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Supply Chain Knowledge Innovation in Chinese Computer Manufacturing Industry

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Abstract: The factors of the knowledge innovation in computer manufacturing industry supply chain is analyzed in this study based on the literature on computer manufacturing, supply chain and knowledge innovation and a influencing factor system of service oriented manufacturing industry supply chain knowledge innovation is constructed. Then, the ability of knowledge innovation of technical, management and market is taken as the input factors and the income rate of net assets is taken as the output factor to construct a Data Envelopment Analysis mode (DEA) according to the characters of supply chain. According to the quantity relationship of the input and output factors in DEA model, the effect to computer manufacturing supply chain knowledge innovation from the ability of knowledge innovation of technical, management and market can be analyzed. The communication equipment industry is taken as a typical example to verify the effect of the influence factors.

Key words: Chinese computer manufacturing, supply chain, knowledge innovation, influence factor, data envelopment analysis (DEA)

INTRODUCTION

The global is in transition from commodity economy to the computer economy with innovation and service gradually becoming the core of the whole economic value. For one thing, the manufacturing industry is undergoing a profound change in which service industry related to consumer closely goes ahead of the pure manufacture industry. According to Dele company research report "based on global service and parts management research" shows that in the survey of 80 manufacturing companies, service income account for more than 25% in average of all the sales, furthermore,19% of the manufacturing company's service income take up more than 50% in the total income (Hilletofth, 2009). In addition, research company Andy Neely on global 13000 manufacturing listed companies provide services were studied and the results show that the developed countries manufacturing service level obviously is higher than is in the process of industrialization in the country, manufacturing service level and regional economic development into positive correlation. Computer manufacturing industry as a typical service industry, the competitiveness of the ascension is mainly embodied in the supply chain knowledge innovation, therefore, the computer manufacturing supply chain knowledge innovation performance evaluation study is very necessary.

The present study on computer manufacturing supply chain knowledge innovation performance evaluation is rarely issued. Many researchers focus much more on enterprises organization learning between supply chain members. Li think enterprises should share and use downstream enterprise knowledge, so as to enhance the core competence of the entire supply chain. between enterprises learning behavior, he thought that the supply chain knowledge flow and logistics, capital is different, not only in the adjacent node flow between enterprises, but common learning to create total value is far more than the sum of the respective member enterprises. Zhou puts forward the supply chain knowledge innovation network model through the supply chain knowledge innovation network elements, the members of the supply chain knowledge innovation network relations and the members to complete three aspects of the research.

LITERATURE REVIEW

The present study on computer manufacturing supply chain knowledge innovation performance evaluation is rarely issued. Many researchers focus much more on enterprises organization learning between supply chain members. Li *et al.* (2005) think enterprises should share and use downstream enterprise knowledge, make the member enterprises with the supply chain knowledge

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in motion will rise in value unceasingly, so as to enhance the core competence of the entire supply chain. Muckstadt *et al*. (2001) studies the supply chain nodes between enterprises learning behavior, he thought that the supply chain knowledge flow and logistics, capital is different, not only in the adjacent node flow between enterprises ,but common learning to create total value is far more than the sum of the respective member enterprises. Zhou and Wang (2009) puts forward the supply chain knowledge innovation network model through the supply chain knowledge innovation network elements, the members of the supply chain knowledge innovation network relations and the members to complete three aspects of the research.

FACTOR ANALYSIS

A typical computer industry has the customer involved in the process, so as to product service integration, a full range of services, regular scale production, flexible manufacturing network. Christopher describes that supply chain is an organization network, which involves the organization from upstream to downstream, in different activities customer products or services have values through final deliveries.

Computer manufacturing supply chain structure is retail manufacturers, core manufacturers, major distributors as the main node organization networks. The knowledge innovation refers to the customer demand as the guide, member enterprises to jointly implemented knowledge innovation of nodal enterprises of the supply chain including independent knowledge innovation and supply nodes between enterprise's knowledge sharing.

Computer manufacturing supply chain knowledge innovation main body can illustrate from enterprise microscopic and national macroscopic. Amply supply chain, from microscopic perspective a single enterprise supply chain innovation main body shows that constitute the main body of enterprise knowledge supply chain system is mainly technical workers-R and D personnel-sales-entrepreneurs (Liu, 2008). Among them, the entrepreneurs as knowledge supply chain managers, organizer, is the core of enterprise knowledge supply chain subject, in the chain plays a leading role. Entrepreneurs through the regulation knowledge innovation resource allocation and use, can effectively coordinate and integrate other of the main body of the behavior innovation activities, in order to reduce the transaction cost. The other main body plays the role of participation, cooperation, makes specific innovation behavior. National macroscopic level of supply chain in knowledge innovation main body refers to analyze respective situation as a whole (Li, 2010). Therefore, put the whole chain in the national innovation system in macro level and supply chain knowledge innovation embodies in the national science and technology resources allocation of various search of knowledge economization process, its final action goal is to improve national core competitiveness and international status.

The classification of knowledge innovation is regarded as the highest degree in style. It will look on a computer manufacturing industry supply chain as a whole, the knowledge innovation take final role in three aspects: Firstly, raise the level of technology, then improve the management ability of ascension and prompt the ascension of the sales ability (Chen *et al*., 2010). That

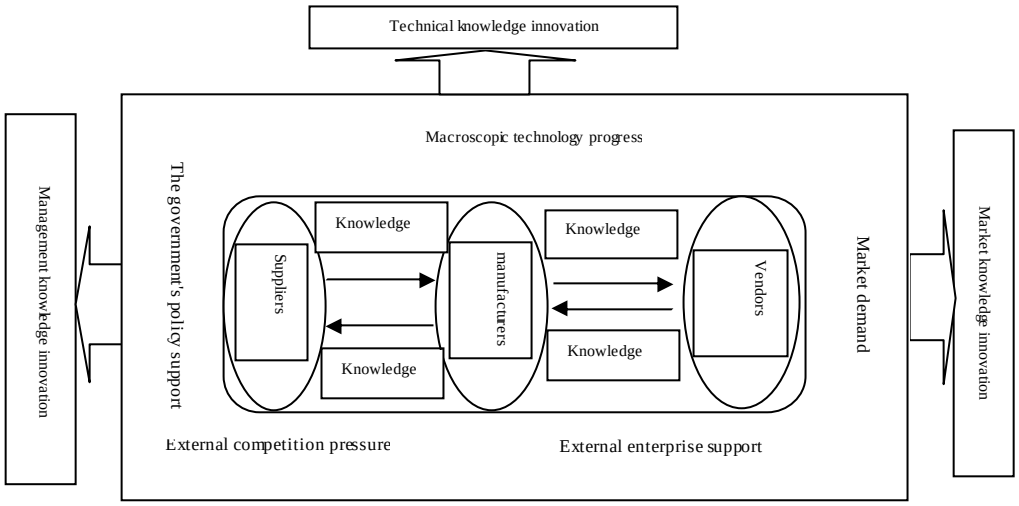

Fig. 1: Structure of influence factors

is to say, the supply chain enterprise's knowledge innovation can be summarized as three categories: Final technical knowledge innovation, management innovation, market knowledge innovation, such as the fallowing picture.

MODEL ANALYSIS

Factors selection: This study selects the factors which influence the supply chain knowledge innovation as the input variables (Li *et al*., 2010), to evaluate the supply chain knowledge innovation ability. The final output result of the innovation ability is that increasing of industries rate embellish. But using the simply profit margin as evaluation index is not enough to explain relative income situation in industry scale. So, we choose industry return on equity as final evaluation index.

As already mentioned, there are many influence factors of each enterprise innovation, including node enterprise itself and the whole supply chain between enterprises knowledge innovation. And which as a supply chain, its knowledge innovation is for the performance of the three forms: Technical support innovation, management knowledge innovation and market knowledge innovation (Kudyba, 2006). Because of the interaction between the nodal enterprises difficult to get powerful data to explain, so we will make supply chain as a whole to complete the knowledge innovation performance evaluation (Modi and Mabert, 2007).

In this study, the content is the evaluation for different period supply chain knowledge innovation of the longitudinal comparison and selecting management knowledge innovation, technology knowledge innovation, market knowledge innovation as the input index, the return on equity as output index. Based on the ach index score from statistical yearbook, we finally obtain input index system of each index and construct the DEA model.

Evaluation process: By the statistical yearbook, we select the data of computer industry in 2002-2010, which can reflect the relative ability of the technology knowledge innovation, market knowledge innovation and management knowledge innovation on supply chain. Then, we carries on the Data Envelopment Analysis (DEA) (Tan and Guo, 2007). The input variables include management innovation input relative value (X_1), technology innovation investment relative value (X_2), market innovation investment relative value (X_3) and output is return on equity (Y). Next, we make the list of sample data statistics, such as Table 1.

Table 1: Sample data statistics

	Y	X_1	X_2	X_3
2002	0.0478	1.825	0.21	0.0376
2003	0.0489	1.891	0.223	0.0421
2004	0.0544	2.465	0.235	0.04
2005	0.0494	1.892	0.301	0.0402
2006	0.0571	2.252	0.231	0.0383
2007	0.0593	2.459	0.243	0.0415
2008	0.0571	2.278	0.218	0.04
2009	0.0591	2.646	0.231	0.0446
2010	0.0762	3.719	0.275	0.0587

Table 2: Output data

Firm	Crste	Vrste	Scale	
1	1.000	1.000	1.000	-
2	0.987	0.991	0.996	drs
3	0.923	0.945	0.967	irs
4	0.997	1.000	0.997	drs
5	1.000	1.000	1.000	-
6	0.971	0.985	0.986	drs
7	1.000	1.000	1.000	-
8	0.959	0.970	0.989	irs
9	1.000	1.000	1.000	-
Mean	0.982	0.989	0.993	

We take the above data into linear planning model, such as equation 4.2 and substitute DEAP software to carry on the calculation. Using the data in 2002 as the base for comparison, we can analysis computer manufacturing scale economic benefit situation in the existing each innovation factor weight, such as Eq. 1:

$$\begin{aligned}
&\text{Max} \quad h_1 = 0.478\,u\\
&\text{s.t.}\ \ 1.835_{v1}+0.210_{v1}+0.0376_{v3}-0.0478u\geq 0\\
&1.891_{v1}+0.223_{v2}+0.0421_{v3}-0.0489u\geq 0\\
&2.465_{v1}+0.235_{v1}+0.04_{v3}-0.0544u\geq 0\\
&1.892_{v1}+0.301_{v1}+0.0402_{v3}-0.0494u\geq 0\\
&2.252_{v1}+0.231_{v1}+0.0383_{v3}-0.0571u\geq 0\\
&2.459_{v1}+0.243_{v1}+0.0415_{v3}-0.0593u\geq 0\\
&2.278_{v1}+0.218_{v1}+0.04_{v3}-0.0571u\geq 0\\
&2.646_{v1}+0.231_{v1}+0.0446_{v3}-0.0591u\geq 0\\
&3.719_{v1}+0.275_{v1}+0.0587_{v3}-0.0762u\geq 0\\
&1.825_{v1}+0.21_{v1}+0.0376_{v3}=1\\
&u\geq 0,\ vi,\ v2,\ v3,\in v
\end{aligned}$$

DEAP software operates the results from the scale income situation, factor weight and expected input variables and output aspects in the data analysis. The scale profit condition list (Table 2) shows the comprehensive results that, 2002, 2006, 2008 and 2010 years of knowledge innovation activities produced a relatively good economic benefit and in 2003, 2005, 2007 years of knowledge innovation, there are some problems (Wang, 2007) and its effect for the performance of the scale diminish returns.

In 2004 and 2009, the performance of knowledge innovation activity shows economic benefits increasing. At the same time, DEAP software have the data been

Table 3: Factor weight

	X_1	X_2	X_3
1	1.000		
2	0.099	0.101	0.800
3	0.662	0.047	0.290
4	1.000		
5	1.000		
6	0.115	0.885	
7	1.000		
8	0.105	0.895	
9	1.000		

Table 4: Expected input and output

	X_1	X_2	X_3	y
1	1.825	0.210	0.038	0.048
2	1.875	0.221	0.038	0.049
3	2.129	0.224	0.038	0.054
4	1.892	0.301	0.040	0.049
5	2.252	0.231	0.038	0.057
6	2.421	0.236	0.041	0.059
7	2.278	0.218	0.040	0.057
8	2.429	0.224	0.042	0.059
9	3.719	0.275	0.059	0.076

adjusted. In the output invariable situation, it optimizes the input combination and makes the scale economic benefit maximize, such as Table 3, 4.

Model evaluation: DEA method can fully consider for decision making unit itself optimal input-output scheme and thus be able to reflect more ideal evaluation object own information and characteristics; At the same time for the evaluation of complex system into many more output analysis has unique feature (Xu, 2010). Therefore, based on the DEA model can reflect the ideal of 2002-2010, different technological innovation, management innovation, market innovation under the situation of economy of scale profit condition. But DEA can handle input and output item number is not without limitation, each adding a input or output will increase several input-output ratio, leading to the DEA model identification ability to drop, so the amount of data is required.

CONCLUSION

To realize the sharing of the demand-oriented technical knowledge innovation: Understandable, for a manufacturing enterprise, the technical innovation is the impulsion of its survival and development. As a product and service integrated maker, the purpose of computer manufacturing enterprise's knowledge innovation is not only promoting the performance of the product, but a full range of further fit the demand of customers results. As a supply chain system, the node enterprise's technical knowledge innovation will transfer to other enterprises on supply chain by knowledge sharing for free or not. Therefore, the effect of knowledge sharing between enterprises on supply chain could affect the result of technology innovation. Knowledge sharing between enterprises need certain trust foundation and knowledge sharing intention between enterprises. It can pass though a project team, established technology exchange and training.

It can make the technical knowledge innovation achievement satisfy diversity, personality demand of the customer that managers use customer demand as the guide of technical knowledge innovation (Yang and You, 2006). Sharing technical knowledge between supply chain enterprises can enlarge the knowledge innovation effect and produce a chain of knowledge innovation achievements. Such, it can not only ensure the computer manufacturing industry supply chain knowledge innovation effectiveness and can make knowledge innovation effect to realize optimal.

Making different systematic management knowledge innovation: For each enterprise, the effective management method is not the same. Supply chain management knowledge innovation includes two levels. First, the management of enterprise on supply chain requires implement differentiation management on the basis of understanding each enterprise, to ensure the enterprise benefits (Yu and Han, 2009). At the same time, implementing systematic adjustment realize resource optimal allocation and the enterprise collaborative development. On the other hand dealing with each node enterprise internal management knowledge innovation, enterprise can profit from each other and combined with the enterprise's own condition, then, make the most suitable management measures (Wu and Liu, 2006).

Making difference to the each node enterprise management can realize management effectively. The systematic management of node enterprise knowledge innovation can realize computer manufacturing industry supply chain enterprise's resource allocation optimization and the coordinated development between enterprises.

Making Accurate position and effective market knowledge innovation: As a typical computer manufacturing industry, the computer manufacturing industry is the most promising manufacturing industry. Market knowledge innovation appears especially important, it's effect is the most obvious as well (Wu and Chang, 2007). Market knowledge innovation including to discover new customers, to develop new markets, to find the products new USES and to formulate new marketing model. In the market knowledge innovation, the first step is to clear the use of the products, the performance and the target customers. It can help making more effective marketing plan, as the

target is clear. Then, the high execution efficiency can help to optimize the result. Purpose, efficiency is the foundation of the maximization in market knowledge innovation.

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