

POTENTIAL OF REVERSE AUCTIONS IN CONSTRUCTION PROCUREMENT

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On-line auctions are widely used in commerce and industry to facilitate sale of goods and services. In the construction sector, use of reverse auctions is however relatively new. Reverse auctions utilise secure Internet technology to enable contractors to participate in the tendering process. This involves contractors bidding on-line against each other and progressively lowering their prices in order to win the contract. Types of auctions and how they influence bidding strategies are firstly discussed in this paper. The use of online bidding in other sectors of business is discussed. This is followed by a description of the procedure for online bidding for construction projects. The relative attractions and disadvantages of reverse auctions in construction procurement are discussed. Guidelines on the proper context for using reverse auctions in construction procurement are provided. Recommendations for further research to provide improved understanding and limitations of using reverse auctions in construction procurement are given.

Keywords: bidding, procurement, reverse auctions, e-commerce.

INTRODUCTION

On-line auctions are widely in commerce and industry to facilitate procurement of goods and services. In the construction sector, reverse auctions utilise secure Internet technology to enable contractors to participate in the tendering process. They allow contractors to bid on-line against each other by lowering their prices in an effort to win the contract. In the UK, the Office of Government Commerce is championing use of reverse auctions to improve procurement efficiency and save project costs. Use of reverse auctions in bidding for construction work is however the subject of current debate. In this paper, the different types of auctions are firstly described including their informational implications and how they influence bidder behaviour. A review of published information on use of reverse auctions in other sectors of business is provided. The procedures for using reverse auctions in construction procurement are discussed. An evaluation of the advantages and disadvantages of using reverse auctions from both clients' and contractors' perspectives is given. Guidelines for a proper context for using reverse auctions in construction procurement are given including general recommendations for further research to provide further information and improved understanding.

TYPES OF AUCTIONS

There are several types auctions for sale of items of value. Klemperer (1999) distinguishes four main types of auctions namely: English, Dutch, Sealed first price and Sealed second price auctions. In the English auction, auctioneer begins with the

Wamuziri, S and Abu-Shaaban, N (2005) Potential of reverse auctions in construction procurement. *In: Khosrowshahi, F (Ed.), 21st Annual ARCOM Conference, 7-9 September 2005, SOAS, University of London. Association of Researchers in Construction Management, Vol. 1, 611-9.*

lowest acceptable price, usually the reserve price. The bidding then goes up until no one is willing to go above the last bid made. Whoever made the final bid gets the item at the price bid. In an English auction, no one is going to stop bidding if there is still the opportunity to buy the item at a price less than his valuation, and also no one is going to continue bidding once his last rival has stopped. English auctions therefore result in the item being sold to the highest bidder, but the actual price paid for the object will be close to the second highest valuation. From a bidders point of view, rational bidding in an English auction involves remaining in the bidding until the price reaches the bidder's own valuation. English auctions or sequential bidding is appropriate when the supply of goods is limited or if an item is unique. The seller of an item in an English auction can specify a reserve price. If the highest bid offered does not exceed the reserve price, the seller is not obliged to sell the item. He may elect to retain the item, thus releasing the highest bidder of any obligation.

In a Dutch auction, which is also known as a multiple items auction, the auctioneer begins with a high asking price that is then lowered until a participant is willing to accept the auctioneer's price. This type of auction is used to offer multiple items for sale or when it is important to auction goods quickly. Used furniture stores sometimes run a Dutch auction by reducing the price of unsold pieces by some percentage say 10% after regular intervals of time.

In the sealed first-price auction, all bidders simultaneously submit bids in such a way that no bidder knows the bid of any other participant until all of the bids are opened at the time of the sale. The bidder with the highest offer wins the auction. If there is a tie among the bids, the winner is chosen at random from those who made the highest bid. Rational bidding in this type of auction requires guessing the valuation of the likely next highest bidder and bidding this amount. The winning bidder earns a profit from the difference between his valuation and the next highest bid. Sealed first price auctions are widely used in awarding of construction contracts. The main difference in this case is that the contract is awarded to the lowest bidder.

The sealed second-price auction is identical to the sealed first-price auction, except that the winning bidder pays the second highest bid value rather than his own. If there is tie for the first place, the winner is chosen at random from the highest bidders. Also called a Vickrey auction, the auctioneer stands to get higher bids in this type of auction compared to other types of auctions because bidders are forced to bid their true valuations. For a bidder, bidding below one's true valuation lessens the probability of winning without altering the amount one would pay. Bidding above one's true valuation implies counting on someone else to bid your true valuation. In which case you will pay your true valuation and perhaps more and therefore not make a profit. No rational bidder would adopt this strategy.

Other types of auctions include the Japanese auction, the take-it-or-leave it auction and finally the candle auction. In a Japanese auction, the auctioneer goes up in price. Bidders have to state whether they are still in the bidding race or not and cannot re-enter once they quit. The advantage of this type of auction is the informational transparency in the valuations of the items. The take-it-or-leave it auction is perhaps the simplest type of auction. In this case, the seller writes a price on the object and prospective buyers can take or leave the item. In a candle auction, the item is awarded to the last bid before a candle goes out. In the next section, electronic reverse auctions are defined followed by an evaluation of published research into their application in procurement of goods of services.

ELECTRONIC REVERSE AUCTIONS

The first Internet auctions were set up in 1995 by auction houses such as Onsale and eBay. Many auction websites have been established since then with the aim of helping to develop a web-based community in which buyers and sellers are brought together in an auction format to buy and sell items.

Electronic auctions are an Internet-based method of bidding for the supply of goods and services. It can be categorized as standard or reverse online auctions. In the standard online auctions, the auctioneer sets the starting bid amount and the bidders drive the price up as they compete to outbid each other. The highest bidder at the close of the auction is the winner of the auction. While in the electronic reverse auctions, the auctioneer sets the starting bid and the bidders compete in successive rounds of downward bidding for the opportunity to offer the specified product or service. It is estimated that in 2001, approximately US \$ 50 billion worth of goods and services were purchased in the USA using reverse auctions (Smeltzer and Carr, 2003).

The communication mechanisms used in online auctions are primarily based on unicast technology. As the number of online auctions increases, the quality of communication between the auctioneer and the bidders become crucial. Unicast-based online auctions suffer from delays of communication between the bidders and the auctioneer. Studies by Liu, Wang and Fei (2003) using laboratory experiments have shown that the communication performance of multicast-based online auctions is significantly better than that of traditional unicast based auctions. This is mainly because multicast online auctions have much lower packet delays and higher traffic rates compared with traditional unicast-based online auctions. Although both types suffer from packet loss when the traffic is heavy, multicast technology is less sensitive to network congestion.

Massad and Tucker (2000) compare on-line auctions with traditional in-person auctions from consumers' points of view. They tested relationships between the sales of 60 collectible figurines at an in-person auction against corresponding figurines at on-line auctions conducted by e-bay. It was found that online auctions exceeded in-person auctions in both mean initial bid prices and mean final sales prices. They suggested that dealers could make a reasonable profit by purchasing goods at in-person auctions and then selling them on-line. Massad and Turker (2000) suggest that this is due to information synergies in online auctioneering at present, which should most probably close in time due to increased use of computer communications technology. These findings clearly illustrate the ability of Internet auctions to stimulate and increase effective demand of products by reaching a large number of potential customers in a short time at a low transaction cost.

Stein, Hawking and Wyld (2003) analysed use of reverse auctions in procurement. They focussed on the auction process itself and the outcomes from buyers and sellers perspectives. They concluded that reverse auctions lead to considerable savings in procurement costs typically of the order of 20%. Whether such savings could be sustained in the long term is a matter for further research. Their case study also found that use of reverse auctions led to replacement of the in-house procurement function and increased supplier distrust. Whilst this study revealed that both the auction vendor and the buyer gained by participating in the auction, the seller was disappointed because of the considerable input of time and effort required before he could participate. Further disappointment on the part of the seller arose from the fact that

reverse auctions placed cost over other factors such as service delivery, customer support and buyer-supplier relationships in awarding the contract.

Joia and Zamot (2002) studied the efficiency, efficacy and accountability of the electronic auction system developed by the Brazilian Federal Government using a case study approach. They analysed the procurement process adopted by the Ministry of Social Security to purchase pharmaceutical products from several suppliers. They concluded that the system is efficient and that savings of approximately 30% in product costs for the public sector can be achieved including also a reduction in purchasing time involved. Their study however raised concerns of accountability when using the system.

Settoon and Wyld (2003) examined the potential impact of strategic implementation of reverse auctions on macroeconomic indicators and government spending in Southeast Asia. They used data from the year 2000 collected from the Asian Development Bank (ADB) and the World Bank. The data was used to assess cost savings from competitive bidding events using econometric analysis for five countries namely Indonesia, Malaysia, Philippines, Singapore and Thailand. The function areas or sectors for which savings estimates were made include:

- General public services (e.g. law and order);
- Defence;
- Education;
- Health;
- Social Security and Welfare;
- Housing and community amenities (e.g. human settlement, regional, rural and urban development);
- Economic services (e.g. agriculture, industry, utilities, transportation and communication.).

Settoon and Wyld (2003) demonstrate that the use of reverse auctions could in the case of each country result in cost savings that average between US \$ 468 million to US \$ 1.6 billion. Such savings could be applied to reduce government deficits or increase government consumption. Such savings in efficient government procurement can help increase a country's GDP. Further analysis for the year 2000 based on the five countries in the study showed that every additional dollar spent caused GDP to rise by a government spending multiplier greater than 8.0.

In order to understand purchasers' motivations, promises, risks and conditions for reverse auctions success, Smeltzer and Carr (2003) interviewed 41 purchasing professionals in the USA. They identified cycle time reduction, and lower purchase price as promises from the buyers' perspective. From the suppliers' viewpoint, the main reasons for using reverse auctions were increased business opportunities and improved communication about the market. They suggested that the following are the main conditions necessary for reverse auctions to be successful namely:

- Specifications for the goods and services to be auctioned must be clear and comprehensive. These should include quality requirements, delivery time, location requirements, order quantities and service issues;

- The required quantities must be large enough to encourage suppliers to bid and to enable them to achieve production efficiencies;
- Appropriate supply market conditions must exist to foster competition between suppliers. Suppliers must also have spare capacity to be able to take on increased business;
- Suppliers must have skilled professional staff in order to understand and implement the purchasing procedures;
- The appropriate computer and software technology must be in place.

In the UK construction industry, use of reverse auctions in bidding for construction work is a subject of current debate. Every year, private sector companies and government departments in the United Kingdom issue thousands of requests for proposals to companies seeking to secure contracts. This process is mostly paper-based with mail, faxes and agents being used to deliver important documents. The Office of Government Commerce (OGC) is championing use of reverse auctions for public sector procurement. It is estimated that savings of approximately 25% will be cut from procurement costs by using reverse auctions when compared with traditional paper-based tender processes. One of the areas identified for such savings is construction procurement. In the next section, we describe the online bidding process with specific reference to the guidelines developed by the UK Construction Industry Council.

ONLINE BIDDING IN CONSTRUCTION

In general, the on-line bidding process for construction contracts as identified by the Construction Industry Council, (2005) is as follows. The process starts with the client or his advisors inviting bidders to submit technical proposals to participate in the reverse auction. Drawings and specifications for the proposed contract and instructions on how to participate in the auction are available to all potential bidders in advance of the event. The client will provide software and training as necessary. The online auction is scheduled, with a specified start and closing time, and conducted on behalf of the owner by a third party; an IT application service provider (ASP). A reserve price may be determined by the client, which is usually based on a consultant's estimate. All bidder identities are kept confidential during the reverse auction event. Once the reverse auction begins, bidders submit initial prices. The submitted prices are ranked and then communicated back to all bidders. Bidders can re-submit new lower prices as many times as they want up to the specified closing time, with the new ranking communicated back to all contractors with their new ranking. The auction process closes when no more new bids are placed and the auction time expires. All bidders are immediately notified of their final bid ranking. The auction service provider notifies the owner of the bidding results. Finally, the owner will contact the winning bidder to complete the formal award of the contract.

Online bidding for construction contracts promises increased efficiency, transparency and reduced costs and this can be seen clearly from the following advantages:

- On-line tendering can be used to standardise the procurement process;
- Bidders can be monitored;
- It increases competitiveness among tendering contractors;

- It provides an opportunity for unknown contractors to bid for work;
- Comparison of bids is easy and simplified;
- There is reduction in paperwork, postage and photocopying costs;
- It facilitates simultaneous communication with multiple bidders;
- Communication with bidders is easier and faster;
- Contractors have the opportunity to submit more than one bid.

Online bidding has a number of disadvantages particularly in the procurement of complex services such as those in engineering and construction projects. On-line reverse auctions have become a popular method for reducing the price of purchased goods and services. However, they expose clients to the real possibility of awarding a contract to the lowest cost bid rather than to one offering best value. In the construction sector, it can be argued that this is contrary to the partnering principles advocated for in the Egan report.

Using auctions as a method of procurement can also lead to difficulties in exercising control over specifications for the goods and services being bought. In reverse auctions, competitors have to deal with multiple rounds of bidding and as a result this may encourage imprudent bidding practices. The process may move too quickly giving competitors insufficient time to accurately reassess their costs. This will have an impact on both the bidder and the owner. If a winning bidder discovers that they are making a loss during project execution, they may resort to using low quality materials, poor workmanship and proliferation of claims.

Some well-qualified bidders may not participate in online bidding because they do not trust the process. In reverse auctions, there will always be an opportunity for contractors to re-submit their prices and therefore this can encourage them to initially submit artificially high prices rather than their competitive prices. As a result, the lowest possible price may not actually be offered.

Potter and Lovatt (2002) explore the legal obligations of the parties to an auction sale with reference to the newly defined liability of managers of auction sales where properties are sold without a reserve price. They studied the rules in English Law underlying the formation of auction contracts. They conclude that according to English Law, if an auctioneer refuses to sell to the highest bidder then he could incur liability to the bidder if there is no reserve price. These legal developments have implications for awarding of construction contracts in online bidding. It would appear that if factors such as experience in the industry, financial strength of the bidder, attitude to quality, safety record etc. have already been taken into account in the prequalification process and if there is no reserve price in the online bidding process, there would appear to be an obligation on the part of the client to award the contract to the lowest bidder unless there are prior explicit instructions to the contrary.

Bywell and Oppenheim (2001) discuss the issue of fraud in online auctions. The buying, selling and transacting of money over the Internet raises important security issues. They also discuss the problem of bidding under false names and addresses. In construction procurement, a fraudulent client could introduce a fictitious contractor to help drive down bid prices- a phenomenon referred to as shill bidding. Reverse auctions could also lead to deterioration in buyer-supplier relationships. Griffiths (2003) discusses the ability of online auctions to adversely affect relationships

between suppliers and buyers. He points out that the trust between the buyer and supplier might be affected if the reverse auction is conducted in an unethical way. For example, inviting suppliers to an auction who never actually in the end win contracts perhaps due to size, quality or language barriers and yet their participation may help the client just to push the prices down.

A major UK client recently used reverse auctions to procure £1 billion worth of engineering consultancy work. All potential bidders however were unanimous in their condemnation of the reverse auction process. A survey reported in the *New Civil Engineer* of 24/31 March, 2005 revealed that 87% of civil engineers were against use of reverse auctions in construction procurement with only 10 percent in favour of their use.

Emiliani and Stec (2004) report results of recent research to assess how aerospace parts and subcomponent suppliers specialising in producing engineered machined parts and sub-assemblies reacted to participation in online reverse auctions. Their results showed that online reverse auctions have shortcomings as far as incumbent suppliers are concerned. Key findings of their research were (Emiliani and Stec, 2004) that:

- Incumbent suppliers realised few benefits, if any, from participating in online reverse auctions;
- Over 70% of incumbent suppliers actively seek opportunities to charge their customer higher prices as a direct result of their participation in online reverse auctions when the opportunity to do so arises;
- Incumbent suppliers viewed online reverse auctions as a divisive purchasing tool that damages relationships with long time customers;
- Most incumbent suppliers drop out of the bidding after one to two years;
- A few suppliers responded to online reverse auctions with efforts to improve productivity by adopting lean production practices.

GUIDELINES FOR ONLINE BIDDING

The primary objective of using reverse auctions in construction procurement should be to obtain best value and not merely to lower the contract price. Most client organisations are aware that lowest tender price does not always equate to lowest final account. Several trade associations representing client and consultant organisations in Canada, USA and the UK have opposed using reverse auctions in construction procurement. Government is driving their use in the UK and as a major client for construction services, contractors and consultants cannot ignore these developments.

To make online bidding successful, clients and their professional advisors should start with a pre-qualification process. Comprehensive information regarding the project or services required should be developed and submitted to all potential bidders first. Clear pre-qualification criteria should be developed and communicated to all potential bidders to ensure parity of tendering and to provide them with the opportunity to collate information for their technical bids. Selection criteria might include experience on similar projects, health and safety record, financial stability, qualifications and experience of key personnel, etc. Bidders who meet the pre-qualification criteria should be trained on the methods to be used for reverse auctions. It is also in the best interests of the parties for the client, potential bidders and the IT application service

provider to sign a confidentiality agreement. The numbers of competing bidders should be disclosed and it is important that there is transparency about the bidding process including the weighting criteria and methods used to combine the financial and technical proposals before arriving at the winning bid.

If all the technical submissions have been reviewed, the only piece of information to be derived from the reverse auction is the price. Best value should be the guiding principle in awarding construction contracts and clients should emphasise this to all potential bidders. Clients should weigh the benefits of using reverse auctions and should only adopt this approach if the benefits outweigh the costs. If the client chooses reverse auctions, they should stick to the approach rather than starting with the well known sealed bid methods and only to change their mind later. Industry well known conditions of contract such ICE conditions of Contract, JCT conditions of contract or the NEC Engineering and Construction Contract should still be used and should not be amended without good reason. Any amendments to standard forms if required should only be done after taking legal and technical advice.

Contractors and consultants participating in online bidding to provide goods and services would be well advised to always include an adequate margin of profit in their final bid prices. This is essential to reduce the incidence of claims and disputes in construction and to help deliver best value. It is important that private sector contracting and consulting firms remain profitable in the long run to maintain quality of goods and services and thereby maintain stability of the construction industry.

CONCLUSIONS

Different types of auctions used in sale of goods and awarding of contracts include the English, Dutch, Sealed first price and Vickrey auctions. The key features of each type of auction are discussed in the paper. Reverse auctions are essentially Dutch auctions. They have been used widely in sale of goods although their use in construction procurement is still relatively new. Published research on use of reverse auctions for sale of goods is reviewed. There is evidence that reverse auctions have the potential to lower procurement costs but may harm client-supplier relationships. The procedures for using reverse auctions in construction procurement are given followed by a discussion of their potential advantages and disadvantages. There is concern in the construction industry that using reverse auctions goes contrary to the Egan principles. There is also the perception that because reverse auctions focus exclusively on price, best value cannot be obtained. Guidelines for using reverse auctions in construction procurement are provided. It is argued that best value can still be achieved provided other factors are taken into account in contractor selection. Such factors include contractor's attitude to quality, health and safety record, experience of similar projects and track record in the industry. Training of potential bidders about the process is essential including transparency about the entire pre-qualification and online bidding process. Contractors and consultants who may find that they have to participate in online reverse auctions to win work would be well advised to always seek to include a reasonable margin of profit in the final bid prices.

Since use of reverse auctions in construction procurement is in its infancy, further research is needed if their potential benefits are to be realised. The challenges and risks associated with their use must also be appreciated. The first question that research should address is to identify the type of construction projects, products or services for which reverse auctions are suitable. The second is to assess the impact of using reverse auctions on purchasing practices in the construction supply chain. The

third is to identify the savings claimed from use of these auctions and the sources of such cost savings. A further area that research should address is the impact of reverse auctions on client-contractor relationships and specifically whether they hinder or help build trust - a key ingredient in modern construction procurement practice.

REFERENCES

- Bywell, C and Oppenheim, C (2001) Fraud on Internet Auctions, *Aslib Proceedings*, **53**(7), 265-72.
- Construction Industry Council (2005) *Online Bidding: A CIC Briefing Note*, available at www.cic.org.uk, accessed on 12th May 2005.
- Emiliani, M L (2000) Business-to-business online auctions: key issues for purchasing process improvement, *International Journal of Supply Chain Management*, **5**(4), 176-86.
- Emiliani, M L and Stec, D J (2002) Realising savings from online reverse auctions, *International Journal of Supply Chain Management*, **7**(1), 12-23.
- Emiliani, M L and Stec D J (2004) Aerospace parts suppliers' reaction to online reverse auctions, *International Journal of Supply Chain Management*, **9**(2) 139-53.
- Griffiths, A (2003) Trusting an auction, *International Journal of Supply Chain Management*, **8**(3), 190-4.
- Joia, L and Zamot, F (2002) Internet-Based Reverse Auctions by the Brazilian Government, *The Electronic Journal on Information Systems in Developing Countries*, **9**(6), 1-12.
- Klemperer, P (1999) Auction theory: a guide to the literature, *Journal of Economic Survey*, Vol. 13, 227-86.
- Liu, H Wang, S and Fei, T (2003) multicast-based online auctions: a performance perspective *International Journal of Benchmarking*, **10**(1), 54-64.
- Massad, V J and Tucker, J M (2000) Comparing bidding and pricing between in-person and online auctions, *Journal of Product and Brand Management*, **9**(5), 325-32.
- Potter, S and Lovatt, S (2002) Let the auctioneer/ manager beware, *Management Research News*, **25**(6), 50-9.
- Settoon, R and Wyld, D C (2003) The ski slope to prosperity: An Analysis of the potential impact of reverse auctions in government procurement in five Southeast Asian nations, *Asia Pacific Journal of Marketing and Logistics*, **15**(3), 3-19.
- Smeltzer, L and Carr, A (2003) Electronic reverse auctions promises, risks and conditions for success, *Journal of Product and Brand Management*, Vol. 32, 481-88.
- Stein, A, Hawking, P and Wyld, D C (2003) The 20% solution?: a case study on the efficacy of reverse auctions, *Management Research News*, **26**(5), 1-20.