The Application of Game Theory in Enterprise’ Transaction of Purchasing

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Abstract: In the market economy, the cost of purchasing is one of the factors affecting the profit, so apply the theory of “dominant strategy” to the process of purchasing, the decision-makers can control the daily transaction of purchasing more smoothly, and thus to realize the purpose of controlling and reducing cost. Practice shows this model is fairly reasonable and scientific especially applying to the enterprises who need a great of material and have many suppliers.

Keywords: game theory; dominant strategy; purchasing; suppliers.

1. Introduction

With the constant improvement of the market economic system, and increasingly fierce competition among enterprises, Strategies in a variety of Competition, price competition without doubt is the most traditional, and the most common and the most effective way. But it is necessary that reducing cost is the basis of price competition, this requires enterprises to the production costs as low as possible to provide the market with the necessary products, otherwise, the business activities of the enterprises is invalid or negative results. Thus reducing and controlling cost are enterprises eternal topic. raw material procurement costs is one of their most important the factors in factors that affect the cost. And the purchase prices of materials is a major component of procurement costs, so how to purchase the lowest possible purchase prices of the materials needed to supply enterprises is the main body to resolve stated.

In this paper, the knowledge of game theory is applied to the procurement business of enterprises, among traditional procurement methods in the analysis of the shortcomings of the enterprise, a model based on game theory model of corporate procurement is developed. Practice shows that the model is a scientific and effective.

2. The Traditional Procurement Model Sample of Enterprises

The sample of enterprises (hereinafter referred to as "Enterprise") investigation found that the traditional procurement model: buyers seek suppliers according to purchasing for direct negotiations, in that case a reasonable price with the supplier contracts are signed by both parties after the contract is performance, Up to fulfill its contractual obligation. This traditional procurement model has two serious flaws making them difficult to complete the procurement of goods the lowest possible prices. One is from the same suppliers for the competition is insensitive, it is the lack of enthusiasm to lower prices to win orders; Second, it is difficult that enterprises supervises the procurement process, and sometimes for emotional factors of the personal, buyers not taken the initiative to require suppliers to lower prices. In view of this, scientific modes of procurement need to eliminate these two shortcomings.

3. "Dominant Strategy" to Establish Procurement Model Assumptions

Generally, the effectiveness of each participant is function of all the strategic in the game, but in some special games. No matter what other people choose to participate in the strategy, the optimal strategy is the only, this optimal strategy known as "dominant strategy"[2]. "dominant strategy" for the purchase of the model is needed for the establishment of the following assumptions:

1. There are four main body in the system: the buyer, the supplier armor, the supplier B, the election group of suppliers;
2. For a minimum value of the supplier's cost of sales is as follows:
Table 1 A Minimum Value of the Supplier’s Cost of Sales

<table>
<thead>
<tr>
<th>Name of suppliers</th>
<th>Supplier A</th>
<th>Supplier B</th>
<th>the election group of suppliers (E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The lowest sale cost</td>
<td>( C_a )</td>
<td>( C_b )</td>
<td>( C_e )</td>
</tr>
</tbody>
</table>

Which is: \( C_a \approx C_b \approx C < C_e \)

3. Buyer wants Procure of goods from the two suppliers;
4. The ultimate buyer’s purchase price for the supplier A and supplier B are the same, and consists of a mutually agreed price, assumption P for price;
5. The buyer purchases from suppliers source final offer low percentage of total procurement of goods, the ratio is X, The ratio of procurement from another 1-X, X>50%;
6. Suppliers do not lose money trading, the final bid price is not lower than the cost.

4. Discussion of the Use of Procurement Model

4.1 Analysis of strategy orders for suppliers

Orders in the competition, the other side is the inevitable loss of orders. To facilitate the discussion, the problem can be simplified to two persons zero-sum game (or matrix game)[1].

Assuming the same quotations is \( P_1 \) in the bidding parties in the first round, in time for get lower prices. The buyer decided to conduct a second round of offers, in the second round the two sides may choose to offer quotations (unit price) as follows :

\[
S_A = \{ P_{A1}, P_{A2}, P_{A3} \} \\
S_B = \{ P_{B1}, P_{B2}, P_{B3} \}
\]

this is in : \( P_1 \geq P_{B1} > P_{A1} > P_{B2} > P_{A2} > P_{B3} > P_{A3} \)

And supplier A win for the matrix :

\[
A = \begin{bmatrix}
  m & -m & -m \\
  m & m & -m \\
  m & m & m
\end{bmatrix}
\]

In the formula: \( m = (2x-1)/2 \)

It is clear to get more orders, suppliers A will give a minimum quotations \( P_{A3} \), at this time no matter what kind of prices B reported are not what the most important influence to the ultimate result. Enterprise get satisfactory results : \( P_2 = P_{A3} \).

4.2 Analysis of strategy of the sales profit which suppliers think

4.2.1 The win matrix of supplier A, B

In fact, the greatest concern of suppliers is the profit, so in practical application suppliers should consider whether the more orders will gain more profit. In upper analysis, supplier A only considers on orders and gives the lowest price \( P_{A3} \), if supplier A gives the price \( P_{A2} \), and the possibly most unfavorable results is the supplier B offers price \( P_{B3} \), supplier A only get \( \frac{1}{2} - m \) orders. Under two circumstances, the profits which supplier A get are calculated as follows :

No.1.circumstance: \( p_{r1} = (P_{A3}-c) \times (1/2 + m) \)

No.2.circumstance: \( p_{r2} = (P_{B3}-c) \times (1/2 - m) \)

When \( p_{r2} - p_{r1} > 0 \), supplier A would rather lose some orders (the loss is m) also reported \( P_{A2} \).

Based on the above analysis we can give win matrix of suppliers A when supplier A think about sales profits:
\[ P_{B1} = (p_{A1} - c)(1-x) - p_r^0 \]
\[ P_{B2} = (p_{B2} - c)x - p_r^0 \]
\[ P_{B3} = (p_{B3} - c)(1-x) - p_r^0 \]

In above formula: \( p_r^0 = (p_1 - c) \times (1/2) \).

Easy to prove when supplier A think about sales profits, these measures have ceased to be a "two persons limited zero-sum game".

To facilitate the discussion, and gives the supplier B win matrix as follows:

\[ A_u^0 = \begin{cases} 
(p_{A1} - c)(1-x) - p_r^0 & (p_{B2} - c)x - p_r^0 & (p_{B3} - c)(1-x) - p_r^0 \\
(p_{A2} - c)(1-x) - p_r^0 & (p_{A2} - c)(1-x) - p_r^0 & (p_{B3} - c)(1-x) - p_r^0 \\
(p_{A3} - c)(1-x) - p_r^0 & (p_{A3} - c)(1-x) - p_r^0 & (p_{A3} - c)(1-x) - p_r^0 
\end{cases} \]

4.2.2 Choice strategy of supplier A

When \((p_{A3} - c)(1-x) - p_r^0 \leq (p_{B3} - c)(1-x) - p_r^0\), supplier A don’t have initiative to quote the price \(P_{A3}\); when \((p_{A2} - c)x - p_r^0 \leq (p_{B2} - c)(1-x) - p_r^0\), supplier A don’t also have initiative to quote the price \(P_{A2}\), under this situation, supplier A only quote the price \(P_{A1}\).

4.2.3 Choice strategy of supplier B

Obviously, When supplier A offers the price \(P_{A3}\), to supplier B, what kind of prices are meaningless. When supplier A offers the price \(P_{A2}\), if \((p_{B3} - c)x - p_r^0 \leq (p_{A2} - c)(1-x) - p_r^0\), and supplier B have initiative to quote \(P_{B3}\), Otherwise, prices he quoted would have seemed meaningless. Similarly, when supplier A quote \(P_{A1}\), if \((p_{B2} - c)x - p_r^0 \leq (p_{A1} - c)(1-x) - p_r^0\), and supplier B have initiative to quote \(P_{B2}\).

4.3 Strategy analysis of buyers

In the second quotations buyer would like to see the minimum profit of supplier A and B, and supplier A and B hoped to increase their profit or loss of profits for the smallest, under this situation, supplier A and B may not create conflicts on quotations, and this is not what the buyer wants to see.

Given the above analysis, in the design of parameters X, it must have to stimulate the enthusiasm in which supplier quote minimum price, Their principle is guaranteed to achieve the desired results on the premise that value of X is as possible as minimum. The purpose of this design is that even though in adverse circumstances, and also have a certain interest, in order to encourage their active participation in future operations.

5. Other Discussion

5.1 about the election group of suppliers

In designing of the system, there is "the election supplier," but it has not been mentioned in the above analysis. Well, in the process of resolving this issue in the end what purpose?

Actual procurement work, a material often have a lot of suppliers, in such circumstances, enterprises have two choices: (1) choice a small number (such as the two mentioned above) suppliers to supply the materials; (2) choice a majority of suppliers to supply the goods and materials. Both options have advantages and disadvantages, the first to choose a scale procurement, Both the fixed procurement (such as negotiation fees, transportation costs, etc.), or the supplier’s profit is quite satisfactory, and because the greater amount of procurement from suppliers of the price and mode of payment and credit
period. The buyer and seller will be relatively easy to achieve the desired purpose. Shortcomings were due to the purchase of the business is concentrated in a small number of suppliers, and risk which supply chain failure is more. Advantages and disadvantages of the second purchase way are opposite with the first.

In a hypothetical model, the suppliers were selected can get a considerable number of orders from the buyer, this is not quite the temptation shortlisted suppliers, and encourage them to strive to reduce the cost of production or distribution cost. And Shortlisted for strength. This is tantamount to the selected suppliers to bring pressure, this is the result of pressure so that they will continue to take various measures maintain cost advantages so as to maintain a price advantage. In some extent this avoid the "selected group of suppliers " formed Union. Therefore, although "the election suppliers group" did not meet with the buyer's business, they play an active role in the procurement process. The selected suppliers is a dynamic group. When "the election group of suppliers," the individual has an advantage there, The selected suppliers should be borne out. Establish a "dynamic is the steady-state" mentality, because the only way to the dominant position is stable.

5.2 About "selected group of suppliers"

As opposed to "the election group of suppliers," supplier A and suppliers B can be called: selected group of suppliers. In the assumption, at the convenience of analysis and discussion, only two selected list of suppliers. How much the number of elected is appropriate in real work? In considering this issue we should take into account two factors : the total amount of procurement and the operating scale suppliers.

Although no literature on this issue for discussion, However, I believe that in a first period from the procurement of materials selected suppliers accounted for 33% to 10% of the very scale of operation a wide margin. More rate easily lead to Enterprise happen on the crisis of supply chain when suppliers occur major changes in internal, a small percentage Will not cause of supply interest and achieve the desired objectives. So when the total procurement scale is more we may appropriate choose suppliers, contrary fewer suppliers election. General suitable 2-5.

5.3 Practical cases

From the above analysis it is not difficult to find the model applied to purchase a large quantity of procurement, often procurement, there are more supply situation. To ensure the normal operation of this model, in actual operation the buyer should set up specialized agencies for responsibility. To achieve a better result, the specialized agency deals with a more detailed understanding of various suppliers.

6. Conclusion

Indeed in the survey sample enterprises, since 2005 the procurement of coal in the winter to achieve the desired results using this model. Whether the purchase price or credit period is better than in previous years. After it, in early 2006 in the steel business we also quoted the method of procurement, and achieved good results, a 70% decrease in the number of steel supply, the lower the price, got the credit cycle from ISPs have two weeks to three months from the original and eased the financial tension, the suppliers reduce so that the exchanges of financial management of the financial sector also facilitate.

References


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