Strategic sourcing Procurement on Internet-based Quoting system

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ABSTRACT

In this paper the supplier selection decision based on the internet-based quoting system is considered a complicated problem given its nature. For this matter, we follow a framework as two functions: cost factor and strategy factor. In Cost factor part we discuss the components of sourcing project and its related investment, the optimized cost function and results analysis. In strategy part we continue to discuss the dynamic bidding function and its influences on bidder strategy. Game theory will be used in strategic bidding analysis by illustrating three different scenarios under varied cost and qualification rate of bidders. The developed framework of bidding system supports the game theory and gives the deep thought on bidding strategy with customer willingness.

INTRODUCTION

Purchasing and sourcing part brought a high degree of international integration of goods, technology, labor and capital in recent years. The increasing globalization of economic development forces US companies to chase more profit not only on cost but also quality. The outsourcing part has increasingly adopted as component of reducing cost which is one of the most important strategic decisions in a company. The key decisive factors of right outsource from the customer stand point are quality, price and delivery time. Additionally, raw material and parts purchases from suppliers always show the main cost of a product. It is very important for customer to choose a suitable supplier, but in practical cases, the cost and quality for traditional purchasing process give US companies a lot of limitations from culture, geographic and quality considerations. One of the effective ways to improve efficiency of business is electronic market for both sides including supplier and customer. Prior to electronic business developed and applied in American retail industry, the bidding system in some business companies such like eBay, Amazon, etc validate the improvement of trade from efficiency and cost reduction point of view. The e-bidding system can be used to exchange information and make transactions for seller and buyer. The new alternative for US Company instead of traditional business purchasing process are adopted and called e-procurement bidding system. The open system enables firms to reach and transact with suppliers and customers in virtual and synchronous environment without the investment of transaction part. In the module of B2B procurement process, Qizhi Dai (2001) in his work mentions:

> According to a recent report, the value of goods and services sold via B2B electronic markets will reach $2.7 trillion by the year 2004, representing some 27% of the overall B2B market and almost 3% of global sales transactions. This growth is slated to occur in the context of a global market for B2B transactions worth $953 billion, growing to about $7.29 trillion by 2004. With more corporate procurement completed online every month, the number of virtual marketplaces in the United States has soared from 300 in June 1999 to more than 1000 in 2000. It is clear that by offering lower prices and a wider range of

suppliers, electronic markets are changing the way firms procure their materials, equipments and supplies.

The system platform gives suppliers and customers a marketplace to create value for their own benefit by competition in the bidding game. The exchange of demand and price helps customer take advantage of competition of bidding also helps suppliers cooperate with customer for efficient purchase process. If the e-procurement bidding system adopted successfully, the main advantages would be first, reduce transaction and material or components cost; second, reduce sourcing related costs; third, build long-term relationship with customer for better quality and competence; forth, the reduction of inventory level with long-term B2B relationship. With those advantages above, we will discuss basic mechanism part of the system and bidding theory-game theory and its applications.

DYNAMIC BIDDING SYSTEM MECHANISM

This section begins to focus on main concepts and some terminology of mechanism design. The physical layer in the system gives the bidder and buyer an environment for dynamic mechanism which followed by the allocation rule. In the second section we introduce a concept bidding process which also contains a mathematical statement of optimization problem of study. The behavior and willingness of also affect the bidding process which applied by game theory.

Bidding System Mechanism

It is usually defined as follows: its allocation rule determines whether each given market participant gets an item and, if appropriate, which one and when; its payment rule determines what each participant must pay as a result of the interaction (and if appropriate, to whom and when); the information structure describes the information available to each participant when trading decisions are made; and the strategy space describes how those trading decisions are expressed, that is the exact format in which participants provide competitive information. The basic rule of this theoretical mechanism is the customer listed the name and number items they requested, and the listed bidder (participants) contribute their prices list to system information structure, the physical function of the system will affect the allocation rule assigned price from high to low at the same time with detail of the evaluation information about bidders, which according to the payment rule and pre-evaluated qualification rate.

The recent study about the incentive of buyer in the bidding system shows us the fact is, in the dynamic bidding mechanism, the buyers are typically intended to buy the merchandise which characterized with high rate of qualification rate with maximize willingness. Although in the dynamic bidding system the primitive role of bidders is price with additional information attached. But the decisive factor in bidding system is evaluated by willingness of buyer based on the prices are known.

Decision Model Mechanism

Decision support system executive process is an effective decision making tool. It represents an efficient way of dealing with complexity and identifying the main components of a problem. It broke down the problem into sub-problems by decomposing a project into several hierarchies, the overall objective will be broke into several different criteria. The optimization model maximizes the total cost of buyer which corresponds to the requirement of participant's strategy. As the formula presented in section 3.1, dynamic bidding algorithm assumes cost expected to be minimize transportation and inventory cost during model analysis. Also, the much stronger restrictions they impose may result in optimal mechanisms yielding lower (predicted) revenue because the trade-off between restriction and cost always are on the buyer's side.

NOTATION

Decision node 1—Production Schedule:

- *Supplier:*

  s_i --Specified supplier (0/1 variable)

  p_i --Production capability

Decision node 2—Transportation:

- *Customer:*

  β_j --Distribution node

  δ_j --Manufacture location

  η_{ik} --Distance from supplier to Distribution node

  μ_{kj} --Distance from distribution node to manufacture

- *Supplier*

  δ_i --Manufacture location

  β_i --Distribution node (Port)

  μ_{ik} --Distance from manufacture to Port

Decision node 3—cost:

c_{ij} --Material marginal cost

p_{ij} --The price of supplier 1

p_{ij}' --The alternative price of supplier 2

l_i --The labor cost

h_i --Holding cost

x_{ij} --Transportation cost

d_{ij} --Demand

THE OPTIMIZED MODEL

The online sourcing model in this case is a reverse-auction procurement, the typical 1:N settings which means customer : supplier. Let v_k denotes the k -th order statistic, in the first price seal-bid: best-response, $B(v) = E[v_2 | v_1 = v]$; expected revenue, $E[B(v_1)] = E[v_2]$; In any efficient auction, the expected payoff to every bidder. The supplier is denoted as p_{ij} --Specified supplier (0/1 variable). The edge opportunity of any part of nodes from supplier to customer (δ_i , δ_j) can be determined by defining capacities p_{ij} of suppliers $p_{ij} \forall e_{ij} \in E$ and finding the maximum flow from δ_i to δ_j . The problem can be formulated by defining zero-one variables $s_i \forall e_{ij} \in E$, so that s_i =1, if the bidder is chosen for the supplier of product, i.e., $s_i \in E'$, and o otherwise. With transportation costs of $x_{ij} \forall e_{ij} \in E$, the linear function will be written as:

$$Minp = \sum_{e_{ij} \in E} x_{ij} p_{ij} \qquad (3)$$

$$\text{s.t.} \quad \begin{aligned} & \sum_{e_{ij} \in E} p_{ij} \geq 2 \\ & p_{ij} = p_{ji} \forall e_{ij} \in E \\ & p_{ij} = o \vee 1 \forall e_{ij} \in E \end{aligned}$$

DYNAMIC BIDDING ALGORITHM:

Use standard reports and dashboards to analyze supplier responses and compare specific line items and data to justify awards. Through dynamic roll-up calculations, the sourcing analytics capability enables profitable decision-making. The bidding system enabled by web-based bidding leveraging combinatorial bid optimization capability. Logistics and transportation optimized model combines inbound and outbound planning. Shipment optimization is implemented with dynamic routing guides. The assumptions of bidding procurement are as follow:

1. Each bidder known its own price and the other bidder's, all the price will be presented as a historical data on system platform, the authority of inspection only open for bidders and owners.
2. For any bidder, if all bidding price are higher than the benchmark, the bidder will withdraw from the bidding system.
3. If two or more bidders place the same cheapest bid, the system will choose one of them according to the qualified rank rate from high to low.
4. The bidder's information is unknown among bidders.

5. Modeling system can help user predict the outcome of alternative scenarios, allowing users to optimize inputs and streamline processes.

NE equilibrium and Description Environment

The objective of this problem minimizes the transportation cost, the constraints

$$\text{Matrix } p = \begin{bmatrix} p_1 & x_1 & q_1 \\ p_2 & x_2 & q_2 \\ p_3 & x_3 & q_3 \end{bmatrix} ;\ p_i < c_i, \qquad (4)$$

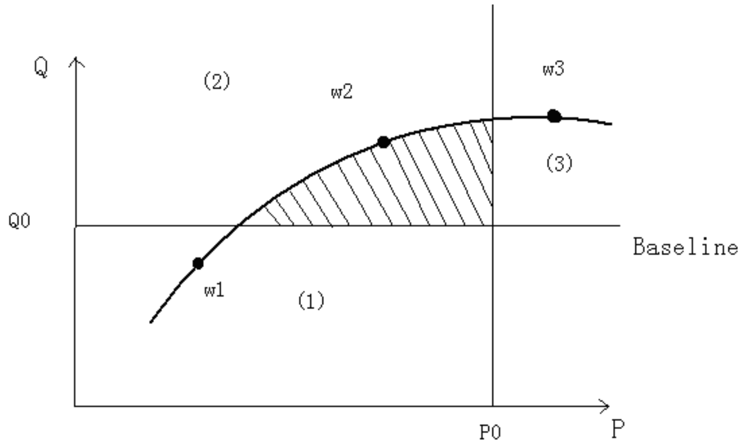
Where $p(p_{ij}, x_{ij})$ is bidder one's total cost supplying price with block 1 and 2. Total cost includes material cost, labor charge and transportation cost. For example, $p(2.2,1.3)$ is the total cost of block 1 and 2 of bidder 1's. Also, the qualified rate q_1 of bidder 1 is high; the willingness is high. The customer's willingness is high presents the acceptance of bidder over price in the matrix.

$$w(b) = \min p_{ij} \cap \max q_i \qquad (5)$$

A NE theory in this matrix is set as a strategy when the lowest price with highest rate. i.e., all the bidders bid for lowest price in order to win the bid $\min p(p_i, p_j)$ in NE bidding theory. That is not to say, the lowest price bidder will win the bidding. The algorithm to determine the combination of NE bid price is the combination(s) that presents the minimum total price of material and transportation cost, with qualified rate of bidders based on the cost matrix. The matrix shows an optimum combination of augmented price and willingness of customer in this reverse auction.

Factor Analysis of Bidding Game

As the proposition of Minimum Cost Network Flows says [1], the constraint matrix $w(b)$ arising in a minimum cost network flow problem is totally unimodular. The idea of bidding cost matrix approximation is to approximate a given function, so that the information cost is shown within given bounds. As a matrix example, consider linear function shown in Figure 1.



Proposition 1: zero acceptance level

With the given matrix and function $Minp$, (3) can be decomposed to sub-problems.
Let X be a cost-minimal flow pattern with flow value P when the first bidder's price set in area (1) as point w_1 , the matrix of bidder 1 will be shown as:

$$p = [p_1, x_1, q_1]$$
$$\text{'} \min \sum_{i=0}^{p} \{p_{ij}(w_1) + l_i + h_i + x_{ij}(w_1)\}$$

s.t

$$0 < p < p_0$$
$$q_i(w_1) \in \{q_0, \infty\};$$

The price $p_i(w_1)$ is presents in the accepted area which is lower than p_0, but the willingness matrix of bidder 1 is lower than q_0 which the constraint of $q_i(w_1) \notin \{q_0, \infty\}$. Even the price is the lowest line within bidders, but the acceptance of willingness is denied by customer. Therefore, area 1 is unaccepted area in matrix coverage.

Proposition 2: accepted level in bound

In this case, the acceptance of willingness is high causing $q_i(w_2) > q_0$, the deviation of price $p_i(w_2)$ is similar to case 1 with $0 < p_1 < p_0$ in area (2), the solution is the same as case 1, the only difference in optimum function is the constraint subject to $q_i(w_2) \in \{q_0, \infty\}$; the price $p_i(w_2) \forall \{p_{ij}(w_2), p_{ij}{'}(w_2)\} \in E$.

Proposition 3: maximum accepted level

In this case, the acceptance of willingness level $q_i(w_3) \in \{q_0, \infty\}$ is qualified but the price $\{p_i(w_3) > p_0\} \cap \left\{pi \in \left(p_{ij}, p_{ij}{}'\right)\right\}$ in this time is higher than the marginal cost which is set by customer, the solution of case 3 will compete with case 2 on total price. The proposed necessary and sufficient conditions are associated with NE bidding strategy in case 3. Therefore, the number of bid option of combination of the opportunity within second and third bidder.

$$
\begin{aligned}
&E_{p_{ij}} = \min \sum_{i=0}^{p} \{[p_{ij}(w_i) + x_{ij}(w_i)]d_{ij} + l_i + h_i\} \\
&s.t. \\
&q_{ij} \in \left\{ w_i(q_{ij}) \cap w_i\left(q_{ij}{}' \right)\right\}; \\
&q_i w_i \in (q_0, \infty)
\end{aligned}
$$

$$
\begin{matrix} l_i \geq 0 \\ hi \geq 0 \end{matrix} \quad \text{for} \quad \begin{matrix} l_i = 0,1,2\ldots m \\ h_i = o,1,2\ldots n \end{matrix}
$$

The customer's preference may vary according to the accepted willingness over price. For bidders, it's hard to predict the preference of customer, the bidder's price no longer is superior advantage. Contrarily, customer may choose higher price but qualified rate are higher than the lower price bidder's.

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