Analysis on Intelligent Manufacturing Transaction Cost in Manufactuing Industry

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Abstract: As Germany's Industry 4.0 program quickly swept the world, China also actively embraced the arrival of the new era. The State Council of China officially announced "Made in China 2025" as a Chinese version of Industry 4.0. This essay is based on the theory of transaction costs of new institutional economics. Through further clarifying the connotation of intelligent manufacturing in manufacturing industry, and using transaction cost theory to analyze the relationship between intelligent manufacturing and transaction costs, and finally proposing suggestions to accelerate intelligent manufacturing in manufacturing industry.

1 CONNOTATION AND INFLUENCING FACTORS OF INTELLIGENT MANUFACTURING TRANSACTION COST IN MANUFACTING INDUSTRY

Intelligent manufacturing refers to the establishment of intelligent production in order to meet the individual customization of the consumers, and get rid of the labor-intensive production methods of high-energy consumption, low efficiency, and less innovation of traditional enterprises (Saridis, 1997). It also improves company's modernization and intelligent manufacturing process. The construction of intelligent manufacturing in manufacturing industry should include the following key elements: strengthening quality technology research and fostering independent brands, improving innovation capability, realizing innovation to improve the development of the national manufacturing industry, upgrading the green manufacturing industry and ecological civilization, optimizing the industrial layout and promoting the coordination development of enterprises in different scales (Miao, 2015).

The main factors affecting the manufacturing intelligent transaction cost in manufacturing industry consist of powerful big data collection and processing technology, fast mobile payment methods, and powerful industry association supervision methods. These three factors play a decisive role in reducing transaction costs and improving transaction efficiency. Meanwhile, they also affect the cost of obtaining information exchange between the transaction objects, the indirect costs from signing to completing the contract, and monitoring cost whether the transaction object trades follows the content of the contract (Dahlman, 1979).

2. ANALYSIS OF INTELLIGENT MANUFACTURING AND TRANSACTION COST IN MANUFACTURING INDUSTRY

2.1 Analysis of the Relationship between Intelligent Manufacturing and Transaction Costs in Manufacturing Industry

The integration of manufacturing industry and modern information technologies such as big data collection and processing and mobile payment technologies has formed a brand-new intelligent manufacturing model, which has resulted in lower transaction costs and higher transaction efficiency.

Therefore, manufacturing industry has facilitated a rapid development due to a series of methods and technologies. First, big data collection and processing technology effectively and accurately position the sales market of manufacturing industry. Second, online payment methods of mobile device terminals build a convenient platform for the transaction. Third, industry associations have strong supervision for the enterprises to ensure the safety and security of trading. The effective operation of these three entities is an important embodiment of transaction efficiency, which reduces information costs, contracting costs, and supervision costs, and promotes the individuality, efficiency, and profitability of manufacturing production(Figure 2-1).

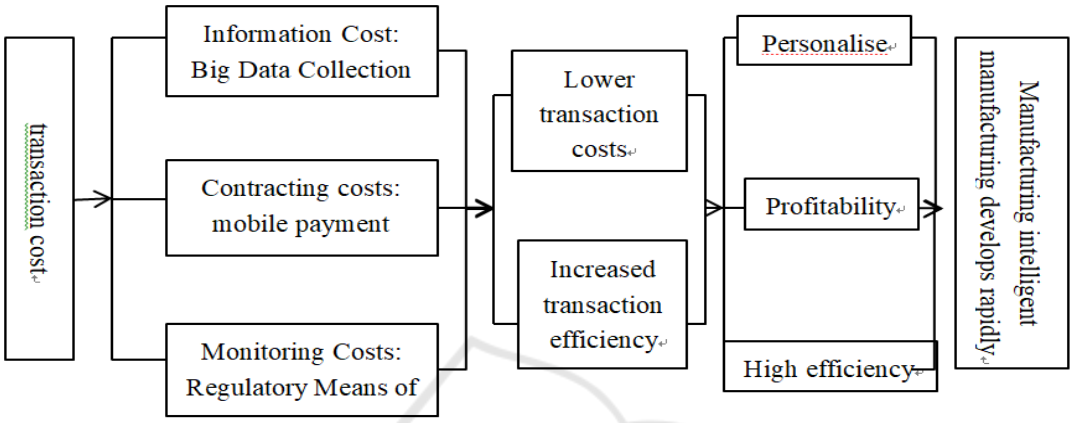

Figure 2-1 The relationship between transaction costs and intelligent manufacturing

2.1.1 The Relationship Between Transaction Costs and Personalization

The relationship between transaction cost and personalization is mainly determined by the collection and processing results of big data. It can be considered that the big data collection and processing technology is positively related to transaction efficiency and the level of personalization, and negatively related to transaction costs. In specific, efficient big data collection and processing technology can promote locating market requirements accurately, personalising product, and reducing transaction costs.

2.1.2 The Relationship Between Transaction Costs and Profitability

The relationship between transaction cost and profitability is mainly determined by the use of mobile payment methods. It can be considered that the application of mobile payment methods is positively related to transaction efficiency and profitability, and negatively related to transaction costs (Yang, 2014). In specific, the rational use of mobile payment methods can reduce transaction costs, increase transaction efficiency, increase the profitability of enterprises, and promote the rapid development of the manufacturing industry.

2.1.3 The Relationship Between Transaction Costs and Efficiency

The relationship between transaction costs and efficiency is mainly determined by the strong supervision of industry associations, which positively related to transaction efficiency and high efficiency, and negatively related to transaction costs. In specific, powerful supervisory measures can reduce transaction costs, improve transaction efficiency, and promote efficient operation of enterprises.

2.2 Analysis of the Influencing Factors for the Transaction Cost in Manufacturing Industry

The determinants of transaction costs include the "contractor" factors, consisting of bounded rationality and opportunism, and trading factors, such as asset specificity, uncertainty, and transaction frequency.

2.2.1 “Contractor” Factors

When the limited rationality and opportunistic behavior of the “contractor” is researched, it can also be analyzed from the perspective of the game theory, in specific, to analyze the emergence of price wars among enterprises and the emergence of free riders and opportunism(Williamson, 1981).

(1) Price Game

In manufacturing industry, since the competition among enterprises is fierce, price wars are being fought with each other, which disrupts the normal market order and damaging the interests of enterprises. This problem can be analyzed from the perspective of game theory. In the price war of an enterprise, it is assumed that each enterprise is rational, and there exist a typical non-cooperative game relationship between the enterprises. In the course of the game, there are two main price strategies for companies to choose from, i.e., price reduction and fixed price. When only two companies participate in the game and meet certain assumptions, the following game payment matrix is available (Table 2-1).

Table 2-1 Price game payment matrix.

		Enterprise 2	
		Fixed	Price
Enterprise 1	Fixed	R R	R-A R+B
	Pricereduc	R+B	R-C R-C

Among them:

R means the equal returns obtained beforethe export price reduction of the export products;

B represents the additional net income gained by the enterprise who reduce the price;

A denotes the loss of price stability under the condition of B;

C indicates the loss caused by both parties' price reductions.

The best strategy for this prisoner's dilemma model is (price reduction, price reduction). Specifically, the "price wars" of enterprises not only damage their own interests, but also harm the interests of other companies, and the results will surely cause harm for both sides. The above payment matrix just describes a game process, but in actual economic life, the enterprises will paticipate multiple games.

Together with a finite number of repeated games, according to backward induction, each game player will adopt the same strategy (price reduction, price reduction) for each game. With consideration of an infinite number of repeated games, it is necessary to introduce the benefit of the latter stage into discount factor $\delta : \delta = 1/(1+\gamma)$, where γ is the market interest rate with one period as deadline.

When the discount coefficient δ is relatively large, for the manufacturers, the future interests are considered more important relate to the current interests. They will not cause their long-term interests to be damaged for the sake of the current interests. However, assumed that more companies participate in the game, the greater the ratio of net income to loss of future profits in each company's one-off opportunistic uncooperative behavior, the greater the incentive for opportunistic behaviour (Jiang, 2014). This situation is consistent with the observation of social reality in China. If the company's product price strategy is carried out in an infinite number of repeated games, and in the case of a large number of companies in a market, it happens that a price drop, which will surely put the company into a vicious cycle of great harm.

(2) The Game between Enterprises under Intelligent Manufacturing

From previous analysis, the manufacturing industry is gradually taking the path of intelligent manufacturing. At present, the majority of enterprises that are capable of intelligent manufacturing are large-scale enterprises with financial advantage. However, there still exist numbers of companies that are not capable of intelligent manufacturing. This will lead to the problem that whether small businesses want to establish intelligent manufacturing. From the perspective of the game, it can be explained by using Smart Pig Game Model.

It is assumed that there are two companies involved in the game, and the players are rational. One of them has a certain scale (enterprise A), which can carry out intelligent manufacturing. The other is smaller (enterprise B), and it cannot perform R&D for intelligent manufacturing. Meanwhile, assume intelligent manufacturing will increase the revenue of the market by 10 units, and the cost of intelligent manufacturing will be 2 units. If two enterprises develop intelligent manufacturing together, A can get 7 units of revenue, while B can get 3 units. If cost of intelligent manufacturing is removed, A gets 5 units, and B gets 1 unit. If A develops intelligent manufacturing, A gets 6 units, and net gains are 4 units, while B gets 4 units. If B develops intelligent manufacturing, A gets 9 units, B gets 1 unit, but after removing costs, A loses 1 unit. If neither develops intelligent manufacturing, they

cannot gain profit. It is summarized as the following game payment matrix (Table 2-2).

Table 2-2 Wise Pig Game Payout Matrix.

		Enterprise B	
		deve	Not
Enterprise A	develop	5 1	4 4
	Not	9 -1	0 0

After analysis, the small-scale enterprise (Enterprise B) will certainly choose not to develop, so that the large-scale enterprise (Enterprise A) will choose to develop intelligent manufacturing. However, if we do not take the cost in account, we found that the large-scale enterprise and small-scale enterprise will share the revenue equally at last, and there will exist free riders.

The above analysis just describes a game process. In the real market, there will usually be repeated games. Thus, from the long term perspective, it is helpful for small-scale enterprises to establish brands through independent R&D or to learn from large-scale companies under certain levels of supervision. Therefore, it can be found that the limited rationality and opportunistic behavior of "the contractor" will disrupt the competitive market among enterprises and increase transaction costs.

2.2.2 Trading Factors

Trading factors mainly include asset specificity, and transaction frequency. On the one hand, when the existing old manufacturing equipment is eliminated or improved in developing intelligent manufacturing, it will lose all or part of the input assets and increase transaction costs. On the other hand, in the course of repetitive transactions, transaction costs will decrease as the frequency of transactions increases. However, transaction costs will not be reduced indefinitely as the frequency of transactions will increase(Williamson, 1979). (Figure 2-2).

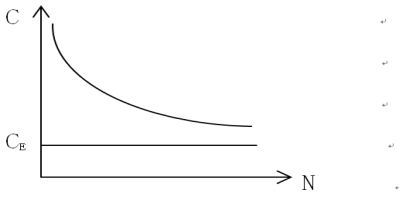

Figure 2-2 Relationship between transaction frequency and transaction cost

3 SUGGESTIONS

According to the current situation of intelligent manufacturing in manufacturing industry in China, it can be proposed that in order to improve intelligent manufacturing in manufacturing industry can be conducted from three perspectives.

3.1 Formulating Production Capacity and Eliminating Backward Production Capacity Based on Market Demand

At present, some enterprises in manufacturing industry are still in a state of overcapacity and backward production capacity. In order to deal with the problem and improve enterprise's performance, on the one hand, large enterprises should reduce the production of high-volume, low-quality products. Moreover, customizing production capacity according to market demand, increasing the introduction of advanced production equipment and technologies, and gradually optimizing product quality is also necessary for large-scale enterprises to achieve the reform. On the other hand, small enterprises should not only reduce the production of low-tech products, but also transform the development target to technology research and development. Therefore, the unique brand will be built.

3.2 Strengthen Innovation to Increase Intelligent Manufacturing Development

Innovation is the driving force for companies to move toward intelligent production. Enterprises should accelerate the pace of innovation with the support from government and higher education institutions. Moreover, they can also increase the introduction of technological talents, the use of intelligent technologies, and the connection and cooperation with other enterprises. Therefore, the core competitiveness of the enterprises, and constant upgrading and optimization of industrial structure can finally be achieved.

3.3 Promoting Clean and Environmental Friendly Production to Upgrade Product

Environmental protection is an issue that cannot be ignored in the development of any industry. The

state's requirements for cleaner production, energy conservation, and emission reductions are increasing. Enterprises should strictly control the disposal and discharge of pollutants, increase investment in wastewater and tail gas treatment, and gradually realize intelligent upgrading of their products.

4 CONCLUSIONS

This essay clarifies the connotation and influencing factors of intelligent manufacturing and transaction costs in manufacturing industry. After analysing the relationship between intelligent manufacturing and transaction costs, we proposed suggestions to accelerate intelligent manufacturing in manufacturing industry, consisting of formulating production capacity, strengthening innovation, and promoting clean and environmental friendly production.

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