USING ELECTRONIC REVERSE AUCTIONS IN PROJECT PROCUREMENT: PERCEPTIONS OF CONSTRUCTION CONTRACTORS

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This paper reports results of ongoing research which aims to evaluate the effects of using electronic reverse auctions in construction procurement on client–contractor relationships. Various types of auctions are firstly described. Origins and optimal bidding strategies under each type of auction are discussed. The principles and procedures for construction procurement using reverse auctions are evaluated. The advantages of using electronic reverse auctions in construction procurement are given. The criticisms which electronic reverse auctions have attracted are evaluated. Results of research data collected using self–completion questionnaires from large UK construction contractors is analysed and discussed. The research reveals that using electronic reverse auctions in construction procurement has potentially a detrimental effect on client–contractor relationships. Most UK construction contractors in the sample believe that construction procurement using electronic reverse auctions undercuts best practice. They also believe that if a client utilises this approach to construction procurement, they should expect retaliation from construction contractors in future business relationships in the form of higher prices. The results show that the uptake of electronic reverse auctions in construction procurement is actually low. Most construction contractors view electronic reverse auctions as a zero sum game which is used by client organisations to drive down bid prices.

Keywords: contractual relationships, electronic procurement, reverse auctions.

INTRODUCTION

Electronic reverse auctions have been used widely in many sectors of commerce and industry for procurement of goods and services. Their use is reported to provide clients with price reductions of the order of 20 percent, (Emiliani and Stec, 2002). A few clients have tried using reverse auctions for procurement of goods and services in engineering and construction. Contractors' organisations worldwide have voiced concerns regarding use of reverse auctions for procurement of construction projects. Most contractors and other stakeholders in construction projects take the view that using reverse auctions goes contrary to the principles of collaborative working, teamwork and partnering which have been developed in the industry in recent years. This paper firstly provides a review of the main characteristics of the various types of auctions. These include English auctions, Dutch auctions, sealed first price auctions, and sealed second price auctions or Vickrey take–it–or–leave–it auctions and candle auctions. Reverse auctions are essentially Dutch auctions. The attractions and major criticisms cited for reverse auctions are outlined. Results of a survey undertaken to

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evaluate the perceptions of the largest contractors in the UK construction industry towards use of reverse auctions in procurement of construction projects are given.

CHARACTERISTICS OF AUCTIONS

Auctions can be classified in various ways. They can be classified according to the characteristics and mechanics of the auction process. The most common auctions include the: English auction, Dutch auction, sealed first price auction, and the Vickrey auction. Some lesser used auctions include the Japanese auction, the take–it–or–leave–it auction and the candle auction. The English or ascending auction is still the most widely used form of public auction despite the development of various other types of auctions. This type of auction is suitable if the supply of goods is limited or if an item being sold is unique. In an English auction, the auctioneer starts the bidding process by announcing a low price for item. The seller can prevent the item from selling for less than this by placing a reserve price on the item. It should be noted that bidding does not always start at the reserve price. English auctions often begin below the reserve price and if the final bid price does not exceed this, the item is not sold. The bidding process continues with the auctioneer successively calling out higher bids for the item. The auction ends when no further bids can be obtained from the bidders. The item is sold to the most recent and the highest bidder. English auctions result in the item being sold to the highest bidder. However, the actual price paid will not be the highest valuation but in fact close to the second highest valuation. This is because from a bidder's point of view, rational bidding involves remaining in the competition until the price reaches the bidder's own valuation. Equally, no rational bidder will continue the bidding process once his last rival has dropped out of the competition. A bidder's dominant strategy is determined by the fact that he always wants to buy the item if the price is less than his valuation, but also he wants to pay the lowest price possible.

Dutch auctions are also called multiple items auctions. They are ironically called Chinese auctions in the Netherlands. The Dutch auction process is an exact opposite of the English auction. Here, the auctioneer starts by setting an extremely high price that is then successively lowered until is a bidder is prepared to accept the offer. Dutch auctions are better suited to perishable items such as flowers, vegetables or airplane seats. Used furniture stores often run Dutch auctions by reducing the price of unsold furniture items by some percentage say 10 per cent after regular intervals of time (Dixit and Skeath, 2004). The idea of predictable time discounting has also been used by bookstores. This means that the price paid is relative to the time i.e. the longer the auction goes on the lower the price. Rational bidding in a Dutch auction requires that the bidder has a clear valuation of the item being sold. It is inevitable that the auctioneer will start the bidding process at a price above this valuation. Rational bidding requires that the bidder waits until the price comes down into his range before considering to bid. If the buyer bids his own valuation, he is guaranteed a zero profit. Waiting longer before bidding will increase the bidder's profit. However, it increases the chances of losing the item to another bidder. The best strategy therefore involves bidding a shaded value of full valuation of the item. A Dutch auction is strategically equivalent to a first–price sealed auction which is described below. This strategic equivalence is due to the fact that no relevant information is disclosed in the course of the auction process but only at the end when it is too late to alter anybody's bidding behaviour.

In first–price sealed auctions, all bidders submit a bid without the knowledge of what rival bidders have submitted. The item is awarded to highest bidder. If there is a tie among the bids, the winner is chosen at random from those that submitted the highest bid. The price the winning bidder pays is equal to his submitted bid. In first–price sealed bid auctions, the bidder does not have the benefit of observing other bidders and their valuations. In this case, the bidder must decide between three options: (1) to bid their full valuation for the item; (2) to bid a shaded value of the full valuation; (3) to bid considerably under the valuation. If one bids his full valuation, the bidder would essentially get no profit if their bid were successful. Should the bidder bid considerably lower than his valuation, he is certain to lose the item to a rival bidder. Experienced first price bidders generally attempt to guess other bidders' valuations and bids slightly more. The optimal bidding strategy in this competition therefore is for the bidder to make an offer that is a shaded amount of their true valuation. In this way, the bidder has a good probability of winning the competition and making a profit as well. The higher the shaded value, the higher the profit but of course, the lower the probability of winning the bidding competition. This method is commonly used in UK construction procurement for awarding of contracts. However, in most cases, it is the lowest bidder that wins the auction.

The second–price sealed auction is identical to the first–price sealed bid auction except that the winning bidder is only required to pay the price of the second highest bid rather than the highest bid. It is also named the Vickrey auction after the economist who first noted that this second–price structure forces bidders to bid their true valuations. Second–price auctions are rarely used in practice. They are however useful for modelling bidder behaviour. From a bidder's point of view, bidding below one's true valuation for an item reduces the probability of winning the auction without altering the amount one would pay. Bidding above one's true valuation implies relying on someone else to bid your true valuation. If rival bidders bid less than your true valuation, then the bidder will receive the item with the profit being his true valuation minus the highest rival bid. However, this profit margin could have been achieved in the first place if the bidder had bid his true valuation in the first place. If rival bidders bid over your bid but under the true valuation, then they will receive the item. Bidding one's full valuation for the item is the optimal strategy in second–price auctions. Second–price sealed bid auctions are strategically similar to English auctions regarding bidding strategy and expected payoffs on the assumption that all bidders are risk neutral. This is because in each case the winner of the auction receives the item at the price of the second highest bidder. However, one difference between a second–price sealed bid auction and an English auction is that of informational transparency. In a Vickrey auction, the bidder is unable to obtain any information from the auction about other participants' bids.

Other less used auctions include the Japanese auction, the take–it–or–leave–it auction and the candle auction. The Japanese is also a sequential auction similar to an English auction. However, in this case the auctioneer regularly increases the price of an item at a predetermined rate. The bidders must signal at every price level their willingness to stay in the auction and pay the current price. Thus, unlike in an English auction, each participant must bid at each level to stay in the competition. The auction concludes when only one bidder indicates a willingness to stay in the auction. Once a bidder leaves the bidding process, he cannot re–enter.

The take–it–or–leave–it auction consists of the auctioneer making a series of take–it–or–leave–it offers to each of the bidders in turn. The bidders are made aware of the

order in which each bidder receives the offers and the amounts prior to the auction. After receiving an offer, the bidder has an allotted time to accept ("take") the offer, in which case the auction ends, or reject ("leave") the offer, in which case the auctioneer or seller may proceed to make other offers. After rejecting an offer, the bidder cannot make a further offer. This auction's key advantage unlike other auctions is that it achieves close to an optimal expected utility for the seller while allowing each bidder the opportunity to retain much of his private valuation information.

The candle auction is reported to have been the most widely used auction method until the turn of the 18th Century, (Dixit and Skeath, 2004). There are two main variations of this auction. The first variation involves lighting a short candle usually about one inch long. Bidding continues until it burns out, and the last bid made before it goes out is the one that stands. In the second variation, a pin or nail is stuck into a lit candle and the bidding stops when it falls out. As in the first instance, the last bid made before the pin falls out is the one that stands.

CONTRACTOR SELECTION USING REVERSE AUCTIONS

Reverse auctions utilises secure Internet Technology to enable contractors to participate in the tendering process. A reverse auction involves an auctioneer setting the starting bid and inviting bidders to compete is successive rounds of downward bidding. In construction, the client or his advisers will normally first go through a pre-qualification procedure. The client will normally desire as many bidders as possible to maximise competition and attempt to drive down the price. The pre-qualification will normally be based on experience on similar previous projects, financial strength of the contractor, etc. Pre-qualified bidders are then supplied with all the relevant information including drawings and specifications to enable them to put together technical proposals. Contractors are then invited to submit their technical proposals containing all relevant details except the price. The client or his advisers will then review the bidder's technical proposals and apply a weighting system to the various factors to indicate his initial preference. The weighting system may also be applied to the prices submitted at the reverse auction stage to take account of other factors in addition to price although this is not always the case.

In addition to project information, the client will also supply all bidders with instructions on how to participate in the reverse auction in advance of the event. The client must also provide software and relevant training to bidders who require it. The reverse auction is scheduled with a specified start and closing time normally between one and two hours. The process is carried out by a third party acting independently. However, it is debatable how independent these third parties are as they normally receive a fraction of the "profits" or any savings generated for the client. These third parties tend to be the IT Application Service Providers (ASP). It should be reiterated that the fees paid to them includes incentive compensation based on the level of savings achieved. Clearly, savings can be maximised by introducing more bidders to drive down bid prices, (Emiliani and Stec, 2004).

The auction process starts with the client setting the initial bid price. Bidders are then invited to participate in the bidding process by submitting successively lower prices. The reverse auction will close when no new bids are received and the closing time has expired. This means that if a bid is received immediately before closing time, the auction will be extended to allow bidders to re-submit a new bid. This time extension or auction overtime allows bidders the opportunity to react to "snipers" (bidders who submit a bid in the final minute of the auction) and minimises the opportunity for

pricing rings. This does carry a serious obligation for serious bidders to return to the auction at closing time and remain to participate in any subsequent extension periods. All bidders' identities will remain confidential during the auction. However, it may be obvious from the bidding patterns who the bigger and stronger participants are as their bidding may depend on their perception of the risks posed to them by the project. The submitted prices are ranked and communicated back to all the bidders. Based on this feedback, every bidder will be able to work out their own ranking in the competition at any time. Any bidder is able to resubmit as many new bids as they wish up to the closing of the reverse auction with their rankings being revised after each bid. Once no more bids have been placed and the time has expired the auction will close. All bidders will be notified of their final ranking position. The ASP also notifies the client of the final bidder rankings. The client will then reassess the bids by applying his weighting system to the bids to determine the bid that offers best value. Once this review is completed, the contract is awarded to the successful bidder against the criteria established at the outset.

ADVANTAGES AND CRITICISMS OF REVERSE AUCTIONS

In the UK construction industry, the use of revere auctions in bidding for construction work remains a subject of current debate. Online bidding for construction promises a number of advantages (Construction Industry Council, 2007). They are:

- Increased efficiency and reduced procurement costs.
- Reduction of overall project costs.
- Increased transparency and an audit trail for bidding documentation.
- Reduction in paperwork, postage, photocopying and costs of communication.
- Standardisation of the procurement process is possible;
- Reduce in procurement cycle time;
- Better control of bidders' submissions
- Increased competition among bidding contractors
- Easier comparison of bids
- A secure bidding environment is provided
- Increased confidence in the validity and integrity of contractual documentation
- It provides the opportunity for contractors to access competitors bid prices
- Contractors have the ability to submit more than one bid.
- Communication with multiple bidders is easier and speedy
- Preferred bidders for contracts can all be contained in a single database.

Online reverse auctions have become a popular method for procurement and reducing the cost of standard goods and services with clear and comprehensive specifications. However, their use has been criticised for procurement of complex services as those in engineering and construction projects. Criticisms which have been cited for using reverse auctions in construction procurement include the following:

- Reverse auctions may lead to contracts being awarded to a contractor quoting the lowest price rather than one who will deliver best value.

- Using reverse auctions contravenes good supply chain management practice.
- Reverse auctions can be used to drive down prices charged by incumbent suppliers.
- Reverse auctions are a divisive purchasing tool that may lead to deterioration of client–contractor relationships.
- Deterioration if client-supplier relationships can lead to retaliation by contractors in the form higher prices charged for change orders and extra work if ordered by the client.
- Contractors increasingly take the view that any benefits from reverse auctions and one sided and that indeed the use of reverse auctions is a zero sum game delivering benefits for only the client.
- Reverse auctions may delivers short term savings on procurement costs but the long term benefits of their use is debatable.
- There is normally insufficient time available for contractors to reassess their bids for complex engineering and construction services.
- The limited time available within which a contractor has to deal with multiple rounds of bidding can lead to reckless bidding practices.
- Many reputable contractors will not tender for projects where reverse auctions are used in the procurement process.
- A fraudulent client could introduce a fictitious contractor to help drive bid prices – a phenomenon known as shill bidding.

RESEARCH AIMS AND METHODOLOLOGY

This paper reports research work which is still in progress and has a number of aims. The first is to evaluate the theoretical principles underpinning various types of auctions to provide the context for a better understanding of reverse auctions. The research also aims to evaluate the extent to which bidder behaviour is influenced by the type of auction adopted by the client. The research further aims to assess the potential of using reverse auctions in construction procurement including an evaluation of the attractions and criticisms. The research is investigating the potential effects of reverse auctions on client–contractor relationships. Perceptions of major clients and contractors who have participated in reverse auctions will be sought and evaluated. Overall, a better understanding of the reasons why reverse auctions have attracted various criticisms will assist in drawing up guidelines to improve the project procurement process where they are adopted.

The data collection process involved initial contact with 119 UK construction contractors. This comprised the largest 100 UK construction contractors; 15 Scottish based construction companies from the CECA (Civil Engineering Contractors' Association) database and a further 4 International construction companies that were understood to be using reverse auctions in construction procurement. All these companies were initially contacted by telephone to ascertain whether they had actually ever participated in the bidding process involving reverse auctions and also to enquire whether the same firms would be willing to participate in a survey on the subject. Out of these 119 contractors initially contacted, 18 did not respond at all. 101 contractors (a response rate of 85 percent) responded to this initial enquiry either via telephone or

email or by letter. Out of the 101 contractors that responded to our initial enquiry only 17 had actually ever participated in bidding for construction projects using reverse auctions. This result reveals that the adoption of reverse auctions in construction procurement actually appears to be low.

Self-completion questionnaires were used for the collection of primary data because they provide a relatively inexpensive way to gather information from a wide geographical area. Self completion questionnaires were then sent to these 17 questionnaires to elicit detailed information and to ascertain their perceptions about the principles and process of reverse auction procurement. Clearly, it was not considered helpful to send questionnaires to the other 84 contractors who had no experience of bidding for construction projects using reverse auctions. However, a letter was sent to the CECA to ascertain the collective view of the Association and a reply was provided confirming that the CECA do not support use of electronic reverse auctions for procurement of construction projects and views them as inappropriate. The view from the CECA was considered essential because the organisation represents the interests of civil engineering contractors and has a membership in excess of 350 civil engineering contractors. Of the 17 contractors to whom self-completion questionnaires were sent, 11 completed and returned the questionnaires giving a response rate of 65 percent. Although the absolute number of respondents appears low, it is nevertheless a good proportion of those who have actually had the experience of participating in the procurement process involving reverse auctions. Of those companies that had participated 73 per cent had participated in 1-5 reverse auctions, 18 per cent had participated in 6-10 reverse auctions and only 9 per cent had participated in over 10 auctions.

ANALYSIS AND DISCUSSION OF RESULTS

Profile of the Respondents: The first section of the questionnaire contained questions that were designed to assess the background of the respondents. All participants who completed the questionnaire had more than 15 years experience in the construction industry. Respondents' job titles included supply chain managers, directors, managing directors, senior estimators, commercial managers, head of purchasing and business development managers. Those who participated in the survey were clearly senior level managers in contracting organisations. Sectors of the construction industry in which responding construction companies operate in were evenly spread across general building, civil engineering, process plant construction or a combination of these. The initial perception was that since reverse auctions were a relatively new approach to construction, only large construction companies were expected to be the major participants. This was surprisingly not the case. 55 percent of companies that responded to our survey had an annual turnover between £10-50m and 73 per cent employed less than 500 full time employees. In fact only 2 percent of the 25 top UK civil engineering contractors had in fact ever had the experience of participating in the bidding process involving reverse auctions. Considering the immense criticism which reverse auctions have attracted, this would suggest that the large companies have not participated because they do not need to for purposes of business survival. On the other hand, small companies that may not be in a position to pick and chose projects may apply for any project irrespective of the procurement process adopted.

Effect of Reverse Auctions on Corporate Overheads and Gross Margins: Research in other sectors such as manufacturing has revealed that using reverse auctions can reduce client organisations' overheads and create better profit margins. Reductions in

purchase prices of the order of 20 to 30 percent for materials and services have also been reported. In this research, we investigated whether participation in reverse auctions have any effects on construction company overheads and the effects of reverse auctions on corporate gross margins of construction companies. 91 per cent of the companies that participated in our survey stated that participation in reverse auctions had no effect on company overheads. Only 9 per cent reported a small increase. Regarding the effects of participating in reverse auctions on company gross profit margins, 73 percent of the companies reported no change; 9 percent reported a small decrease, 9 percent reported a large decrease and 9 percent in fact reported a small increase. Clearly, the effect of reverse auctions on corporate overheads and gross profit margins in the construction sector appears to be small for two reasons. The first is that a high degree of preparation is required when submitting a tender irrespective of whether reverse auctions will be used or whether it will be submitted using traditional means. The second reason is that work obtained through participation in reverse auctions has been a small proportion of the turnover of the companies that responded to the survey.

Are Electronic Reverse Auctions an Ethical Business Practice? In our survey, only 9 percent of the respondents agreed that electronic reverse auctions are an ethical business practice. Ninety one percent of the contractors took the view that electronic reverse auction are unethical. Ninety one percent of these companies also agreed or strongly agreed that reverse auctions are used by client organisations with the predominant aim of driving down contractors prices. On the reasons why contractors consider reverse auctions to be an unethical business practice, many contractors do not enter participation in reverse auctions by choice. A reasonable proportion of contractors (45 per cent) believe that they are forced by the desire for business survival to participate in bidding for work via reverse auctions. Only 37 percent take the view that they are not forced into participating in reverse auctions with the remaining 18 percent being neutral. One business development manager wrote: *"reverse auctions encourage collusion with our competitors. We actually received a telephone call from one of our competitors during the latter stages of the bidding. We ignored their request to confirm our involvement. We didn't win the works package in the end and became very suspicious of the process."*

Lowest Price Vis-à-vis Best Value in Awarding Contracts: Eighty two per cent of the contractors take the view that where reverse auctions are used in project procurement; contracts are awarded on lowest price rather than best value. On this same subject, 91 per cent of contractors agree that reverse auctions undercut best practices in supply chain management such as collaborative working, development of long term business relationships and joint capacity building and problem-solving. Fifty five per cent of the contractors also agree that using reverse auctions in procurement generally results in poor quality projects. Twenty seven per cent of the respondents were neutral and only 18 percent disagreed with the proposition that using reverse auctions results in poor quality projects. In fact, one contractor commented that a client who uses reverse auctions in the procurement process *"gets a cheap job done badly."* Another contractor stated that those winning contracts through reverse auctions could *"use alternative materials or construction methods without approval in an effort to reduce bid costs."* Asked whether using electronic reverse auctions was a positive development for construction procurement, 82 per cent disagreed/or strongly disagreed. Only 9 per cent agreed that reverse auctions are a positive development in construction procurement with another 9 per cent being neutral. It is clear from the

above responses that contractors perceive procurement using reverse auctions as being synonymous with lowest price rather than best value.

Effects of Reverse Auctions on Client Contractor Relationships: One of the major criticisms of reverse auctions is that they are a divisive tool that damages relationships between clients and their suppliers. Research in other sectors of business and industry has shown that clients have in some cases used reverse auctions to drive down prices without the willingness to switch suppliers. Seventy three per cent of the respondents to our survey reported no change in their business relationships with their clients in relation to use of reverse auctions. However, 27 per cent of the contractors however felt that using reverse auctions can affect client – contractor relationships in a negative way. To explore this further, we asked contractors whether as a result of their experience with clients using online reverse auctions, they would actively seek the opportunity to charge clients higher prices if an opportunity arose for example through claims or changes to specifications in the project. Fifty four percent of the contractors agreed that they would indeed do so as opposed to 46 percent who replied that they not. It is clear from this survey that construction contractors would actively seek retaliation against a client who used reverse auctions in construction procurement. This would be done where possible by actively seeking opportunities to charge higher prices for change orders or through contractual claims.

Time Available for the Reverse Auction Process: The real time pricing dynamic pricing system with a clearly defined time limit places immense pressure on bidders. This highly pressurised environment and lack of time to re-evaluate bids may lead to reckless pricing by some bidders to submit tenders that may lead to little or no profit. We asked construction contractors about the process and in particular whether reverse auctions offer sufficient time to contractors during the auction for reassessing their bids. Seventy three percent of the contractors disagree with this statement while 18% are neutral and only 9 per cent agree. This means that the vast majority feel that clients using reverse auctions should allow contractors more time to reassess their bids. Inadequate time for contractors to re-evaluate their bids can lead to a poor quality service or product or a high level of claims by the contractor to try to recoup all their costs and minimise any losses.

Modifications to Improve Electronic Reverse Auctions: In our study we were interested in whether electronic reverse auctions can actually be modified and if so how in order to deliver benefits for both the client and the contractors. The survey revealed that only 9 per cent of the contractors agree that this is possible. Fifty five percent of the contractors responding to our survey do not believe that electronic reverse auctions can be modified to deliver benefits to both clients and contractors while 27 per cent are neutral and 9 per cent do not know. In response to the open ended questions, one commercial manager stated that "clients would need to spend a lot of time and money in preparing tenders for reverse auctions to work however the civil engineering industry is not like a factory process and uncertainties will always leave gaps in the information provided. In response to the same question, a chief estimator commented *"lowest price does not automatically mean it is the best. What about quality, health and safety, environmental issues and all other drivers that are at the forefront of the industry?"* The estimator concludes by stating that using electronic reverse auctions in construction procurement should be banned.

CONCLUSIONS

The key features of various auction types have been discussed in this paper. These include English auctions, Dutch Auctions, sealed first price auctions, and Vickrey auctions. Some lesser used auctions also briefly described include the Japanese auction, the take–it–or–leave–it auction and the candle auction. The procedure for using reverse auctions in construction procurement is discussed. It is concluded the electronic reverse auctions are essentially Dutch auctions where contractors bid online against each other successively by lowering their prices in an effort to win the contract. The advantages and criticisms of construction procurement using reverse auctions are outlined. The rest of the paper details an analysis of data collected from leading construction constructors who have had the experience of participation in electronic reverse auctions.

Most contractors who participated in our survey take the view the using electronic reverse auctions in construction procurement is not an ethical business practice and that their use represents a retrograde step that ignores developments such as collaborative working and partnering that are have taken place in the industry in recent years. This survey revealed a case in which one contractor reported having received a request to join a "ring" from another competing contractor. The vast majority of construction contractors take the view that contractor selection using reverse auctions has as its basis lowest price rather than best value. Most contractors who participated in the survey also take the view that using reverse auctions has an impact on client–contractor relationships. Most contractors who participated in the survey confirmed that they would be prepared to retaliate against a client who uses reverse auctions in the procurement process by charging higher prices for change orders and through submission of claim. About the reverse auction process itself, most contractors also revealed that they would prefer an extended period to enable bid managers to confer with their colleagues before resubmitting revised bids. Most construction contractors consider use of electronic reverse to be a zero–sum game that is heavily weighted in favour of the client and against construction contractors. The analysis in this paper is based on a limited sample size. Further detailed research is therefore recommended. However, on the basis of the available evidence, it is difficult to see how electronic reverse auctions can have a long–term future for procurement of major projects in the UK construction industry.

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