

Formation and Evolution of the Global Manufacturing and Service Modular Network

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Keywords: Manufacturing and service, Modular network, Evolution path, Growth strategy.

Abstract. With the adjustment of the international industrial structure, it has become an international trend for multinational corporations to outsource their productive service module. When global contractors produce and transmit productive service modules according to the design rules formulated by multinational corporations, a new form of network which is named the global "manufacturing and service modular network" began to emerge. There are four main factors affecting the formation of the network. The network will pass through four stages: embryo, germination, development and maturity. At present, the network is in the stage between development and maturity. Now, only by relying on the strategy of cluster upgrading can the Chinese local productive service enterprises' position keep rising in the network.

1. Introduction

In recent years, along with the adjustment of international industrial structure, productive services' transnational transfer has become a remarkable feature of today's economic globalization. The main way of multinational corporations' productive services transnational transfer is service outsourcing. Among all modes of productive service outsourcing, modular outsourcing of productive services has three advantages: parallel innovation of outsourcing module, lower innovation cost based on "information package" and lower outsourcing risk based on design rules[1]. Therefore, in practice, productive services' modular outsourcing has become the main way for multinational companies to outsource productive services. Under this background of global strategic outsourcing, global productive service contractors increasingly design and produce productive service modules through standardized interface rules set by multinational corporations[2]. These behaviors have led to changes in the form of industrial structure. A "manufacturing and service modular network" with knowledge and capability as its main boundary has gradually appeared in reality.

2. Formation mechanism of the global manufacturing and service modular network

2.1 The Needs of Multinational Corporations' Differentiated Competition

In today's fierce market competition, the non-price competition based on product differentiation has replaced the traditional price competition. With the application of large-scale production lines and various advanced manufacturing methods such as agile manufacturing and lean production, there is a small gap in the physical properties of different enterprises' products. In this context, how can multinational corporations pull away from the competitors through differentiated competition? This mainly depends on the input of a large number of productive services in the production value chain. When these productive service modules are integrated in the production value chain, multinational corporations can produce a variety of differentiated products, thus will form a differentiated competition mode.

2.2 Change in consumer demand

With the development of economy and the improvement of consumers' income level, the market demand pattern has changed. This change requires cooperation and coordination among industries in order to meet the needs of consumers[3]. This is because the market requirement has changed from a single product need to a complex and systematic need. Consumers become more rational, and their consumptions tend to be more personalized and diversified. In this case, enterprises are required to provide customers with a comprehensive "product + service" system, which becomes the key for enterprises to obtain high added value and maintain a lasting competitive advantage. However, manufacturing enterprises often only provide products with physical functions for consumers. Although modularization reduces production costs, only by integrating services into products can manufacturing enterprises not only meet the complex and systematic needs of consumers, but also increase the added value. In this context, multinational corporations outsourcing part of the productive service modules to contractor not only has cost advantages, but also can "splice" or "assemble" into a variety of personalized "product + service" products in a short time. By providing these products, it promotes the embedding of productive service module into multinational corporations' manufacturing value chain, thus the global "manufacturing and service modular network" appeared.

2.3 Rapid Development of Information Technology

Productive services have traditionally been viewed as many characteristics, such as non-storage, indivisibility, simultaneous production and consumption. Firstly, the emergence of various storage media and cloud storage solves the problem of non-storage of productive services. Secondly, the development of information technology has also changed the indivisibility of productive services. Productive services can be divided by information technology. For example, many productive service processes in the multinational corporations' value chain can be decomposed into modules through information technology, and then these modules can be coded by information technology to achieve digital storage, processing and transportation. Thirdly, with regard to productive service products, the simultaneity of consumption and production has also changed. The digital storage which the productive service module are attached to can not only realize the separation of time and space, but also it can realize mail, network transmission and remote service. These methods solve the simultaneous problem of the productive services' production and consumption. In general, information technology speeds up the processing of information contained in the productive service module, which realizes the scale economy and scope economy of multinational corporations' production service outsourcing, and promotes the emergence of the global "manufacturing and service modular network".

2.4 Development of Service Industry and Manufacturing Industry's Mixed Operation

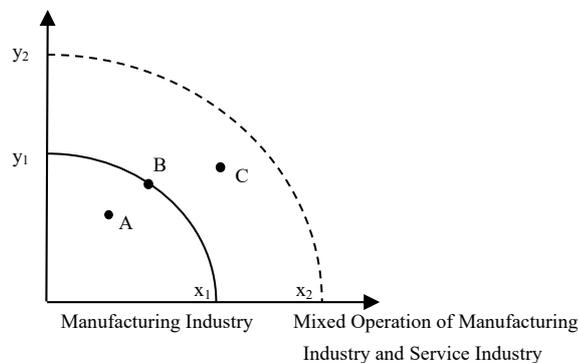


Fig. 1. Economic Analysis of Mixed Operation

The initial mixed operation appeared in the financial service industry, and then gradually extended to the manufacturing industry. The mixed operation between manufacturing industry and service industry is realized through the module integration of manufacturing value chain and service value

chain. As we all know, production technology and corresponding institution are resource scarcity, which makes the social economy have a production possibility boundary. The range of possible boundary is a combination of the maximum number of products that can be produced by the resources mentioned above. This means that if the nature of institutional resources does not change in a certain period of time, no matter how we increase the production factors and technological capabilities, the total production of society could not be substantially improved, because there has a restrictive boundary in the system. We can use Figure 1 to explain this.

Point A in Figure 1 is the production output in the manufacturing industry, and point B in the x_1y_1 curve represents the maximum output generated by the most rational use of production factors and technical capabilities in the manufacturing industry. Because of the restriction of manufacturing institution, it is impossible to obtain higher production output level beyond curve x_1y_1 . If we want to continue to get more production output, we must break through the restrictions of the institution. The essence of mixed operation is a breakthrough of institution restriction. In this process, through the combination of manufacturing module and service module, the transaction cost within the enterprise is reduced and the ability of portfolio innovation is acquired. Thus, the boundary of the institution moves outward to the point where the institution of mixed operation can be formally established in the economic society, that is, from the x_1y_1 curve to the x_2y_2 curve. The production factors and technology determined by the x_2y_2 curve have a higher degree of freedom, so that the economic output determined by the x_2y_2 institution has been greatly improved compared with that determined by the x_1y_1 institution. Therefore, it can be seen that the mixed operation is a more efficient institutional arrangement than the single manufacturing industry. This also objectively promotes the formation of the global “manufacturing and service modular network” in reality.

3. The Evolution Path of Global “Manufacturing and Service Modular Network”

3.1 embryonic stage

When the integration model of multinational corporations is expanded to a certain extent, this over-detailed division of labor will bring about a large increase in costs. At this time, the development of information technology and consumer demand changes also require multinational corporations to carry modular decomposition vertically and horizontally, and gradually decompose and outsource non-core productive services, so as to focus on their own core competence. As a result, independent contractor began to emerge, which re-embedded in the manufacturing value chain of multinational corporations in the way of providing productive service modules. They improve the resource allocation efficiency by providing a more intelligent promoter to the manufacturing value chain, that is, by means of a circuitous production mode. As a result, multinational corporations can focus on their own core value chain segments and improve their market competitiveness. From then on, the manufacturing and service modular network began to emerge.

3.2 Generation stage

With the development of multinational corporations’ productive service outsourcing, the number of contractors in different segments of their value chains keep increasing, which triggers the dynamic growth of the segments in the value chain. Finally, the relationship between upstream and downstream nodes in the value chain of multinational corporations evolves into a spatial network relationship[4]. Generally speaking, before the modular outsourcing of productive services, multinational corporations will first determine the design rules of the whole “manufacturing and service modular network”. Then, multinational corporations outsource productive service modules to different external module suppliers. Due to the advantage position of multinational corporations in the industry, the information transmission between multinational corporations and productive service providers is basically one-way flow. Unless the environment changes dramatically, multinational corporations need to readjust the whole product design thinking. At this period, multinational corporations need and have the right to change the design rules, while productive service module

suppliers can only accept the rules. Therefore, this model often exists in the early growth stage of the Network. Because of the unidirectional nature of information links, the innovation ability is low.

3.3 Development stage

In the stage of development, with the deepening understanding of design rules in the "Manufacturing and Service Modular Network", especially the knowledge learning among members, contractors' service production capacity is constantly improved. Owing to different learning abilities and different value chain segment occupying, the productive service providers' organizational learning results in hierarchical differentiation. Finally, the network has formed three members: multinational corporations, general productive service module suppliers and specialized producer service module suppliers. For multinational corporation, it is an enterprise that defines and integrates the needs of the whole network, and it is also a system designer of the network. General Productive Services Module Supplier is that uses scale economy, learning curve, etc. to produce labor-intensive modules more efficiently. Specialized Productive Service module supplier refers to that uses its own "tacit knowledge" to obtain "back-to-back" innovation under the guidance of explicit rules. Of course, the outsourcing of multinational corporations' manufacturing value chain segments can also form specialized and general suppliers of manufacturing modules. They and the productive service module suppliers are interconnected in the network.

3.4 Mature stage

In the mature stage, the outsourcing value chain of multinational corporations become longer and thicker, that is, more and more contractors participate in the value chain from all over the world. At this period, there are many "manufacturing and service modular networks" in the industry, and there are very fierce competitions among them. Because the resources of each "Manufacturing and Service Modular Network" are different, some multinational companies in "Manufacturing and Service Modular Network" have stronger learning ability, and the knowledge integration speed of their whole network is faster. Therefore, the status of this "manufacturing and service modular network" will gradually rise. On the contrary, in some "modular manufacturing and service networks", the multinational corporations' have lower learning ability and the knowledge integration speed in the whole network is slower, then their position will gradually decline, and their living space will become smaller and smaller. Finally, multinational corporations in these "Manufacturing and Service Modular Networks" with smaller living space will be forced to accept the design rules of the winner's network, and their Networks will degenerate into a sub-network of the winner. When more sub-networks gather around the winners, the multinational corporation in the winner network will become a super multinational corporation in the industry.

4. Growth Strategy of Chinese Productive Service Enterprises

At present, the global "manufacturing and service modular network" is in the period between development stage and mature stage. The status of the multinational corporation in the network is relatively stable. Because multinational corporation manage the whole network hierarchically by designing rules, As a result, most of Chinese productive service enterprises embedded in the network are captured in the low-value segments of the network, and it is difficult for them to climb up to the high-value segments [5]. Penner-Hahn & Shaver (2005) established the "Local Information Field-Global Pipeline" model. They believed that the knowledge and technology needed by local cluster enterprises to upgrade along the network value chain could only be realized through the combination of "Global Pipeline" and "Local Information Field"[6]. Therefore, the establishment of the "government guidance + pioneer enterprise driving" mode can be a useful way to promote the upgrading of the productive service cluster enterprises in China. The so-called pioneer enterprise refers to the productive service enterprise which is close to the multinational corporations and meanwhile, deeply rooted in the local clusters. The proximity to multinational corporations enables them to acquire advanced knowledge spilt by multinational corporations. Considering that it is not

enough for the pioneer enterprise only having knowledge advantage, it is necessary to transform this knowledge advantage into competitive advantage. Therefore, under the pressure of international market competition, the pioneer enterprise has the motivation to cooperate with other enterprises in the local cluster and pursue win-win situation. Therefore, the government can formulate relevant incentive policies to encourage the pioneer enterprise to establish a modular labor division within the cluster. By this way, the coordination and cooperation ability of local productive service cluster can be further improved, and the "flexibility plus specialization" ability of local productive service enterprises can be integrated into a new wooden barrel. In this way, the pioneer enterprise can make use of the supply chain advantages and market advantages of local clusters to integrate and re-innovate internal and external knowledge. And it can spill the innovation knowledge into the whole cluster to realize the positive feedback cycle of knowledge and realize the continuous position rise of the whole cluster enterprises in the global "manufacturing and service modular network".

5. Summary

In short, the global "manufacturing and service modular network" is formed by multinational corporations' productive service modular outsourcing. The formation of the network is not only the need of multinational corporations' differentiated competitive strategy, but also affected by the modern information technology development, market demand changes and mixed operation. The development of the network will go through four stages, and now it's between the growth stage and the mature stage. In this case, only by adopting the cluster upgrading mode of "government guidance + leading vanguard enterprises" can Chinese productive service enterprises enhance their position in the value chain.

Acknowledgement

The research work was financially supported by National Social Science Foundation of china: Study on the Growth Strategy of Local Productive Service Enterprise Which is Embedded in the "Global Manufacturing and Service Chaos Modular Network" (NO. 13CGL042).

References

- [1] N. Langlois, R. Paul, Networks and innovation in a modular system: Lessons from the microcomputer and stereo component industries, *Research Policy*, vol.21, pp.297-313, 1992.
- [2] Peng Liu, Yu Xiang Liu, Integration of Productive Services industry and Manufacturing industry Based on Industrial Value Chain, *Library and Information Guide*, vol.18, pp.113-115, 2008.
- [3] H. Tohidi, M M. Jabbari, The process of virtual organization formation, *Procedia Technology*, vol.1, pp. 539-543, 2012.
- [4] M A. Schilling, H K. Steensma, The Use of Modular Organizational Forms: An Industry-Level Analysis, *Academy of Management Journal*, vol.44, pp.1149-1168, 2001.
- [5] J. Humphrey, Upgrading in global value chains, *Social Science Electronic Publishing*, pp.209-239, 2004.
- [6] J. Penner-Hahn, J M. Shaver, Does international research and development increase patent output? An analysis of Japanese pharmaceutical firms, *Strategic Management Journal*, vol.26, pp.121-140, 2005.