



An analytical study on service-oriented manufacturing strategies

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ABSTRACT

Service-Oriented Manufacturing (SOM) strategy is a new manufacturing mode by integrating servitization with the traditional manufacturing industry. The advantages and importance of the SOM strategy are gradually recognized by more and more enterprises. However, the enterprises' specific cost structures and cost configurations for providing customized services have influences on the decisions about whether the SOM strategy should be adopted, how to determine the suitable scope of SOM, and how to set the suitable pricing scheme of their offerings. This paper performs an analytical study on the above objectives and proposes an optimal decision model for designing SOM strategy. Our analysis on the SOM strategy under competition offers some insights into: when enterprises should perform SOM; what the suitable scope of SOM is, and how to design pricing strategies for SOM. From this analytical study, we draw some managerial implications that: for an enterprise in a duopoly market, if the fixed part in the unit cost of service is lower than the one third of the equilibrium price, the enterprise should adopt the SOM strategy; in addition, one half of the enterprise's customers should be covered by the SOM strategy at most.

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1. Introduction

In the past decades, the servitization was gradually integrated with the traditional manufacturing industry, which brought out an advanced manufacturing mode, i.e., Service-Oriented Manufacturing (SOM) (Fry et al., 1994). By performing the SOM strategy, manufacturing enterprises try to provide customers with a bundle of innovative services and the goods so as to meet the customers' special requirements (Vandermerve and Rada, 1988). The SOM strategy helps the manufacturing enterprises to extend their reach ever closer to the customers and the customers' underlying needs.

From the advent of the Industrial Revolution in the later part of the 18th century, almost all manufacturing enterprises simply engaged in manufacturing. They did not provide bundled services and also did not control their supply chain through vertical integration (Schmenner, 2001). From the 20th century, some enterprises firstly engaged in vertical integration to control their supply chains; then they went a step further to bundle goods and services together for their customers. Some of the world-famous enterprises, e.g., IBM, GE, HP, are becoming more than the simply manufacturers and entering the realm of service providers. For a long time, IBM was oriented at being 'a manufacturer of IT products', and covered many aspects of IT categories, e.g., chip

design and manufacturing, hard disk drive, mainframe computer, personal computer, software, etc. However, with the advent of the recession of the hardware manufacturing, IBM entered a difficult situation. Its deficit reached 16 billion USD during the first three years in 1990s. Then a series of reforms were performed to adjust its business structure. IBM got rid of some unimportant business sections and utilized the OEM mode in its manufacturing process. Moreover, through the buyout of Lotus Software Company, some consulting business of PwC, IBM completed its transformation from an IT product manufacturer to an IT service provider. On the basis of this, IBM performs the service innovation and has extended its service scope to: strategic-level consulting; design, implementation, and maintenance of information systems, etc. The new SOM mode brought IBM with strong competitiveness. In the past decade, the growth rate is kept higher than 10%. Within its revenue, more than 50% is earned by providing services.

As the World Factory, China is encouraging their enterprises to transform from the traditional pure-manufacturing mode to the SOM strategy. In China, an example of performing SOM, which is commonly used in the case study of business schools, is Shanxi Blower Group Co., Ltd. This company mainly manufactures blower turbines, and also provides services, e.g., spare parts, wear parts, repairs, inspections, preventive maintenance, technical advice, consulting, etc. It has established a service center that specially handles all types of service issues. A remote trouble shooting online system was also implemented so as to inspect the real-time states of the equipments in its customers' sites. The revenue of this company increased by seven times from 50

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million USD in 2000 to 367 million USD in 2005. The annual growth rate of profit reached 89% during 2000–2005, which is much higher than the growth rate of revenue, i.e., 49%.

By performing the SOM strategy, enterprises can offer multiple services tailored to meet diverse customer requirements, especially for some customers with high priority, or some market segments unserved or poorly served by existing products (Hobo et al., 2006). The SOM strategy also allows the enterprises to charge higher prices for their offerings. Customers are also frequently willing to pay a premium, which reflects the added value of satisfaction that arises from the individualized services. Although the SOM strategy can bring some advantages to the enterprises, it is not clear whether the enterprises can benefit from the SOM strategy in the face of competition since their rivals can also adopt the similar SOM strategy. Besides, the enterprises may not provide services to all of their customers. In other words, the SOM strategy maybe just cover some of the customers; and for others, only products are sold to them without customized services. In this case, increasing the scope of SOM will incur undesirable influences on the total cost, product and service quality. Thus enterprises should carefully evaluate the benefit and the cost of adopting SOM over no SOM. Therefore, how to design an effective and profitable SOM strategy is becoming more and more critical in nowadays' competitive markets. Each possible SOM strategy will impact the completion differently. For an enterprise who is interested in performing SOM, three key questions should be investigated firstly: (1) whether the SOM strategy should be adopted; (2) what is the suitable scope of SOM; (3) what is the suitable pricing scheme of their offerings.

The decisions for the above three questions are mainly influenced by operational factors and market characteristics. The operational factors include: the cost associated with investment in service center and manufacturing technologies that enable the SOM strategy, and the unit cost of providing customized services to an individual customer. The market characteristics mainly include the competition between rivals within the market, pricing strategies, etc. This study considers the above factors and proposes an optimal decision model for designing SOM strategy. Our analysis on the SOM strategy under competition offers some insights into: when enterprises should perform SOM; what the suitable scope of SOM is, and how to design pricing strategies for SOM. We conduct an analytical study on these issues. Several managerial implications are obtained and discussed at the end of this study.

2. Literature review

The merge and interaction of manufacturing and services trigger the emergence of the SOM strategy, which is a new advanced manufacturing paradigm. The SOM strategy is different from other traditional manufacturing paradigms, e.g., Lean Manufacturing (Shah and Ward, 2003), Flexible Manufacturing (Konak et al., 2008), Computer-Integrated Manufacturing (Altuntas et al., 2007), Just-In-Time Manufacturing (Kojima et al., 2008), Agile Manufacturing (Zhang, 2011), Green Manufacturing (Ahiska and King, 2010), Mass Customization Manufacturing (Anzanello and Fogliatto, 2011), Virtual Enterprise (Monroy and Arto, 2010), Marketing-Manufacturing Integration (MMI) (Paiva, 2010), Re-Manufacturing (Kenné et al., 2012). General speaking, all of these manufacturing paradigms or concepts have some characteristics as follows: (1) value is mainly created by manufacturing the tangible goods. (2) The above paradigms emphasize the integration of distributed manufacturing resources, but neglect the collaborative with producer services and service enhancement.

The roots of SOM can be traced back to the rise of the concept on 'producer services' (Greenfield, 1996), which was proposed by Greenfield in 1966 when he studied the service industry and its classification. In the later decades, a lot of scholars studied the positive influence of developing the 'producer services' industry on the national economy, and the interaction between the 'producer services' and the conventional manufacturing industry (Francois, 1990; MacPherson, 1997; Markusen, 1989; Gunasekaran and Spalanzani, 2012). The concept of 'service enhancement' was proposed when the service industry was gradually rising up in some developed countries (Berger and Lester, 1997; Pappas and Sheehan, 1998). Some studies were performed to investigate the micro mechanisms of producer services in operations management (Carson, 1998; Garcia and McGuire, 1998). The concept of 'producer services' focuses on how to manufacture products based on outsourcing services from other suppliers, but does not concern the target of the services. Grönroos pointed out that the key to establishing competitiveness is to create value by perceiving customers' requirements and providing them with a set of tangible products and customized services (Grönroos, 2000). The participation of customers into the whole process of manufacturing and servicing providing is one of the key characteristics for SOM (Schmenner, 2004,2009). Gebauer and Fischer explored five different clusters on service needs in the context of Chinese business culture (Gebauer and Fischer, 2009).

The management theories developed for manufacturing may not be applicable to service operations (Reed and Storrud-Barnes, 2009). Frohlich and Westbrook investigated the different performances of manufacturing and services in the Internet-enabled supply chain integration strategies (Frohlich and Westbrook, 2002). Compared to manufacturers, successful service firms must place greater emphasis on the selection, development, and management of employees who work directly with the customer (Crosby et al., 1990). Therefore, the total cost of the service is mainly the human resource cost. The unit cost of service provided to an individual service is impacted by the number (scale) of the customers to whom the enterprise provides services (Cowell, 1988). The differences between manufacturing and services in the aspects of cost measuring and pricing are considered in this study so as to design an optimal SOM strategy.

Various methodologies were utilized in the literature on SOM. Gao et al. studied the SOM strategy through the perspectives of business model, industry insight and technology strength (Gao et al., 2011). Nylund and Andersson employed the simulation technology to study the SOM strategy (Nylund and Andersson, 2010). Popescu and Lastra used an incremental Petri Net based method to model the resource and service flows in SOM systems (Popescu and Lastra, 2010). Zhang and Jiang proposed a conceptual framework and hierarchical structure model for SOM executive systems (Zhang and Jiang, 2009). Franco et al. also designed an architectural style of SOM platform (Franco et al., 2009). For supporting SOM, Zhao et al. studied the development flow of service design based on product lifecycle and Six Sigma (Zhao et al., 2008).

Our paper contributes to the extant literature in several ways:

- This study uses an analytical study approach to quantitatively investigate the SOM strategy; while other literature on SOM is mainly to build conceptual frameworks or perform some empirical studies.
- Most of the literature concludes that SOM can bring advantages to the enterprises. However, it is not clear whether the enterprises can benefit from the SOM strategy in the face of competition since their rivals can also adopt the similar SOM strategy. This paper makes an explorative study to investigate this issue.

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