Research on Game of the Interaction between Government and Enterprises in the Construction of Information network
——Analysis on the perspective of Shanxi Sci-Tech SMEs

Guo Yu-Bing a, Liu Jieb, Zhai Zhi-Bin a,b*

*Taiyuan University of Science and Technology Taiyuan, P.R.China
bTaiyuan University of Science and Technology Taiyuan, P.R.China

Abstract
From the point of game theory, this paper studied on how could it achieve the Pareto Optimality between the government and High-tech SMEs in Shanxi. From this way, we can find the important key factor that effect the construction of information network platform, that is, the government technical service and support and the degree of awareness of SMES to the information network platform.

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1. Introduction
In the soft science project ‘Research on the Development of Science and Technology Small and Medium-sized Enterprises (Here in after to be referred as Sci-Tech SMEs) Service System in Shanxi’, she hosted in 2006, Ph.d Guo Yu-bing has proposed: Being the indispensable element of the development of Shanxi Sci-Tech SMEs, the construction of information network platform requires the joint efforts of

* E-mail address: icesnow80@sina.com; Tel:+8613834216489

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the government and Sci-Tech SMEs of Shanxi province. Then, how could they achieve the Pareto Optimality? This paper research on it by the game theory and the ideas are as follows:

- Both government and Sci-Tech SMEs of Shanxi province are principal parts in the game
- Both parts will not support the construction of information network platform unless they could maximize their benefits
- Actually, the construction of information network platform can benefit them, that is, government can save costs and improve efficiency, Shanxi Sci-Tech SMEs can improve efficiency and earnings rate. Therefore, both sides can achieve the maximum effectiveness from the information network platform
- If one side is positive, while the other is negative, in the implementation of information network platform construction. The positive side will obtain greater benefits than the other side, because it could improve efficiency and reduce costs unilaterally
- If both sides rejected the information network platform, the effectiveness of both sides are minimum. That is the inefficiency and high cost original government model

2. Assumptions of Model And Definitions Of Study

According to the above ideas, the paper analyzes the strategies of both sides by establishing game model. Above all, we take a assumptions of the model:

- Firstly, the paper analyzes the model in a given environment. All the factors affect the model in the game are behavior or strategies of Sci-Tech SMEs and government in Shanxi province. They are endogenous. Other exogenous factors, such as uncertainties of the economy of the state, social situation or war etc are not considered;
- Secondly, the utility theory and cost-benefit theory are applicable in this model;
- Thirdly, the strategies that government and Sci-Tech SMEs of Shanxi province use in the game follows the principle of utility maximization;
- Fourth, It is proposed that both the government and Sci-Tech SMEs of Shanxi province are rational in the game and they will choose the most appropriate game strategies for themselves.

3. Game Model

The strategies that government and Sci-Tech SMEs of Shanxi province use in the game can be expressed as:

\[ S = \max_F (x_1, x_2) \quad (x_1 \in X_1, \quad x_2 \in X_2) \]

In the above formula, ‘\( S \)’ is the outcome of the game, ‘\( \max_F (x_1, x_2) \) ‘is the game function of ‘\( x_1 \)’ and ‘\( x_2 \)’, ‘\( x_1 \)’ is the strategies the government use in the game, ‘\( X_1 \)’is the collection of the government's strategies, ‘\( x_2 \)’ is the strategies the Shanxi Sci-Tech SMEs use in the game, ‘\( X_2 \)’ is the collection of the Shanxi Sci-Tech SMEs’ strategies. Then, the effectiveness of government can be expressed as:

\[ T(X_1) = T(a, b, c) \]

In the above formula: ‘\( a \)’ is the fund the government invested, ‘\( b \)’ is the degree of technical support and services, ‘\( c \)’ is the extent of e-government construction.

The effectiveness of Shanxi Sci-Tech SMEs can be expressed as:

\[ T(X_2) = T(d, e, f) \]

In the above formula: ‘\( d \)’ is the awareness level for Shanxi Sci-Tech SMEs to construct the information network platform, ‘\( e \)’ is the cost to construct information network platform for Shanxi Sci-
Tech SMEs, 'f' represents whether a Shanxi Sci-Tech SMEs involved in the construction of information network platform actively.

So, in the construction course of information network platform, the total utility of government and Sci-Tech SMEs of Shanxi province can be expressed as:

\[ TU = T(X_1) + T(X_2) \]

According to the analysis, the research draws effectiveness table of government and Sci-Tech SMEs of Shanxi province respectively as shown in Table 1 and Table2.

Table 1. Effectiveness of government of Shanxi province

<table>
<thead>
<tr>
<th>The investment extent of government (a)</th>
<th>The level of technical services and support (b)</th>
<th>The level to construct the information network platform (c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>low</td>
<td>low</td>
<td>low</td>
</tr>
<tr>
<td>Effectiveness of government</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 2. Effectiveness of Shanxi Sci-Tech SMEs

<table>
<thead>
<tr>
<th>The awareness degree of enterprise to the construction of information network platform (d)</th>
<th>The input of enterprise to the construction of information network platform (e)</th>
<th>The participation degree of enterprise to the construction of Information network platform (f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>low</td>
<td>low</td>
<td>low</td>
</tr>
<tr>
<td>Effectiveness of Shanxi Sci-Tech SMEs</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

From the effectiveness tables of government and Sci-Tech SMEs of Shanxi province, it can be seen that there are three main factors influencing the effectiveness of government, that is, the investment extent of government (a), the level of technical services and support (b) and the level to construct the information network platform (c). Meanwhile, the factors affect the effectiveness of Shanxi Sci-Tech SMEs are three too, that is, the awareness degree of enterprise to the construction of information network platform (d), the input of enterprise to the construction of information network platform (e) and the participation degree of enterprise to the construction of Information network platform (f). It also can be seen from the table that the six factors affect the total effectiveness of government and Sci-Tech SMEs of Shanxi province together during construct the information network platform. Therefore, the research combines all the six effective factors in accordance with their different levels, and then, analyzes the impacts that come from different level of combinations factors to the total utility, in order to find out the combination that can maximize the overall effectiveness by analysing the structure.

For the effectiveness of the government: \( T(X_1) = T(a, b, c) \), which is shown in Table 1

- When the factors ‘b’ and ‘c’ are fixed, if the investment extent of government is higher, the utility it get will be 5; if the investment extent of government is lower, the utility it get will be 3;
- When the factors ‘a’ and ‘c’ are fixed, if technical support and services by government could be guaranteed, the utility it get will be 6; if they are not guaranteed by government, the utility it get will be 2;
When the factors ‘a’ and ‘b’ are fixed, if the level of construction of government information network platform is higher, the utility it get will be 5, if the level is lower, the utility it get will be 2;

For the effectiveness of Shanxi Sci-Tech SMEs: \( T(X2) = T(d, e, f) \), which is shown in Table 2

- When the factors ‘e’ and ‘f’ are fixed, if the attention of Sci-Tech SMEs to the construction of information network platform are more, the utility they get will be 6, if the attention are less, the utility they get will be 3;
- When the factors ‘d’ and ‘f’ are fixed, if the input of SMEs to the construction of Information network platform actively, the utility they get will be 5; if they participate in the construction of Information network platform negatively, the utility they get will be 3.

By analyzing the Table1 and Table 2, we can combine the variety factors that influence the construction of information network platform and get the strategy combination that maximize the effectiveness of government and Sci-Tech SMEs of Shanxi province, which be shown as Table 3.

Table 3. Analysis of total utility of government and Sci-Tech SMEs of Shanxi province

<table>
<thead>
<tr>
<th>Shanxi Sci-Tech SMES</th>
<th>The awareness degree of enterprise to the construction of information network platform ((d))</th>
<th>The input of enterprise to the construction of information network platform ((e))</th>
<th>The participation degree of enterprise to the construction of Information network platform ((f))</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Government</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The investment extent of government ((a))</td>
<td>high (x) 5, 6 low (1-x) 3, 6</td>
<td>high (y) 6, 6 low (1-y) 2, 6</td>
<td>high (z) 5, 6 low (1-z) 2, 6</td>
</tr>
<tr>
<td>The level of technical services and support ((b))</td>
<td>high (y) 6, 6 low (1-y) 2, 6</td>
<td>high (z) 5, 6 low (1-z) 2, 6</td>
<td></td>
</tr>
<tr>
<td>The level to construct the information network platform ((c))</td>
<td>high (z) 5, 6 low (1-z) 2, 6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As shown in table 3, ‘r’, ‘w’, ‘u’, ‘x’, ‘y’ and ‘z’ represent the probability of different strategies of government or Sci-Tech SMEs of Shanxi province respectively, for example, ‘r’ is the probability when the awareness degree of Sci-Tech SMEs to the information network platform is higher, so ‘1-r’ is the probability when the awareness degree of Sci-Tech SMEs to information network platform is lower. Each combination of numbers represents a policy mix for government and Sci-Tech SMEs of Shanxi province, for example, the combination (5, 6) in the third column and third row, it is the utilities of government and Sci-Tech SMEs when both the investment extent of government and the awareness degree for Sci-Tech SMEs to information network platform are high, at that time, the effectiveness of the government is 5, and the effectiveness of Sci-Tech SMEs is 6. We should choose the strategy combination that both the effectiveness of government and Sci-Tech SMES are high. By the help of the above tables, we try to find the best strategy mix of the game.
4. Best Model

It can be drawn from the formula $TU = T(X1) + T(X2)$: Getting the maximize strategy combination of overall effectiveness, which requires meeting the $T(X1)$ and $T(X2)$ maximum at the same time. So, in all the decision-making combinations, the one which total utility is the highest should be chosen. From Table 3, it is easily seen that when both the level of government technical service and support as well as the degree of awareness of Sci-Tech SMEs to the information network platform are high, the decision-making combination makes the overall effectiveness of the government and Sci-Tech SMEs maximum. At that point each utility is 6, the total utility is 12. In this strategy mix, the effectiveness of government and Sci-Tech SMEs are the highest of all.

5. Conclusion

Through the research it can be found: Both the government technical service and support as well as the awareness of Sci-Tech SMEs of Shanxi province to the information network platform play vital role in the construction of information network platform. The information network platform is a kind of network office mode emerging in recent years, and it changes the old-fashioned office mode. Because the acceptance of new things for people is limited, they cannot comprehend difference between the network and the traditional office modes, so they don’t know the benefits of information network platform. The traditional idea affects and hinders the construction and development of information network platform. Even though some enterprises have accepted and used the information platform, they didn’t have the professionals. At this time, the technical services and support of government is a great help for the enterprises who have established information platform. It could help enterprises use the information network correctly and guide them to track into the office network. So we can draw the conclusion: In all these factors, the technical services and support of government as well as degree of awareness of Sci-Tech SMEs to the information network platform influence the effectiveness of government and Sci-Tech SMEs of Shanxi province most greatly.

At the same time, other factors also affect the construction and development of Shanxi Sci-Tech SMEs Information network platform, government and corporate investment are the foundation for the platform, purchasing of equipment, network installation and training inter-disciplinary talents are essential for the platform. So all the factors mentioned are key factors in the development of information platform, and can not be ignored.

References