A Framework of Value Creation for Industrial Product-service

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Abstract. With the increase of service profits, traditional manufacturing enterprises are transforming into providing Product-service System (PSS) which is a new product pattern and manufacturing paradigm. In order to respond to the transformation, this paper proposes the concept of product-service value creation as the value source of PSS. Firstly, this paper proposed the concept of product-service value creation network in order to reflect the complex nonlinear interaction of different value individuals. And the product-service value creation system is analyzed based on value network. Secondly, this paper proposed the product-service value creation process which includes value identification, value proposal, value delivery, and value evaluation. These four steps compose the close-loop of product-service value creation. The study on the product-service value creation lays a basis for further development and application of PSS.

Keywords: Product-service System; value network; value creation; service-oriented manufacturing.

1 Introduction

Since the early 1990s, the driver in our economy has been changing from production of material goods to product-service offers based on knowledge and information[1]. It has become an important trend in the manufacturing industry that service is used to enhance the competitiveness of businesses as well as an important source of values. As a response to this trend, more and more traditional manufacturing enterprises are transforming into providing Product-service System (PSS) which is a new product pattern and manufacturing paradigm[2]. In the mode of PSS, manufacturers provide producer services on process level mutually for cooperative production through integration of services and manufacturing; tangible artifacts and intangible services are integrated to provide a comprehensive solution for customers[3]. Different from traditional manufacturing, the production process of service needs the participation of customers. And the value creation of PSS depends on the close cooperation of stakeholders[4]. So, the value source of PSS is the product-service value creation among stakeholders of PSS[5]. However, there is less research on this topic, in fact

only some application on a small scale[6]. So, this paper will study on product-service value creation process based on value creation network, system, and mode. In this paper, product-service means industrial service portfolio which is derived from physical products and used to meet the value demands of customers.

2 Model of product-service value creation

2.1 Value creation Network

This paper proposed the concept of product-service value creation network in order to reflect the complex nonlinear interaction of different value individuals in the context of PSS. The value creation network is constituted by PSS clusters (realizing scale economy and circular economy) around one or several core business under diffusion effect. The stakeholders and network flows of value creation network could be described in figure 1.

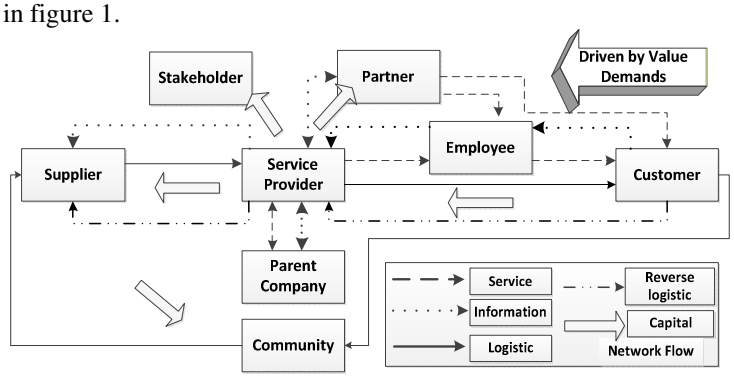


Fig. 1. Product-service value creation network

The value creation network should be interpreted as a value creation alliance with the organization principle of value creation. Its complexity depends on both the number of stakeholders and the service delivery process. The value in network could be defined as the contribution of all stakeholders, including wealth, utility, benefits and rewards. It evolves constantly along with the changes of stakeholders' status, such as priority sequence, viewing angle, willingness to pay, and time range.

Product-service value network is a value creation and management system composed of basic elements such as resource, activity, institution, rule, information, market, relation and so on under the background of service economy. It has the capability of self-regulation and dynamic matching. Stakeholders in different links of value chain could realize continued value increment through value transmission mechanism and network rules. Value network is an open group based on value creation which could provide customized value combination and respond to customer demands quickly by integrated operation.

2.2 Value creation System

Modern enterprises cannot dominate the whole value chain and should improve core competitiveness by outsourcing non-core business. Integration of product and service makes value chain of manufacturing become complex and evolve into reticular. Enterprises' values are determined by final customers and delivered in the value networks.

Value of product-service comes from the customer's willingness to pay for service which is different from traditional value realization based on product delivery. The product-service value creation depends on the closely relationship with customers, such as service contact of product lifecycle. It has been found that value obtained by technology innovation or increased production is limited without taking the customer value as the core. So the value innovation of PSS is a new strategic approach of creating Blue Ocean and breaking through development bottleneck for manufacturers.

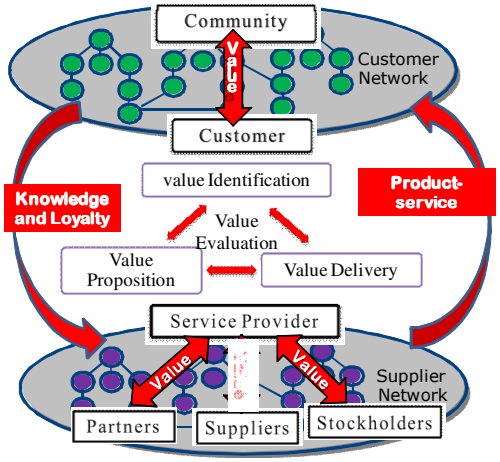


Fig. 2. Product-service value creation system

Service value creation reflects in constructing service system through integrating service resource dynamically and transform the service system into value co-create network composed by people, technology, and organization. In the context of PSS, manufacturer should not be treated in isolation because the value network is composed by supplier, customer, competitor, stockholders and partners as shown in figure 2. The relationships sustain the network across the industry and even national boundaries. The customer demands could transfer in the value network and available for every participant. The value network could bring required product and service to customers accurately through abandoning the activities which is not conductive to increasing customer value. So, value creation mechanism will be formed in order to adjust to dynamic value network and service system. The stakeholders could cultivate value creation capability expected by customers and transform customer knowledge into competitive advantages. The ultimate goal of PSS is providing perfect service experience and sustainable service value to customers circularly through four steps of value creation which will be described in detail in next section.

3 Process of Product-service Value Creation

Based on the above discussion, this paper proposes the value creation process which includes four steps and three cycles. The four steps are: value identification, value proposition, value delivery, and value evaluation. And the three cycles are: value creation, meet demands, and value realization as shown in figure 3. These three cycles reflect the trend of turning from the virtual to reality.

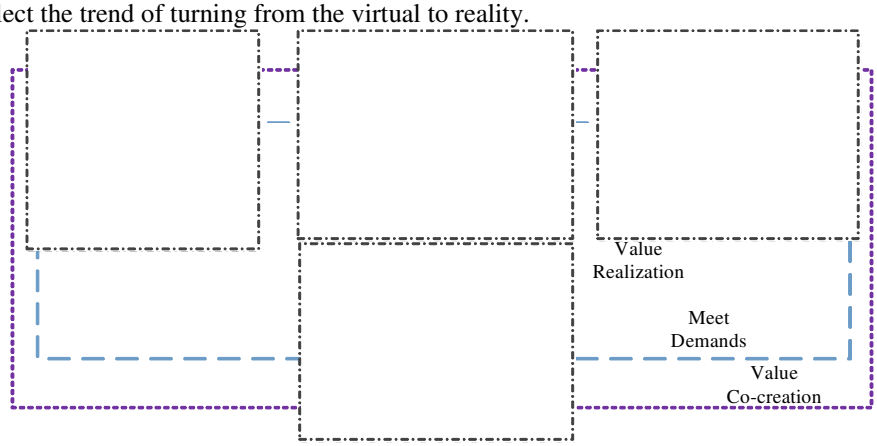


Fig. 3. Product-service Value Creation Process

3.1 Value Identification

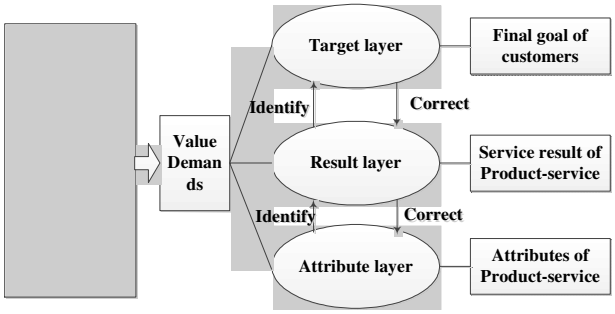


Fig. 4. Product-service value identification

The value of services should be customer perceived value which depends on the subjective evaluation from customers. In order to maximize customer value, the product-service value should be defined according to the most accurate value demands from customers. So this paper mining customer demands from three layers: target layer, result layer, and attribute layer as shown in figure 4. The target layer is the final goal of customers; the result layer is the service result of product-service; the attribute layer is the attributes of product-service. The target layer defines maximize customer perceived gains and minimize customer perceived losses; the result layer defines appropriate function combination of product-service; the attribute layer

defines the reasonable process arrangement of product-service. Based on the value demands identification from customer, the product-service value could be defined from six dimensions according to SERVQUAL model as shown in table 1.

Table 1. Product-service Value Define

Dimension	Value	Description
Reliability	Safety Value	The validity and reliability of product-service
Responsiveness	Efficiency Value	The speed, betimes, and activeness of product-service
Assurance	Credible Value	The power of delivering promised product-service
Empathy	Flexible Value	Personalization of service process; participation and feedback of customers
Tangible	Social Value	Service encounter; service behavior; and service display
Economical	Economic Value	Value perception and service contract

3.2 Value Proposition

The value demands of customers get more services into value chain of traditional manufacturers. With the rise of service, there are more and more value-added parts in value chain. The value chain needs integration and optimization in order to provide more values for customers. So the product-service scheme should be configured according to value demands and value chain extension as shown in figure 5.

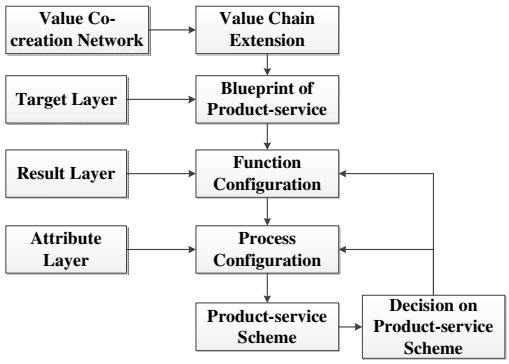


Fig. 5. Product-service value proposition process

Manufacturers integrate and cultivate service capability through service innovation based on optimized value chain. Figure 6 shows two typical roads of product-service extension. The first way is to transform product-oriented service to customer-oriented service which emphasizes improving customer value. And the improvement of product efficiency and effectiveness would be reflected within the customer process. The second way is to transform transaction-based service to relationship-based service by enhancing service innovation.

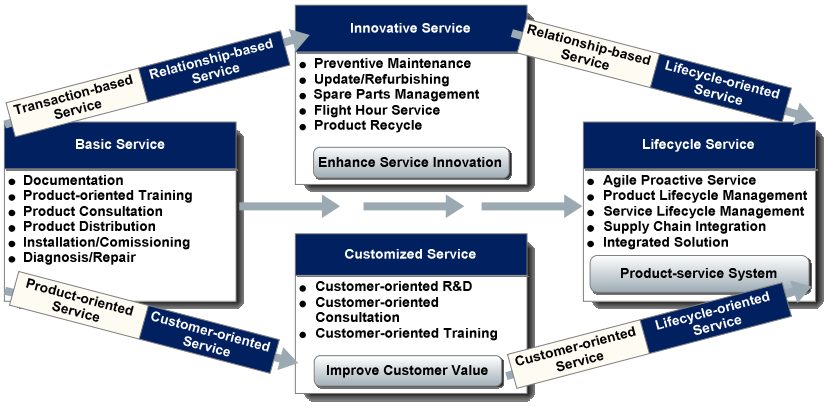


Fig. 6. Spectrum of Product-service

With enough service capability, manufacturers have to propose product-service scheme according to value demands of customers. Modular method is suitable for the configuration of product-service scheme which could be provided to customers in the form of customization-oriented menu. However, different from physical products, service is a set of continuous processes. So service modules could be divided into functional modules and process modules. The functional modules are configured according to the result layer of customer demands. And the process modules are configured according to the attribute layer of customer demands.

3.3 Value Delivery

The value delivery network should be built before product-service delivery as shown in figure 7. The value delivery network could be divided into service network, relations network, trade network, and knowledge network according to product-service value creation network. In service network, service level is the network flow which is a key index evaluating service behavior among enterprises. The higher the service level is, the higher the heterogeneous is. In relation network, relation level is the network flow which is a key index affecting corporate business practices such as business concession, membership system, public praise, reliance, friendship, and so on. In trade network, production level is the network flow which is a comprehensive reflection of various factors such as production technology, production efficiency, added value of service, and so on. In knowledge network, knowledge communication level is the network flow which is the reflection of knowledge kinds, quantity, integrity, and so on.

Different from physical products, product-service could be changed and optimized in the delivery process (service process). In order to maximize the value of product-service, the product-service scheme should be optimized real-timely during the service delivery. For example, the service demands described by customers are not exactly the value demands of customers which are usually mined during service

process. Besides, the service encounter and service process could be optimized along with the improvement of relation level.

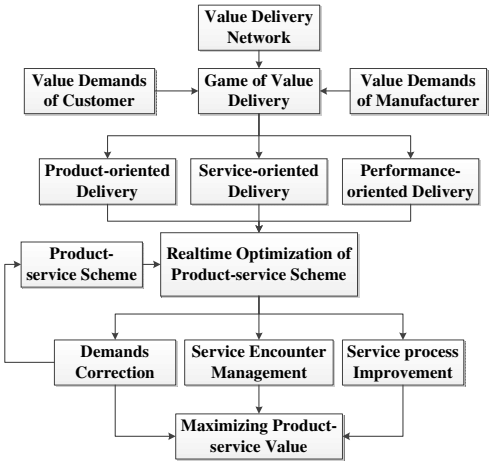


Fig. 7. Product-service Value Delivery Process

3.4 Value Evaluation

The value evaluation of product-service value creation includes two parts: performance evaluation of product-service and ability evaluation of value creation. The first part focuses on the quality of product-service. This paper evaluates product-service from two perspectives: service function and service process as shown in figure 8. The evaluation indexes of service function includes service resource(equipment, capability, and knowledge), service recovery (remedial measure and speed), service level (professional level, advanced level, customization level), service reliable (accessible, sustainable, and flexible), service contract (service price and qualification), service guarantee (preventive, active and supportive); the evaluation indexes of service process includes service response (response mode, constraint, and speed), service operation (continuity, rapid, and convenient), service manifestation (behavior, environment, encounter), service participation (participation style and extent), service personal (personal quality and ability), and service feedback (communication, complaint, and suggestion).

The second part focuses on the realization degree of value needs from customers. This paper evaluates the ability of value creation from three layers: target layer, result layer, and attribute layer. These three layers are corresponding to the layers of customer demands. The target layer evaluates product-service value realization and meeting customer demands; the result layer evaluates customer satisfaction, customer loyalty, financial performance, and product-service performance; the attribute layer evaluates detailed contents of result layer. And improvement suggestion of value creation capability could be proposed through evaluation and analysis of three layers.

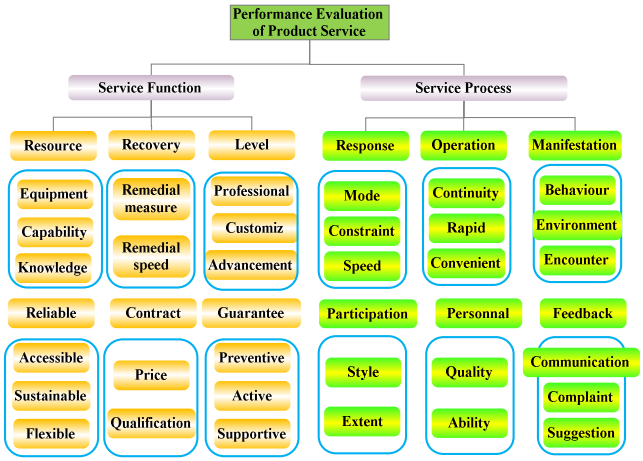


Fig. 8. Product-service Performance Evaluation

4 Case study

4.1 Industrial background

The object of case study is the customer service department of a civil aircraft manufacturer in China. As we all know, aircraft is one of the most complex products. Although the revenue share of after-sales market is less than 25% in aviation industry, the profit contribution can reach 40-70%, or even higher. Now the international large aircraft manufacturers have been trying to extend value chain, improving core competitiveness, and turning into integrated service providers. This case study tries to develop product-service value blueprint for the customer service department based on the assumption that market requirements have been efficiently identified.

4.2 Industrial applications

Aviation industry can show the highly interdependent relationship among stakeholders in value network. This civil aircraft manufacturer could be divided into three departments: design center, manufacturing center, and service center. Along with the lifecycle of civil aircraft, all stakeholders (customers, suppliers, partners and stockholders) participate in value creation around the core enterprise (aircraft manufacturer). Customer services of civil aircraft lifecycle need closely collaboration among customers, suppliers, design department, and manufacturer.

In the value chain of traditional civil aircraft manufacturer, service business belongs to the downstream and is accessory of aircraft sales. As shown in figure 10, in order to develop into an international aviation service solution provider, this enterprise escapes the shackles of traditional value chain (value chain decomposition), construct service value chain and develop core service business (value chain expansion), and finally re-engineering value chain (value chain integration). The main

customers of civil aircraft manufacturer are airlines, so it is important to streamline value chain after identifying customer value, optimize core business process under value chain management, and realize value-added through service innovation around business needs of airlines. The whole service system is established through the four steps of value creation process.

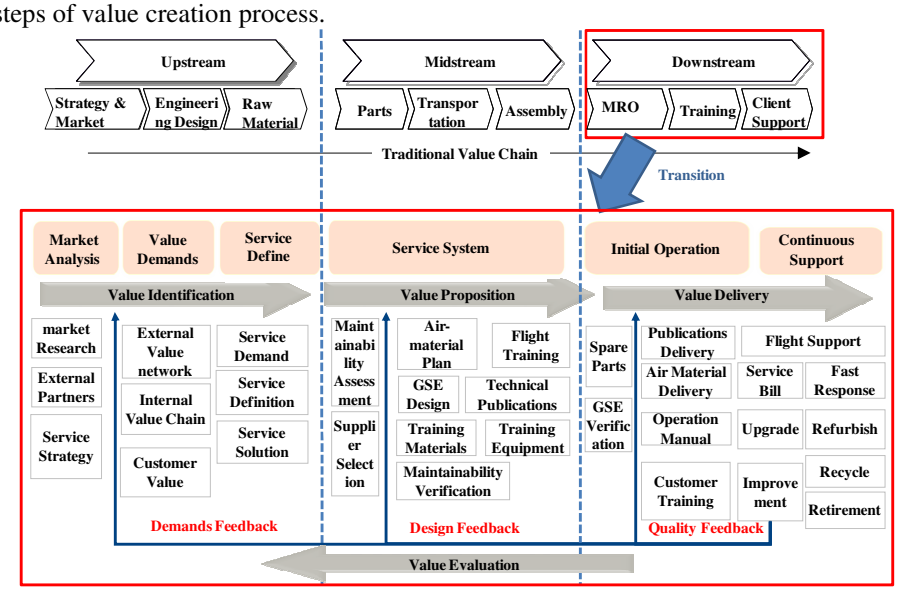


Fig. 8. Value creation process of civil aircraft services

4.3 Potential industrial benefits

According to the value creation model, the sustained profitability of service enterprises derives from close cooperation among stakeholders of value network. Through the external value network analysis, service enterprises could extend their internal value chain from manufacturing domain to service domain and improve their position in the value chain. Based on the optimized value chain, service enterprises could integrate and cultivate service capability through service innovation.

With the value creation process, the product-service blueprint of civil aircraft could be formed which is divided into three parts: basic services, extended services, and value-added services. The basic services are supportability services used to meet the flight demands of safety and reliable. It must be provided to airlines by manufacturer and meet the minimum industry standard. The extended services are used to improve customer satisfaction and assist airlines to reduce operation and maintenance costs. The value-added services belong to innovative services. It is highly customized service solution and needs advanced service technologies and equipment. It could raise the service profit and would not be copied easily by competitors.

5 Conclusion

Industrial product-service is beneficial for manufacturing industry upgrading on value chain in order to get more profits. This paper study on product-service from the perspective of value creation and proposes a framework of product-service value creation. And it also provides a new research road of product-service. However, the study in this paper is mainly based on qualitative discussions. And it needs the quantitative model and algorithms which are the follow-up study of authors in the future.

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