On the Collaborative Game of Low-skill Manufactures Based on Value-creation

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Abstract: Faced with the dilemma of low-skill manufactures in the process of value-creation, this paper presents factors of all interest bodies in the entire industry chain and sets up the value-creation game model of resources complementarity, collaborative production, management control for the goal of low-skill manufactures value optimization.

1. Introduction

Although the technology is very mature for the low-skill manufactures, there are no standards for high, medium and low technology industry. The OECD classified the industry according to the percent of R&D—if the R&D in industry is lower than 1%, then the low-tech industrial characteristic would be very obvious. 23 industries in 29 manufacturing industries are classified as low-skill manufactures according to the data from the yearbook of science and technology of China 2009. Lots of Chinese scholars also studied the low-skill manufactures. For example, Lijun Sun, Xueping Ye, Jing Chen(2011) defined low-skill manufactures; Lijun Sun(2010) made research from the stages in the development of China’s low-skill manufactures and the angle of innovation strategy; Jun Feng and Yongcai Yan(2011) studied it from the stage of technological innovation model and Lijun Sun(2011) researched the countermeasures from the policy frame of the Chinese government. China is a country with great traditional manufacturing industries. Efficiency, mechanism and management problems—low capital operation efficiency, low return on capital and high capital cost, arise in the process of value-creation. In order to improve the efficiency of value-creation in long term and the competitive power for the Chinese low-skill manufactures, and make it remain invincible in China and in the world, this study can be adopted to guide the decisions for the authorities of China.

The issue of value-creation covers wide range and complexity. Current research does not analyze the content of value management deeply, neither the chain-type structure and organizational influence after establishing the value chain built by the interest bodies, nor the inner and outer mechanism of value creation, especially the lack of management model and evaluation system. For example, there is few micro-management theory and application research on some typical Chinese low-skill industries----food manufacturing, textile and garment industry, plastics and rubber industry.

2. The factors of game

When the interest bodies of value-creation in low-skill manufactures make decision, they will be restrained and affected by other interest bodies. In order to protect their own benefits, these bodies standing on the opposite position would make unfavorable policies to former one, which is game.
The participants in the strategic collaboration of value creation will choose different strategies according to their financial powers and operating condition. Strategy space is composed of the Cartesian product of participants. If the strategy space of party i is Si, the strategy space for n members can be defined as follows:

\[
\prod_{i=1}^{n} S_i = S_1 \times S_2 \times \ldots \times S_n
\]  

According to analysis, the amount of strategy space will become bigger with the increase of n. In the view of limited strategic collaboration, it is quite complex to list all the strategies, results and benefits, especially when the number of player become bigger. Therefore, in general, the infinite strategies can only be defined by function or data set.

The binding rule is made before game, the participants of strategic collaboration in value creation should conform to the rule. If there are a number of rules, the participants must obey equal rules. (e.g. choices for once or many times, choices according to order or at the same time.)

This paper uses cooperation game to analyze the focus of game: how to reorganize the manufacturing and operating activities; how to allocate different resources; how to distribute the surplus after each agreement.

3. Model of cooperation game

The resources allocation, manufacturing and operating activities and management control in the process of value-creation can be analyzed by game theory and expressed by characteristic function, showing the quantitative relations between specific resources with value creation and reflecting the size of value gained from the combination of specific resources and value creation. If the activity m of value-creation is allocated with the specific resource x, then the value created by the activity m can be expressed with \( v(m, x) \). By that analogy, the allocation between manufacturing and operating activities with resources creates all the possible value space of function: one resource and a kind of manufacturing and operating activity can make a kind of value; two resources and a kind of manufacturing and operating activity can make three kind of value and so on. If a kind of manufacturing and operating activity is allocated with k resources, then the total value should be expressed with \( 2^k - 1 \); if there are k resources and i kind of activities, then the characteristic function describing the value after allocation should be expressed with:

\[
v = \sum_{i=1}^{k} \left( \prod_{j=1}^{i} x_j \right)
\]  

3.1. Creating value through resources complementarity

Adjusting different type of resources to allocate to participants of strategic collaboration for value-creation activities means injecting new activity energy in former resources, and it certainly will create new value. However, if resources aren’t complementary, the characteristic function is only equal to additivity.

\[
v(m, x_1 + x_2) = f(m, x_1) + c(x_2)
\]  

In which \( c(x2) \) means the external opportunity cost of the resource x2. There are lots of different type of resources. If the upstream and downstream resources are complementary or they can cooperate specifically, multiple resources more than additive quantity shall be got in the same activity of value creation:

\[
f(m, x_1 + x_2) \geq f(m, x_1) + c(x_2)
\]  

Through the activity of value-creation, the individual participants of low-skill manufactures in the
value chain can gain favorable resources for development. Because of some external factors, they also can get specific resources which are reallocated to create greater value than original value. In this condition, the external cost makes the new value become the next activity’s cost of value creation.

3.2. Creating value through manufacturing and operating activity collaboration

The strategic position of low-skill manufactures is depended by its competitive power. This power can be improved by adjusting the manufacturing and operating activities. The more efficient the organizing of the manufacturing and operating activities is, the more powerful the competitive is, which is the typical function of collaboration in the manufacturing and operating activities. The strategic collaboration of low-skill manufactures is realized in the value chain: by adjusting the value chain; utilizing the competitive advantages; creating different value; making collaborative effect.

The characteristic function of game model of reflecting value is additive without collaboration.

\[ \nu(m_1 \oplus m_2, x_1 + x_2) = \nu(m_1, x_1) + \nu(m_2, x_2) \]  

(5)

In which \( m_1 \oplus m_2 \) means a combination of two kinds of manufacturing and operating activity.

The characteristic function of game model of reflecting value is more than additivity with collaboration.

\[ \nu(m_1 \oplus m_2, x_1 + x_2) \geq \nu(m_1, x_1) + \nu(m_2, x_2) \]  

(6)

Value is created in the manufacturing and operating activity after reallocating different resources to party A and party B, more precisely, in a collection of resources, adjusting and reallocating these resources through the manufacturing and operating activity in the process of collaboration to create new value.

If value is created through the strategic collaboration to connect the manufacturing and operating activities in the low-skill manufactures by party A and party B, then the value of collaborative effect can be expressed with:

\[ \nu_{m_{A_1} \oplus m_{B_1}} = \nu(m_{A_1} \oplus m_{B_1}, (x_{A_1}, x_{A_1}, \ldots) + (x_{B_1}, x_{B_1}, \ldots)) \]

\[ \geq \nu(m_{A_1}, x_{A_1}, x_{A_1}, \ldots) + \nu(m_{B_1}, x_{B_1}, x_{B_1}, \ldots) = \nu_{m_{A_1}} + \nu_{m_{B_1}} \]  

(7)

In which \( m_{A_1} \) means the manufacturing and operating activity of A; \( m_{B_1} \) means the manufacturing and operating activity of B; \( \nu_{m_{A_1}} \) means the value of manufacturing and operating activity of A; \( \nu_{m_{B_1}} \) means the value of manufacturing and operating activity of B.

The advantage of strategic collaboration in low-skill manufactures is to get rid of the restraint of the original value chain, to rebuild the manufacturing and operating activity after optimizing the allocation of resources, which can improve the performance for the low-skill manufactures in the new value-creation activity. Because of the restrict of its resources, however, it always losses the chance and ability of readjustment. Consequently, in order to create new value through the value chain, the low-skill manufactures must allocate reasonable resources to different manufacturing and operating activities.

3.3. To gain value through management control

The so-called management control is to optimize the resources distribution when the low-skill manufactures hold its own resources. It distributes the limited resources to the value creating activity reasonably, and creates value for the low-skill manufactures through effective value-creation activities, such as budget management, cost management and merger control. As to the research on obtaining value through management, Lippmna found that the enterprise could achieve value through resources management if it had already obtained the external resources. In 1991, Conner published the theory of obstacles for wealth increasing would never come from of resources complementary. He found that the value of resources increased than the original one after the complementarity. However, in some scholars’ opinion, the control of resources would damage itself. Dierichx and Cool were among them. They found that the control of resources would prevent the resources from fulfill itself, and they even
attributed the unsustainable of resource development to the resource transactions. Peteraf found that, the elements could be divided into two kinds: complementarity and inseparability, if not controlled. While Lippman and Rumlt found that complementarity was the precondition for capital market to achieve resources value, the uniqueness and controllability of resources was the necessary condition to for enterprise maximizing its value. In a word, value can be attained by resource management controlling, resources complementarity or resources reallocation. The resources’ advantages of low-skilled manufactures lie in the reallocation among value chain to generate profit. The characteristic of value enhancement for resource control can be expressed as follows:

$$f(m_1, x_1) + f(m_2, x_2) < f(m_1, x_2) + f(m_2, x_1)$$  (8)

If the condition for formula (3-9) is met, value-creation activities m1 and m2 will produce value enhancement for management control with the giving resources x1 and x2. Consequently, the resources which can be assigned to the value-creation activities come from the low-skill manufactures. Reasonable allocation of resources in a certain environment is the premise of achieving interest. In the internal of low-skilled manufactures, reallocation of the resources in the value creating activities will maximize the profit; on the industry chain of low-skilled manufactures, the resource control for different low-skill manufactures will bring about new profit for both sides.

If K kinds of internal resources (x1, x2, ..., xk) from low-skill manufactures are assigned to I kinds of production and operation activities (m1, m2, ..., mi), the relationship between some of these resources and production and operation activities meet the requirements of formula (8), and the characteristic function is known. Then there must be an effective way of assignment to maximize the profit from value creation activities.

Let $\sum = \varepsilon_1, \varepsilon_2, ..., \varepsilon_i$ be the ways of resources allocation, $\varepsilon_i$: the ways of resources’ combination of production and operation activities mi, and there is space $\Omega$ for the allocation of resources. The ways of distribution include the following combination:

$$\Omega = \binom{k}{i} \times i^{k-i}$$  (9)

The formula shows that way of allocation is always limited. The characteristic function is known, so there must be a way to maximize the value.

$$v_{\text{max}} = \max \sum_{\varepsilon_i} v(m_i, \varepsilon_i)$$  (10)

For all parties involved in low-skilled manufacture, the members participated in the allocation of resources will be able to create value, which satisfy the following conditions:

$$f(m_1, x_1) \geq f(m_2, x_1), f(m_2, x_1) \geq f(m_2, x_2)$$  (11)

In the value chain of low-skill manufactures, resources $x_{\alpha \beta}$ and $x_{\beta \beta}$ have the characteristic of value enhancement for production and operation activities $m_{\alpha \omega}$ and $m_{\beta}$, thus value can be created by resources $X_{\alpha \beta}$ and $X_{\beta \beta}$. This is because resources $X_{\alpha \beta}$ and $X_{\beta \beta}$ has the effect of exchange enhancement for production and operation activities $m_{\alpha \omega}$ and $m_{\beta}$.
The value of production and operation activities is preserved:

\[
v(m_{A;\ldots}, x_{E;\ldots}) + v(m_{B;\ldots}, x_{E;\ldots}) \geq v(m_{A;\ldots}, x_{E;\ldots}) + v(m_{B;\ldots}, x_{E;\ldots})
\] (12)

At least one formula from (12) and (13) can be satisfied. Thus, the participants from the low-skilled manufactures can realize the value enhancement by exchange and control of resources \( x_{E;\ldots} \) and \( x_{E;\ldots} \).

4. Conclusion

The ability of value creation reflects the comprehensive strength of low-skill manufactures. In addition, it embodies the strategies, resources and competitiveness of low-skill manufactures. As necessary input for low-skill manufactures, resources must be allocated under reasonable strategic guidance, which is the necessary condition to make core competitiveness for low-skill manufactures. Strategy, resources and capacity, as it were, are still the main requirement for low-skill manufactures to form the core competitiveness. Under the guidance of collaborative strategy, by obtaining and cultivating the unique resources to fulfill the value, scarcity and uniqueness, low-skill manufactures can establish a value-creation system based on advantaged resources, and develop a long-term competitive advantage based on resources to achieve resources optimization, resources complementarity, resources coordination and innovation oriented value-creation.

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