

Analysis Of Sustainable Product Service Systems Within Chinese Manufacturing Industries

Wen Liu

Institute of Manufacturing
University of Cambridge
Cambridge, UK
wl322@cam.ac.uk

Dr Maria Holgado Granados

Institute of Manufacturing
University of Cambridge
Cambridge, UK
mh769@cam.ac.uk

Abstract — Product services system (PSS) can be seen as a sustainable business model, which is a process of creating value by adding services to products. Sustainable PSS have significant potentials to deliver social benefit and economic prosperity as well as address environmental challenges. Many firms see sustainable PSS as an excellent vehicle that can simultaneously enhance their competitiveness, realize product value enhancement and foster sustainability. Furthermore, consultants and industry groups have made some considerable contributions regarding implementation of sustainability principles within the manufacturing industries. But there are still few academic contributions and empirical examples on this issue. The overall research purpose is to gain a deep understanding of the barriers for implementation of sustainable PSS in China. The aim thus is to explore the current situation of sustainable PSS adoption and make Chinese companies become more aware of the needs of implementing sustainable PSS.

The results of the research showed that in China, the state-owned manufacturers are lack of understanding of servitization and PSS compared to private and multinational companies. They struggle to come up with new and creative ways to provide services for their customers. Chinese manufacturers face enormous cultural challenges and uncertainties about the impacts of servitization. They have unclear perspectives about the transitional process towards servitization and fear about financial risks in the long term. Therefore, wider adoption of sustainable PSS in China is limited and there is still no guarantee that sustainable PSS will be widely adopted and become common in China. The findings suggested Chinese manufacturing firms carrying out a more effective plan to make a further attempt to implement sustainable PSS and reshape business models in Chinese manufacturing industries.

Keywords— Sustainability, Product Service Systems, Servitization, Manufacturing

INTRODUCTION

With 30 years of rapid growth, China has become the world's largest manufacturing industry, while also becoming one of the world's most significant polluters (Huaxia, 2015). The Chinese government is aware of the significant environmental impacts of increased fossil fuel use, and the manufacture of goods for export (Huaxia, 2015). Large amount of exhausts such as carbon monoxide, hydrocarbons and chemicals into the air dramatically contribute to air pollution, which threatens the public health and undermines the lives of future generations (Chen, J.X., 2010). Large shares of the country's pollutants are generated during the manufacture of goods (Huaxia, 2015). China is now the world's leading contributor to greenhouse gas emissions (Huaxia, 2015). In China, industrial pollution is one of the biggest sources of the air pollution problems, which cause Beijing's heavy smog (Chen, J.X., 2010).

Nowadays, enterprises are more willing to provide a combination of physical products and services within solutions in order to decrease waste (Brax, S. 2005). PSS can be seen as a sustainable business model, which is an integrated product and service offering that delivers value in use to fulfill customers' needs (Baines et al, 2007). 'Servitization is the term that used when a company creates value by adding service to product (Baines et al., 2007; Martinez et al., 2010). The term 'servitization' and 'product service system' are usually used as synonyms. Many firms see PSS as an excellent vehicle that can simultaneously enhance their competitiveness and realize new product value enhancement as well as foster sustainability (Brax, S. 2005). Particularly, PSS can enhance the eco-efficiency by closing materials cycle, dematerializing, and improving resource efficiency (Brax, S. 2005). It also emphasizes environment performance compared to a "business-as-usual" approach to servitization in meeting customer needs. Furthermore, consultants and industry groups have made some considerable contributions regarding implementation of sustainability principles within the Chinese manufacturing industry. But it is still difficult to convince manufacturers of the benefits in integrating sustainability principles into their

businesses (Chen, J.X., 2010). In order to maintain competitiveness and decrease environmental impacts, Chinese manufacturing firms need to move up the value chain and focus on delivering knowledge-intensive products and services instead of low-end labor-intensive products (Huaxia, 2015). Chinese manufacturing companies has placed emphasis on offering services and the companies that offering services have grown from 2% in 2007 to nearly 20% in 2011 (Neely A., 2011). However, wider adoption of PSS in China is still limited in traditional manufacturing areas. Considering a service-oriented development in manufacturing industry, this article mainly focus on the current progresses of PSS in Chinese manufacturing industries, and investigate product service solutions in the whole product life-cycle activities.

RESULTS AND DISCUSS

The results presents the key issues that emerged from the research data and considered these data in light of literature review. A large part of the interviews were dedicated to know the situation of PSS adoption in these firms and the key success factors for these companies. The nine companies involve in three different types of manufacturing industries. The senior managers interviewed mentioned the significance of sustainable development in manufacturing industry. However, managers working in different classifications of companies hold different levels of recognition of sustainability and servitization.

Table 1: Main features of each manufacturing company

	Company Name	Classification	Main Product
1	Company A	State-owned	Electricity
2	Company B	State-owned	Oil and Gas
3	Company C	State-owned	Mining Equipment
4	Company D	State-owned	Metallurgical equipment
5	Company E	Private	Automobile
6	Company F	Private	Electronic Device
7	Company G	Private	Consumer Electronics
8	Company H	Multinational	Computer Hardware
9	Company I	Multinational	Medical Device

Manufacturing companies have placed significant emphasis on offering services instead of just providing pure physical products. The result showed that the multinational manufacturing companies have a deep understanding of servitization strategy and they have already implemented the product-oriented PSS offering technical support, maintenance and consulting services. Some of them have also adopted use-oriented PSS such as rental service. By comparison, seldom has any firm transformed to complete the resulted-oriented service offering that no longer sells product but service contract. The result-oriented PSS is not an ideal choice for many manufacturing

companies as the difficulty of pricing services and higher cultural resistance and risks than the use-oriented one. On the other hand, in the private manufacturing companies, managers showed strong interests in the implementation of servitization and they have implemented the product-oriented and use-oriented PSSs, particularly in the electronic and automobile industries. Chinese government has made policy to promote sustainability and to encourage the state-owned manufacturing company to sell more services instead of pure products. Particularly, the way of making the policy in China is to use a command-control way and through a top-down approach instead of market-based ones, which is quite different than European policy. China expects to see more of redesigning and remanufacturing products to enable a sustainable transition to green industrial growth. Furthermore, the government endeavors to create a fine and open environment to attract foreign capital to invest in traditional manufacturing companies. Also, setting up a post qualification training program to educate industrial people to gain the knowledge and experience of designing service methods and systems would be another driving force of sustainable development in manufacturing industry.

In terms of Chinese manufacturing companies, they highly pay attention to decrease environment impacts and improve social issues. Thus, sustainable PSS as an innovative business model can bring Chinese manufacturing companies with significant benefits such as changing consumption patterns, reducing materials use and extending the product life cycle (Creusen, 2011). The senior manager, in the state-owned Company A observed a phenomenon that after substantial investment in extending the service business such as leasing and technical support services to its existing product portfolio, it indeed decreased the need for manufacturing and environmental impacts. However, the increased service offerings did not generate the expected correspondingly higher returns based on the company's annual report. Managers in Company B and D also obtained the same perspectives during the interview processes. Surprisingly, even adding services to product offerings, companies usually perform less well than conventional manufacturing firms, which stick to pure product offerings (Neely A., 2009). This phenomenon has been named as the "service paradox in manufacturing companies" (Gebauer, Fleisch, and Friedli, 2005). The reason about manufacturing company failing to gain the financial benefit of extending their service business is very complicated. Managers considered "service paradox" as the significant challenge to further adopt sustainable PSS within the large equipment manufacturing companies in China. Only a very few manufacturing firms in China have transformed completely from selling products to selling pure solutions (Chen, J.X., 2010). Specifically, very few firms provide result-oriented services, which no longer sells product but only service contracts. While the

majority of the manufacturing companies are still at the stage of adding limited services into the existing product portfolio (Chen, J.X., 2010).

On the other hand, the senior manager, in the state-owned Company A has recognized that the servitization could bring several benefits. He mentioned that after providing additional services, the firm indeed enhanced customer satisfaction and loyalty, thus strengthening its competitiveness. Furthermore, by extending services into the product portfolio, the company no longer needed to solely depend on selling pure products and the company could minimize the impact of resource price volatility on the company's profitability (Gebauer, Fleisch, and Friedli, 2005). Academic scholars have further discussed about encountering the paradox on the path to servitization and provided some key advices. They asserted that simply adding services to the existing product offerings usually brings negative financial performance (Parida, Sjödin, Wincent, & Kohtamäki, 2014). From the organizational level, once a manufacturing firm implements the servitization strategy, some changes will be invited. Specifically, these major changes include setting up a new service department, educating new professional knowledge and optimizing human resources, all of which incur a large amount of capital and time (Parida, Sjödin, Wincent, & Kohtamäki, 2014). From the culture level, manufacturing firms need to increase the awareness of servitization, recognize the risks of adding the service business and believing in the economic benefits of servitization to overcome the "service paradox" and ensure correspondingly high returns (Parida, Sjödin, Wincent, & Kohtamäki, 2014). Moreover, Brax, S. (2005) indicated that during the process of implementing servitization strategy, the operation cost and management complexity increase substantially in the manufacturing companies. In order to minimize potential cost and risk, Oliva, R. & Kallenberg, R (2003) suggested that manufacturer should estimate if the expected returns from servitization outweigh the cost occurs, also manufacturers should look at the value chain through customers' eyes and observe customer behaviors to create new sources of revenue thus creating more value for the firm. Neely (2009) explored the relationship between servitization and firm performance. He found those manufacturing firms that provide services usually could achieve higher sale revenue than the ones only provide physical products. However, the ratios of profit to revenue for servitized manufacturing firms are lower than the firms only provide physical products. Neely (2009) further explained that the transitional process towards servitization requires higher labor costs and working capital costs, especially in larger manufacturing firms which means larger firms are better off if they stick to the traditional pure manufacturing pattern. Therefore, Neely (2009) suggested larger firms should think twice before conducting the transitional process towards servitization due to challenges in changing mindset. Those valuable suggestions are applicable to the

Chinese large manufacturing companies. The senior manager, in Company B implied that as the company started providing additional services including maintenance, technical support and consulting services, it indeed gained profits at a short period of time; after a while, when profit was absorbed by increasing investment, returns declined and the firm experienced the servitization paradox. It has been indicated that manufacturing firms hardly can enhance profits continuously by increasing their service provision, especially for large equipment firms with a wide range of service provisions (Neely A., 2009). One of the reasons is that leasing its large equipment instead of selling them directly would require high initial capital investment and generate big risks. Company also held the opinion that leasing could encourage the client to hold a careless attitude towards the good using and conservation of this machine. The manager had no idea when profit would pick up and go towards a prosperous direction and whether the company should continue to conduct the transitional process towards servitization or not. In sum, the uptake of servitization strategy across manufacturers in China is however slow. The interview results showed the similarities that manufacturers from all state-owned, private and multinational companies have an awareness of the significance of sustainability and servitization in Chinese manufacturing industries. While, manufactures held different degrees of understanding of servitization, with high degree of understanding in multinational and private companies and relatively low degree in state-owned companies. Manufacturers in multinational and private companies are more willing to implement sustainable PSS and they all believe that PSS will make a big difference in the company and bring significant environmental and society benefits. The results also showed that private and multinational companies that interviewed are providing services, along with some have implemented the use-oriented PSS providing leasing and rental services. The adoption of sustainable PSS in large state-owned equipment manufacturing companies is limited. By comparison, none of these three types of companies have provided result-oriented services due to the internal resistance and cultural issues. It is very difficult for them to change their mindsets to offer complete services rather than selling physical product. Furthermore, some state-owned manufacturers are lack of understanding about sustainability principles. They struggle to come up with new and creative ways to provide services for their customers. The large state-owned equipment manufacturers, unfortunately, are not generating expected financial returns when stepping into servitization. They showed uncertainties about the impacts of servitization and fear about financial risks on the pathway to servitization. Thus, there is still no guarantee that sustainable PSS will be widely adopted and become common in China. There still much to be done to gain critical insights into the transitional process towards servitization.

CONCLUSION AND RECOMMENDATION

In the private and multinational manufacturing companies, managers showed strong interests in the implementation of servitization and they have implemented the product-oriented and use-oriented PSSs, particularly in the electronic and automobile industries. In comparison, wider adoption of sustainable PSS within Chinese manufacturing industries, particularly in large state-owned equipment manufacturing companies is limited. Many state-owned equipment manufacturers, unfortunately, are not generating expected financial returns when stepping into servitization. There is a phenomenon that has been identified the increased service offerings did not generate the expected correspondingly higher returns. Managers confront significant barriers in setting clear and measureable goals, and they also find it very difficult to measure the social and environmental impacts (Huaxia, 2015). Some noteworthy challenges includes understanding the concept of sustainability, lacking corporate policy that encourages implementing sustainability principles, and shifting the attitudes of manufacturers towards more sustainable modes of production process (Chen, J.X., 2010). Therefore, manufacturing firms should continue to increase the awareness of servitization, recognize the risks of adding the service business and believing in the economic benefits of servitization to overcome the "service paradox" and ensure correspondingly high returns as well as foster sustainability.

In sum, Chinese manufacturing industries endeavor to address the issues such as recycling of waste, reusing of products, and sell more services instead of pure products. It is expected to see more of redesigning and remanufacturing products to enable a sustainable industrial growth. However, many of Chinese manufacturing industries are still struggling for the production of large volumes of standardized products. There is still no guarantee that sustainable PSS will be widely adopted and become common in China. The uptake of PSS across various manufacturers in China is however slow. The findings have been identified so far are quite challenging. In China, a significant number of state-owned manufacturers are lack of understanding about servitization and PSS. They struggle to come up with new and creative ways to provide services for their customers. Also they have unclear perspectives about PSS and fear about financial risks in short-term and long-term. As a result, there is a need to inform, educate employees about PSS and servitization. There is a need to gain a deep understanding of the process of transformation to services, when the business models enable manufacturers to create and capture values through sustainable PSS. There is a need to design service systems and methods to make Chinese manufacturing effectively implement sustainable PSS and reshape business models. There is a gap related to development of tools to visualize the potential

economic and environmental impacts upon their business.

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