

# PSS Value Transformation: From Mass-Manufactured Vehicles to Provision of Mass-Customized Services - A Case Study of Designing and Prototyping Customized Digital Services for SAIC Motor in China

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## Abstract

This work focuses on exploring how to transform the PSS strategy through conceptual design and prototyping to a way in which different stakeholders in the case car company – SAIC Motor – can experience and give feedback on the PSS strategy, analyze the impact of the PSS strategy on the process of customized digital service design in a traditional Chinese car company. Also, the work discusses how to increase the service value for different stakeholders in the overall PSS system.

*Keywords: product-service systems (PSS), experience design, prototyping, case study*

## 1. Introduction

The gradually spreading servitization trend (Vandermerwe et al., 1989) has been identified among industrial companies acting in the global market. Manufacturing companies that were traditionally perceived as product-centered, are today increasingly influenced by a service-oriented theory, which claims that the company's provision is merely a proposition for the customer to realize at point of use (Vargo et al., 2008). In the past decade, this theory has attracted global interest from researchers and industry players, spinning-off initiatives such as Product–Service Systems (PSS) (Goedkoop et al., 1999), Functional Products, Industrial Product Service Systems (IPS2) (Meier et al., 2010). Researchers highlight that large traditional manufacturing companies have moved their position in the value-chain from product manufacturers to providing customers with "desired outcomes" (Bertoni et al., 2016), by combining products and services. Not only does this theory allow manufacturing companies to generate new revenue streams, to build closer relationships with the customers (Ravald et al., 1996) and to increase business value to a level not reachable by only relying on hardware improvements (Mathieu et al., 2001), but it also carries great potential to deliver designs that are sustainable while meeting customer needs (Roy et al., 2000).

By integrating the hardware product and pure service toward the provision of a functional solution rather than individual products, manufacturers can arrive at Product–Service System (PSS) solutions (Tukker, 2004). When purposefully designed, PSS solutions provide increased customer value, improved long-term return on investment, built-in environmental-friendly aspects and potentially also spare part and environmental waste reductions (Tukker, 2004). However, focusing on the functional integration of products and services affects the manufacturer's product development process. how development work is organised and which tools and methods are used. The traditional car companies pursue production and sales in the industry primarily through car manufacturing and car sales. The

products provided to customers are still standardized, and there is little room to cater for individual needs. The design procedure was cost-effective because the basic product was re-designed, and consumers could select the assembly combination they preferred the most (Pine, 1993). This product-oriented model that relies on mass-manufacturing also involves challenges in bringing sustainable revenue growth, and reducing the consumption of resources and environmental pollution from manufacturing. From the product sales model, what car companies can finally obtain is the price difference of selling cars to traditional dealers, which is far from enough to support the high R&D cost of product development, marketing and logistics system construction (Lei, 2019). The traditional product sales model inevitably causes a series of customer pain points (Lei, 2019) which poses long-term challenges to the industry but has been unable to find corresponding solutions. The pain points faced by car customers in the process from car search, selection, delivery, and use to replacement can be summarized into four categories:

1. One-way communication: lack of interaction between customers and car companies.
2. Product-oriented: lack of customer-oriented service.
3. Strong standardization: difficult to configure personalized solutions.
4. Slow upgrade cycles: product and service upgrades can not keep up with changes of customer demands.

In view of the pain points surrounding the full life-cycle of car customers, the challenges faced by PSS researchers of this work can be summarized into two major issues:

1. How to provide a customized digital service for mass-personalized demands in the early design and development phase?
2. How to prototype the PSS strategy to let different stakeholders in the car company understand service value in the early design process and implementation stage?

## 2. Research methodology

This work started with a review-based study of the literature and of existing design support, then leading into case study research (Yin 2013) focusing on applying a PSS perspective on the design of customized digital services for SAIC Motor. More specifically, how the PSS design can facilitate a transformation of the relationship between customer and car company. Testing of the new PSS concept's impact was conducted via conceptual design and experiential prototyping, to explore how the new concept could transform the company's PSS strategy and also enable different stakeholders in the car company to understand its value in the early design process and implementation stage. Data from the prototyping process was gathered in the form of user feedback via questionnaires and qualitative data from researchers conducting prototype testing with stakeholders. The selection of the data collection methods depends on the kind of information the researcher intends to retrieve, from whom and under what circumstances (Robson 2002). Finally, the qualitative table comparison was used to analyze the service value changes perceived by different stakeholders due to the applied PSS strategy.

## 3. Scientific Background

### 3.1. PSS Design

Complexity in product development is emphasized when hardware, software and services are packaged into a single 'total offer' (Alonso-Rasgado et al., 2004). Product-Service Systems, PSS, (Mont, 2002) is one of the industrial trends representing the shift in manufacturers' strategic focus from selling a physical product to providing performance and availability, as a way to satisfy more sophisticated needs and expectations (Baines et al., 2007). Even though PSS originates from a strong sustainability perspective, a shift in focus from environmental benefits to economic benefits has occurred during the last decade (Haase et al., 2017). PSS are increasingly seen as business strategies created by companies that intend to strengthen their market position and create a competitive advantage by traditional transactional product sales.

The most dominant way of describing PSS in the literature (Tukker 2015) distinguishes three types of PSS, as follows:

- Product-oriented PSS: Products are sold to the user, but additional services are added, such as maintenance or product-related consultancy.
- Use-oriented PSS: The business model is geared toward selling the product function, that is, through leasing or renting and the product remains the ownership of the PSS provider.
- Result-oriented PSS: The business model is geared toward selling a result and is as such closest to offering a pure service, where no predetermined product is involved.

Compared to the traditional one-sale model, designing these PSS types challenges engineers to raise their awareness of customer and stakeholders' needs along the entire product lifecycle, in order to realize solutions that are value-adding for all the actors involved (Isaksson et al., 2009). The need to integrate several domains (i.e. product development, service development, recycling, etc.) means for organizations to move "downstream" knowledge (from the later phases of the life cycle) into the early phases of the design process and raises the demand for methods and strategies that support collaboration and cross-disciplinary integration in design. A strategy to foster collaboration is to structure this knowledge in models that enable design teams to play with the definition of design concepts, and to sort out the optimal combination of hardware and service that maximize the 'value' trade-off (Isaksson et al., 2015). However, how to build effective 'value models' to support trade-off activities and decision making in the early stages of an intentional PSS design is still an open question both in literature (Isaksson et al., 2015), (Bertoni et al., 2016) and in industrial practice.

### 3.2. Experiential Prototype

Overall, the venture of prototyping is to gather information to help in the decision-making process of design. Prototyping provides opportunities for fast feedback, new inputs and a hands-on user experience readily available. Furr and Dyer (2014) assert that rapid prototypes have a fundamental role in hypothesis validation. They also discovered that in some cases it can be beneficial to fake the capability of a product if the experience is your key point of investigation (Furr and Dyer, 2014).

Experiential prototyping techniques endeavor to accomplish three goals towards addressing the problem: communicating ideas to an audience, exploring and evaluating design ideas, and understanding existing user experiences and context (Buchenau and Suri, 2000).

## 4. Results

### 4.1. PSS IMPACT

From the perspective of analyzing SAIC Motor's, their traditional model was dominated by pure car sales, in the entire lifecycle, car company manufacturing according to annual sales targets and production plans. The cars were sold to dealers, and then the dealers sold to consumers. Even in the early design stage, products and services are not designed by closely taking into account customer demand and real feedback from consumers. From the perspective of service, the entire chain of car companies does not provide customer services to customers but the provisions were provided by dealers, and customers do not have the possibility to articulate their own needs to the car company, and they are not involved in the process of product development. The entire value chain was product value oriented, with far less value coming from services (Figure 1).

Through the new PSS design (Figure 2), an online customized digital platform called "SAIC Maxus" was designed to guide customers to participate in design and product development. The core of the customized digital service is the digital direct connection between the entire value chain and customers, which means that every link in the value chain that creates value for customers will also directly face customers through the platform. The whole value chain was intended to be user-driven and participatory, allowing customers to create their own exclusive models. The stakeholders responsible for product definition, service model, pricing model, and even profit model can all communicate with customers. The operation of car companies and operation of dealers thus has the potential to be more fair and transparent for customers' service experience. However, in the face of

the complex of customized service system engineering, how can product-service system design reorganize the value chain in SAIC internally? The new PSS system mainly consists of three stages constituting the customer value stream:

1. Front stage of end users: directly obtain first-hand customer demand information and data.
2. Midstage of service providers: Establish an interactive platform to communicate with customers and provide service delivery to customers.
3. Backstage of industry providers: Connecting to the smart supplier system, realizing the digital direct connection between the entire value chain and users in a fully transparent model of the entire vehicle. PSS design has established a digital transparent factory and transparent company with a full business chain that is transparent to customers.

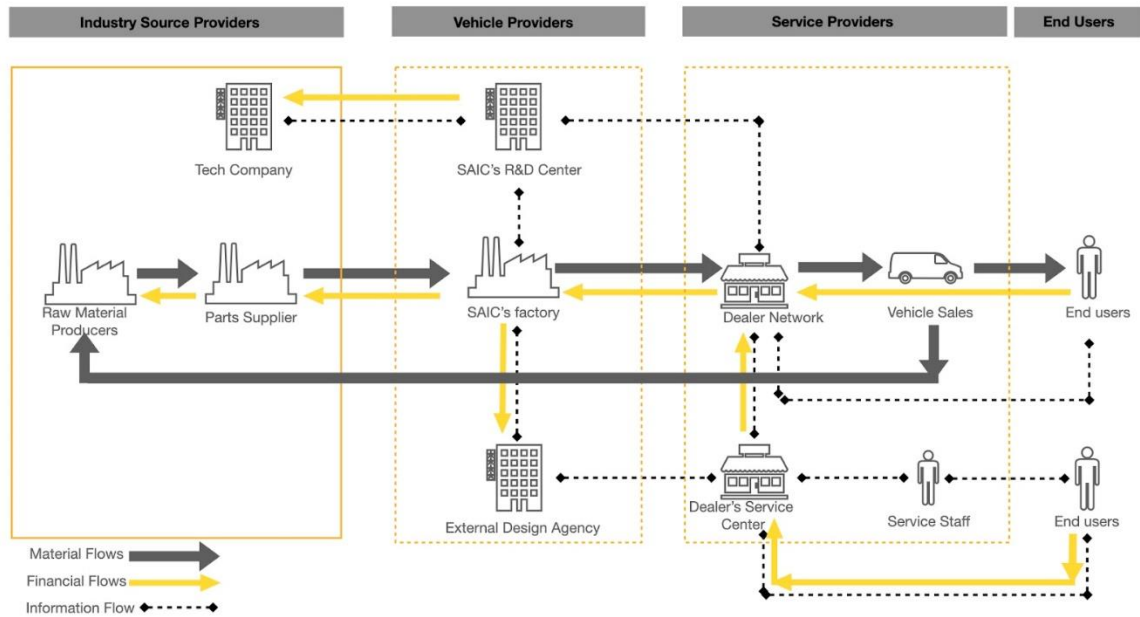


Figure 1. Existing model of SAIC selling pure products before PSS design

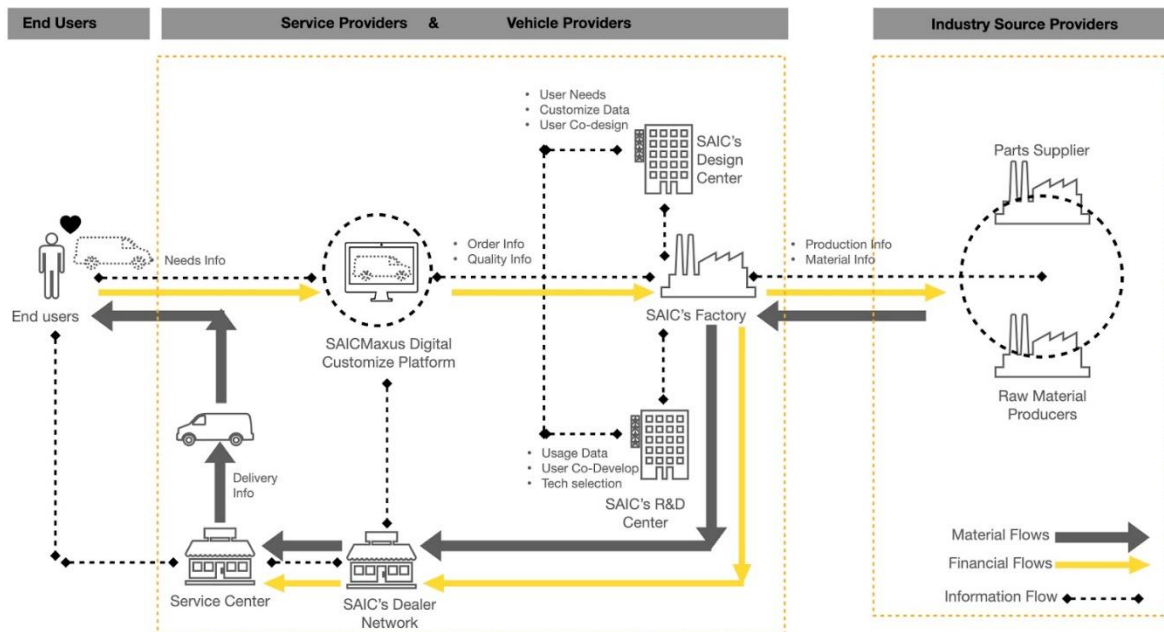


Figure 2. New PSS model of SAIC providing customized digital services

## 4.2. Digital Service Prototype

In order for the PSS strategy to be understood by different stakeholders in SAIC and to support the implementation of the PSS design, the digital service prototype progressed through three stages: conceptual design sketch, small-scale prototype and full-scale prototype.

**Conceptual design sketch:** First of all, according to the strategic intent in the PSS system diagram in the early design stage, the concept was hand-drawn into a customized service (Figure 3). In the design process, the connection of service flow between the customer and SAICMaxus, which is a digital customization platform of SAIC, was expressed in the form of characters, customer experience journey, service process, and digital experience. Through the conceptual prototype of the customized digital service, the PSS theory was clearly explained to different stakeholders within SAIC.

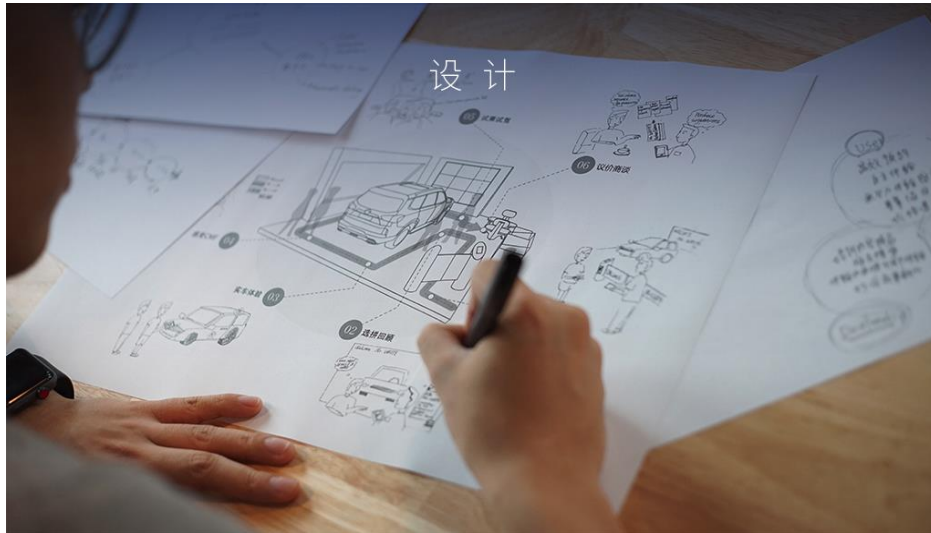


Figure 3. Conceptual design sketch of PSS strategy

**Small-scale prototype:** The design concept was deployed in accordance with the 1:15 ratio of SAIC's product D90. The customized service was designed in advance to become a digital service experience, and the entire service process can be experienced through visual display and interaction. By embedding an iPad on the prototype to simulate the process and experience of customized services (Figure 4). The entire prototype was used to evaluate beneficial tools for user experience and service process improvement before implementation.

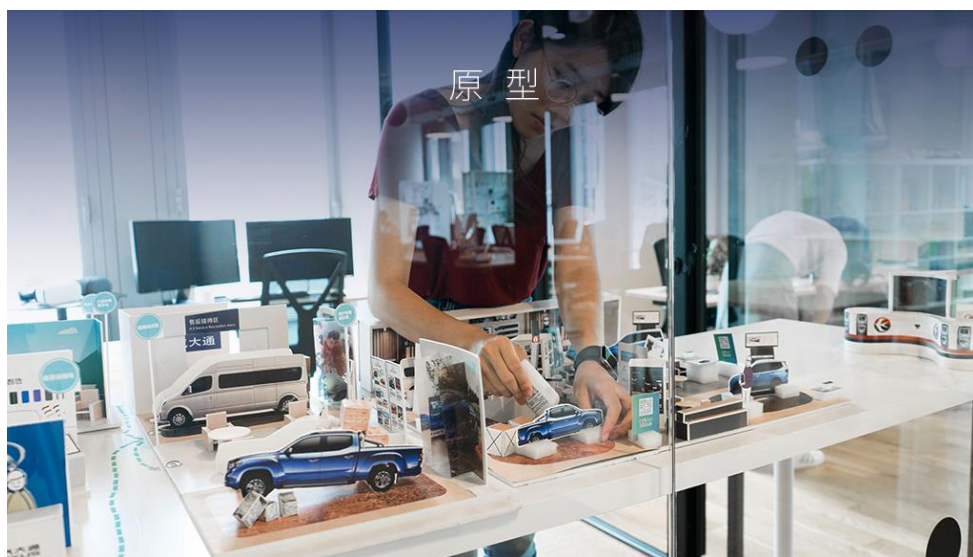


Figure 4. Small scale prototype of customized service in a simulated environment

**Full-scale prototype:** The entire prototype was built in full-scale 1:1 for testing in the real use environment. The prototype construction process brought together different equipment, space solution suppliers and system developers in the implementation (Figure 5). The digital prototype was equipped with the SAIC Maxus customization system. Customers can customize the vehicle configuration according to their personalized demands directly in front of the large screen. The proposed configuration information will be transmitted to SAIC's data center to optimize the design plan. At the same time, SAIC Maxus will also be based on customer needs to introduce the best configuration options, the total cost of the options, and the production time.



Figure 5. Experiential prototype of customized digital service on 1:1 scale site

## 5. Discussion

In the prototype phase, this work allowed different stakeholders to experience the real scale of service prototypes. This table (Table 1) was used to compare the impact of pre-PSS and post-PSS strategies on designing customized service for different stakeholders of SAIC Motor. Through comparative analysis, customized digital services allow SAIC to conduct product development and design based on mass user data. Moreover, users were allowed to collaborate with SAIC in the design process. For car dealers, customized digital services allow them to provide not only consulting services, but also allow customers to experience a digital experience in the store. For customers, customers can participate in the co-creation process, and at same time they can generate their own dream car online according to their personal needs and demands. For the supply chain, there are opportunities to customize accessories and parts according to the data of customer needs. The supply chain can also provide customized services to customers as well.

The service transformation of auto companies is no longer a long-term goal but an urgent action. Introducing the PSS strategy into large car companies, especially the strategy of service-oriented transformation, will face many doubts about whether or not it can be implemented. In the design process, the PSS strategy needs to be shared and explained to different key stakeholders within the car company. It is far from enough to explain the PSS system design diagram to decision makers and stakeholders. What is more complicated is to make customers feel the service value and experience brought by the PSS strategy.

The main contribution of this work was about integrating the PSS strategy into the customized digital service design. Through designing the digital service platform – SAICMaxus – more customer needs can be directly connected to the process of design and development in car companies, so that customers

can participate in the early design phase of PSS. Car companies can also provide customized digital services based on collecting massive customer needs. Traditional car company services serve the car itself, but customized digital services can serve a mass number of customer needs. Moreover, the data platform can share demand data with the automotive supply chain, forming a new model of the automotive value chain driven by customer demands.

**Table 1. PSS strategies supporting value-adding services to different stakeholders**

<b>PSS type</b>	<b>SAIC value-adding services</b>	<b>Dealer value-adding services</b>	<b>Customer value-adding services</b>	<b>Supplier value-adding services</b>
Pure Product Product sales (Without PSS implied )	<b>Manufacture according to the dealer's order.</b> Relying on the sales indicators of the automobile industry for manufacturing. No customer service provided	<b>Provide vehicle sales and aftermarket service</b> Provide sales services based on SAIC's guideline.	<b>Receive sales service</b>	<b>Manufacture according to SAIC's order</b>
Product Oriented Product related services (Without PSS implied )	<b>According to customer orders</b> Relying on dealers' annual sales volume for manufacturing, SAIC provides service standards for dealers, but Maxus does not provide services by itself.	<b>Provide 4S service standardization</b> process to provide services, the service is only for sales and maintenance.	<b>Receive 4S service</b> The service that the customer receives is only the service related to the vehicle.	<b>Manufacture according to SAIC's order</b>
Product Oriented Product related advice (PSS implied in this case)	<b>R&amp;D and production planning via user's data /User demand feedback / Customized digital service/ User Participation Design</b> Users can inform SAIC of their mobility needs and preferences through the digital terminal. Users can participate in the online design activities provided by the Maxus design center and put forward their own creative ideas. Users can personalize their vehicles on the digital terminal and continue to optimize their dream vehicle configurations.	<b>Customized service Digital Experience Service</b> Dealer helps users to use digital equipment to customize vehicles through service consultancy. And they can experience vehicle usage scenarios through digital and virtual approaches.	<b>Receive customized service</b> Through the digital platform, customers can customize their dream car according to their needs, just like a virtual game. Customers can better understand the virtual usage scenarios through the digital terminal, and then decide the configuration plan.	<b>According to customer orders</b> Parts customization service. Suppliers design and produce parts according to the needs of customers to satisfy customers, and have the opportunity to connect with customers through a digital approach.

It was not easy for stakeholders to understand customized digital services formed through PSS strategies during the implementation process. The overarching PSS concepts and complex engineering systems make it difficult for stakeholders to understand and accept. In this work, by selecting an experiential prototyping approach, firstly, a small-scale model was used to establish the entire systemic and participatory experience, and digital interaction was used to simulate the customer's full service journey and digital experience during customization. The prototyping allows stakeholders and PSS designers to adjust and modify the concepts based on real feedback during testing. After that, this work established

a 1:1 full-scale prototype, through joint collaboration with different suppliers at the time of deployment, a prototype that allow customers to actually perform customized services was built in place at SAIC, and digital and multimedia technologies were used to simulate the transparent connection between customer needs and the SAIC product customization process. The service value in PSS design can thus be accepted by customers, and the customized service that SAIC expects to provide can be tested and adjusted in an agile way by different stakeholders. Eventually, it was also released to the market in 2018.

From the perspective of the entire product life cycle, mass-customization is planned early in the process, in advance of the actual product purchase, so that the product can better meet the needs of customers using a data-driven approach. A key motivation behind such an approach is to allow customers to derive the expected value from the product during its use phase, and avoid vehicle overproduction and abandonment caused by unsatisfied needs or unexpected product characteristics discovered by the customer after the purchase. This increases the complexity of the PSS design and development (Mourtzis, 2018) and this complexity needs to be managed early on in the PSS design process.

The scalability of PSS solutions can provide better customer service and create more value by transforming production capacity into service (functional) capacity. At the same time, mass-customization also changes the existing sales model from producing product value to providing service value via use of function rather than provision of goods, hence PSS is gradually affecting car companies' value models via servitization.

## 6. Conclusion

The automotive industry is in the process of transforming from traditional product manufacturing to providing customer service in the form of PSS solutions (i.e. functional provision). This work applies the PSS concept to the design of customized digital services provided to SAIC, a leading car company in China. In the process of PSS design, by proposing a digital custom platform – SAICMaxus – it connects the customer demands data and involves the customer participation during the process of product design, product development, service upgrade and supply chain reconstruction based on mass of user data. During the design process, the experiential prototypes were used to allow different stakeholders to better understand and provide feedback on adjustments to the services in the PSS design. PSS Design plays an important role in the service transformation of car companies.

As part of the PSS solution, the customized digital services described in this case have only been introduced to one car brand, SAIC Motor in China, and have not been widely accepted and applied in the entire automobile industry. Future research should also take into account the impact of PSS solutions in other industrial sectors and in other countries around the world.

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