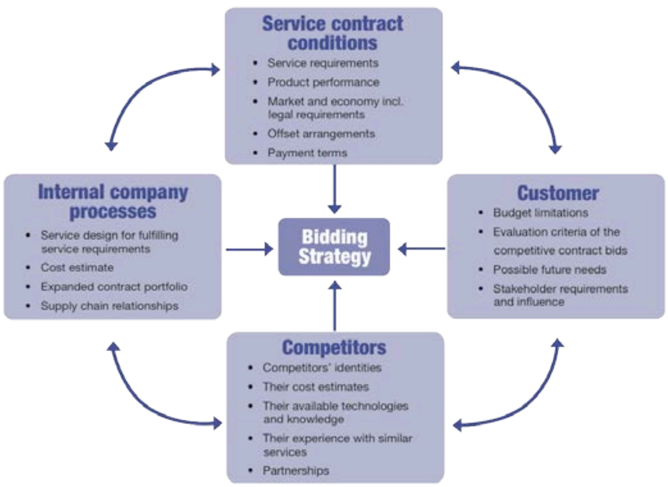

Figure 1 Contract Bidding Framework

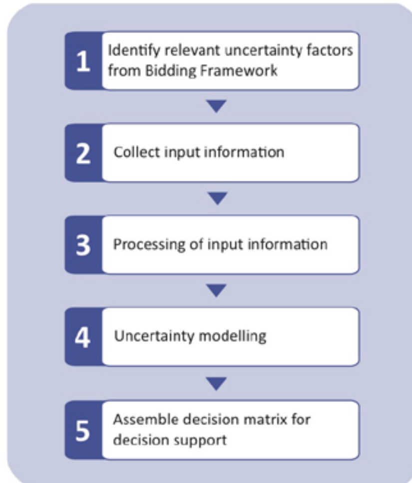

Figure 2 Five-Step Process

3 USING THE FIVE-STEP PROCESS – AN AVAILABILITY EXEMPLAR

To demonstrate the application of our framework consider a company called P2W. P2W is bidding for a 15-year aircraft availability contract. P2W and their three competitors all have experience of aircraft availability contracts, however, this contract is for a new aircraft, which has not been in-service before. Our approach is utilized by industry by following the five-step process shown in Figure 2. The following sections describe the generic process using a sub-set of the data – the expected price bid of the three competitors. However, to undertake the uncertainty modelling and provide the final decision matrix other data will be required.

3.1 Step 1 – Identify relevant uncertainties

In this scenario, the P2W bid team identified one uncertainty – the price competitors would likely bid. The bid team had limited knowledge on what the competitors would likely bid. However, the bid team identified a member of staff within P2W who had a good knowledge of the three competitors who were expected to bid against P2W. Where previous data is not available and/or data is limited expert judgment is used to gather data for analysis as described in step 2.

3.2 Step 2 – Collect Input Information

The expert was asked to estimate what they believed the competitors would bid. They were asked for four values the expected minimum and maximum price bid for each competitor as well as the absolute minimum and maximum price bids. As part of the process the expert was also asked to identify the confidence they had in their estimates as either a numerical or verbal response. To assist the expert and the modelling process, the confidence levels were provided to the expert in both pictorial and numerical form as shown in Figure 3. Figure 4, shows an example of the type of information an expert may provide. In this case the expert provided an interval response based on the questions asked by the bid team.

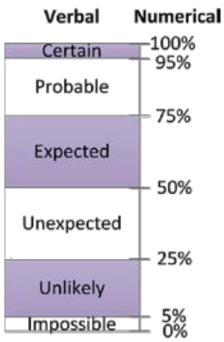

Figure 3 Confidence Levels

Figure 4 Expert opinion Expected Price Bid Competitor A

3.3 Step 3 – Process Input Information

Once all the expert judgments and data are collected the information needs to be processed. Each of the experts gave an interval response as well as their associated confidence levels for their estimates. To process the information the diagrammatic and mathematical representations are processed for each expert. For the example shown in Figure 4, equation 1 is used to determine the Probability Density Function and equation 2 is used to determine the cumulative density function.

$$\begin{cases} 0 & \text{for } x < 8 \\ \left[\frac{0.025}{(9-8)} = 0.025, \frac{0.125}{(9-8)} = 0.125\right] & \text{for } 8 \le x < 9 \\ \left[\frac{0.75}{(11-9)} = 0.375, \frac{0.95}{(11-9)} = 0.475\right] & \text{for } 9 \le x \le 11 \\ \left[\frac{0.025}{(12-11)} = 0.025, \frac{0.125}{(12-11)} = 0.125\right] & \text{for } 11 \le x \le 12 \\ 0 & \text{for } x > 12 \end{cases}$$

Equation 1- used to calculate the PDF

$$\begin{cases} 0 & \text{for } x < 8 \\ [0.025(x-8), 0.125(x-8)] & \text{for } 8 \le x < 9 \\ [\min\{0.375(x-9)+0.125, 0.475(x-9)+0.025\}, \max\{0.375(x-9)+0.125, 0.475(x-9)+0.025\}] & \text{for } 9 \le x \le 11 \\ [\min\{0.025(x-11)+0.975, 0.125(x-11)+0.875\}, \max\{0.025(x-11)+0.975, 0.125(x-11)+0.875\}] & \text{for } 11 \le x \le 12 \\ 1 & \text{for } x > 12 \end{cases}$$

Equation 2 – used to calculate CDF

For each of the three competitors the collected data is processed and the values for the PDF and CDFs calculated. The expected price bid for competitors A and C are based on interval analysis, where the price bid for Competitor B uses a triangular distribution.

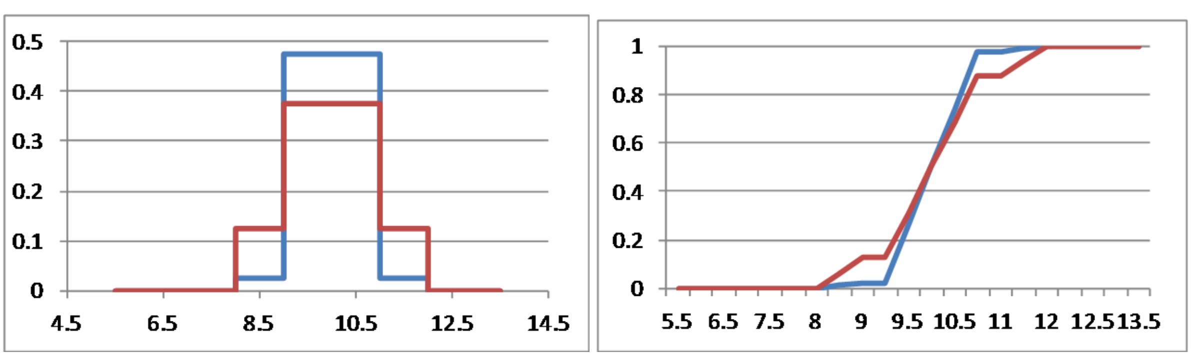

Figure 5 – Pictorial PDF & CDF for the Estimated price bid for competitor A

3.4 Step 4 – Uncertainty Modelling

Once all the data is collected and processed the uncertainty modelling focuses on using the input information to derive the probability of making a profit as well as the expected profit and the probability of winning the contract. To achieve this, the bidding companies expected cost to provide the service is used as well as data on the expected budget for the customer.

a) Probability of P2W making a profit and their expected profit

The cost estimate for P2W to provide the service is in the form of a three-point estimate with a minimum of 8.6, a lost likely cost of 10 and a maximum of 11.4M cost units. To bound the modelling the absolute minimum was defined as 7.5M and the absolute maximum being 12.5M cost units. The probability of making a profit can be interpreted as the probability of the cost being less than the price bid. The expected profit is the price bid minus the estimated cost. The estimated cost will depend on the company process, although often the most likely value is used, in this case 10M cost units.

If the P2W bid team decided to bid 9.25M cost units to estimate the probability of making a profit, substitute 9.25 for x in equation 3. However, this would result in an expected profit of 9.25-10, -0.75M cost units.

Equation 3

b) Probability of P2W winning the contract

To determine the probability of winning the contract the key customer requirements are determined. If we assume in this example the customers budget limitation is the key driver, then the probability of winning the contract in this example would be a combination of the price bid being acceptable to the customer and P2W being the lead bidder.

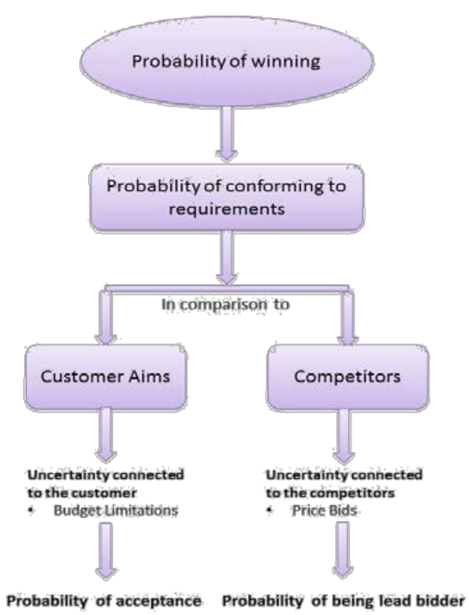

Figure 6 – Probability of Winning

The uncertainty connected to the customer is defined, as the probability of acceptance and the uncertainty connected to the competitors is the probability of being the lead bidder. These are shown in Figure 6.

The probability of acceptance by the customer is 1 minus the probability that the customers' budget is greater than the price bid. To ascertain whether P2W will be the lead bidder the probability of their bid being less than the other competitors needs to be calculated. The final stage of the uncertainty modelling is to determine the probability of winning the contract. In this example a weighting of 0.8 is allocated to the customer budget and 0.2 is allocated to being lead bidder.

3.5 Step 5 – Decision Matrix

The final step is to combine all the analysis undertaken in the form of a decision matrix. Table 1 shows the decision matrix for price bids between 7.5 and 12.5 M cost units. In this example if P2W want to have a bid price giving them more than a 65% probability of winning the contract, their probability of making a profit is 2% or less.

Table 1 – Decision Matrix

Decision Matrix															
Price bid		6	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11	11.5	12	12.5
Probability of winning %	**upper**	97%	93%	88%	79%	71%	62%	51%	38%	24%	15%	8%	4%	0%	0%
	lower	97%	93%	87%	77%	67%	56%	45%	33%	21%	12%	6%	3%	0%	0%
Probability of making a profit %		0%	0%	0%	0%	2%	8%	18%	32%	50%	68%	82%	92%	98%	100%
Expected Profit	**£M**	-4	-3.5	-3	-2.5	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5

4 DISCUSSION AND FUTURE WORK

In this paper we have presented a framework and a five-step process used for identifying and assessing the uncertainties in contract bidding. These are currently being used in industry to provide information within the contract bidding process. How the uncertainties are identified and calculated has been demonstrated for one of the competitors in the bidding process. To undertake the whole process in detail the same steps would be applied for the bidding companies cost estimate, all the competitors and the customer budget. When more than one expert is used the probabilities are combined for the experts to obtain the probabilities to be used.

In this paper we have presented the analysis using monetary values as the core decision criteria/dominant influence. However, there are other factors such as trust in the provider of the service, societal benefits. This has become more evident with the recent vote in the European Parliament where European legislation is aimed at driving other factors than price to be used in the contract selection process. The legislation is attempting to encourage contracting authorities to select ‘Value for Money’ where the value may include societal, impact on the supply chain, support for apprentiships and money being spent in the UK.

The next phase of our research is to extend the modelling approaches presented in this paper to ascertain the influence of non-monetary factors in the contract winning evaluation. Dr Goh and Newnes will complete the activity by August 2014 and will be running industry workshops in the Autumn of 2014.

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