Impact of Smart Services to Current Value Networks

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ABSTRACT

Promising market offerings are increasingly based on the close interaction of physical products and accompanying services – this is expresses by the term product service systems. A new trend is the expansion of the product service systems by data-driven, intelligent services (called Smart Service). Examples include predictive maintenance or automated re-ordering of consumables and materials. Such enhancements can significantly help to secure the customer interface and generate additional profitable business with new revenue models, such as pay-per-use rather than selling a machine. To take advantage of this opportunity, companies must develop promising Smart Services and implement them in their value network. The present paper shows the necessary steps for a company. The first step shows methods for the conception of Smart Services. The second step is the analysis of the current value networks. A comparison of the new functions and requirements of the Smart Services with the value network leads to effects and necessary changes. In the last step, changes are translated into a roadmap for implementation.

Keywords: *Digital Transformation, Product-Service-Systems, Smart Services, Value Networks*

Digitalization of the Industrial Services

More than 100 years ago, Henry Ford began the mass production on assembly lines making automobiles affordable for a large part of the population. However the cost reduction did not lay only within the perfected production lines but also on the rationalized value chain - from raw material acquisition

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to vehicle delivery [14]. With the introduction of industrial mass production and division of labor, the individualization of the products disappeared due to the lack of direct customer contact. The companies responded by diversifying their product portfolio [23] and focusing on the development, production and distribution of physical goods [1]. The market offer of the companies consisted of the sale of their products with many variants and complementary services (for example, maintenance or training).

Services are gaining in importance: The share of the tertiary sector in the overall economic performance is now more than 70% [8], [12]. Products are often viewed as a platform to offer complementary, product-related services to the customers. For some time, there has been an uninterrupted and rapid progress in digital transformation [17]. Information and communication technology affects all areas of life and enables unimagined new potential for innovative product-service-systems: the combination of intelligent, networked products with a life cycle complementary, data-based services – so-called Smart Services [15]. In general if new technologies are introduced or customer requirements change, companies are at risk of a changing competition. The arrival of intelligent, networked products and Smart Services will dramatically change competition. To illustrate the changes regarding Smart Service the method of Porters Five Forces is used in the following. The forces are bargaining power of buyers, industry rivalry, threat of new entrants, threat of substitutes and bargaining power of suppliers [15], [17].

Bargaining power of buyers is reduced: Smart Services offer much more potential for differentiation and customization, which means that the price as a competitive factor loses in importance. Knowing how customers use their products, companies can better fit their market offer and pricing to their products and expand their value proposition. Companies can bind their customers more closely by using the customer data to generate a lock-in effect.

The nature and intensity of the industry competition is changing: Companies can expand their value proposition beyond the actual product through valuable data and value-added services. This creates new possibilities for differentiation. The value network changes and companies from different sectors suddenly compete.

New market players are entering the scene: If companies fail to play an active role in designing the digital transformation and shield themselves instead, new competitors can tap into this gap. A particular threat arises by new market participants without a physical product, who are developing a profitable service business for an existing third-party product. Platform providers are a special threat as they try to fill the customer interface completely and skim a significant share of the profit. When the producer is

separated from his customers, he runs the risk of being a supplier. Although gaps arise for new market participants, well-established companies have the opportunity to improve their products and services based on the customer's data, as well as to redefine their service business with Smart Services. However, this often requires a fundamental change in value creation.

Threat of substitute products and services: Product-service-systems with on Smart Services are threatening established products due to their increased range of functions. Conversely, product-service-systems are often more powerful, individually configurable and offer higher customer value, making them more resistant to substitutes

The bargaining power of the supplier's shifts: Smart Services increase the customer value with intangible, software-based functions. The share of traditional supplier's decreases or will eventually be completely replaced by software. However, Smart Services are creating new dependencies with new suppliers (for example sensors, data analytics). The balance of power of supplier relationships is shifted.

Many companies in the manufacturing sector are now faced with the challenge of designing their digital transformation. The biggest challenge is the redefinition of the established business in the direction of product-service-systems. This step is crucial to occupy the customer interface and to block platform providers as new competitors. There are two main fields of action:

1. Strategic planning and conception of product-service-systems for existing products by integrating smart services into these systems.
2. Proactive change of the value network to offer smart services in addition to the production of physical products.

Impact of Smart Services to current Value Networks

In the following we show the interplay of the two fields of action mentioned above. This is divided into the four areas: planning and designing smart services, current value network, impact on value creation and the related implementation planning. The result is the basis for the further course of a company, whether and how (make-or-buy) the new product-service-concept should be implemented. To illustrate the fields of action the example of a professional dish-washer is used, which is to be expanded by smart services.

Planning and Conception of Smart Services

In a first step, promising services for a product have to be identified (planning) in order to develop selected ideas for concrete concepts (conception) in a

second step. In the present paper only the conception is considered. It is assumed that the result of the planning is a selected new service. In this example of the professional dishwasher it is an automatic reordering of consumables (detergent, rinse aid and salt).

The basis for a smart service is an intelligent, mechatronic system that performs services fully or partially automatically and thus forms a product-service-system (PSS). For the specification and model-based representation the modelling languages CONSENS [10], Service Blueprint [6] and a modelling language for value networks [21] are used. Figure 1 shows the used language elements for the integrative and model-based representation in the overview. Starting with the product concept, the single constructs are explained in the following.

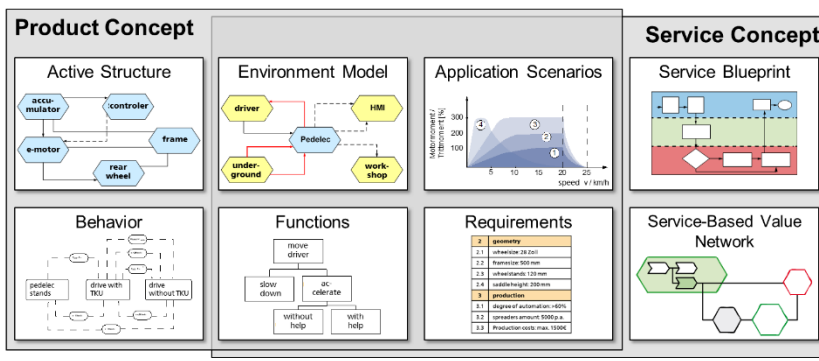

Figure 1: Constructs for the model-based representation of product service systems, which contains Smart Services

The product concept is specified by the architecture as well as by the interfaces. This includes an active structure, environment model, functions, behavior, application scenarios and list of requirements. The overlapping of the product and service concept lies with the environment model, functions, application scenarios and requirements. The environment model describes interfaces to the user of the system (service recipient) as well as its environment. Smart Services are data-based services, whereby the data exchange with the systems in the environment is important part of the functionality. Application scenarios describe the fundamental behavior of the system. In the example "Automated reordering of consumables", the interaction of the product (for example filling levels) with the service (delivery of detergent and billing) is described here. A function hierarchy describes functions of product and service equally. An assignment can only take place at the lowest hierarchical level. The same applies to the list of requirements.

The service concept is essentially a process with executing resources and can be represented by using appropriate methods. Methods for business process modeling enable the representation of service creation processes [7]. Semiformal modeling methods are basically suitable for representing service processes. Examples are ARIS, BPMN and OMEGA. A very important component of smart services is the customer interface as well as customer activities in the process, which are not adequately considered with these methods. A more suitable method for the representation of the customer interface is the Service Blueprint, which originally only offers a few constructs [20]. It is appropriate to link constructs for the presentation of business processes and the structure of Service Blueprints to one another [19].

A service is subjected to a principle called uno-actu, i.e. the service delivery and its' usage are at the same time [3]. This leads us to see the value creation system, which provides the service in conjunction with the product system, as part of the service concept. In the example of the dishwasher, the service of reordering consumables is delivered through the dishwasher since it is measuring the filling level, the consumption and triggering the reorder. Then other parts of the value network are involved: The placed reorder needs to be executed by the logistics. Furthermore the accounting need the information to invoice the order. Recently the service need to make sure that the customer received the order and replaced the container correctly which is all performed by the intelligent system as part of the value network.

To illustrate the value network an own model-based method was developed. It is used to describe the existing value creation and plays a central role in further requirements analysis and implementation planning [5], [21]. For the service concept, only the value network units, processes, resources and relationships relevant for the service are specified.

Current Value Creation

Value networks form the starting point for product-service-systems. The value creation is no longer only the development and production of physical products and ends with its sale. Products need to be accompanied by a technology- and service-infrastructure [11], [16]. This results in two main challenges for the design of viable value networks for product-service-systems, which are based on the system's lifecycle: (1) The product-based value-added system for the realization of the product at the beginning of the product life cycle. Generally it comprises the necessary production processes, resources and supplier relationships [7], [8]. (2) The service-based value network during the use phase of the product-service-system. The information and communication flows between the user, the product-service-system, and the corresponding processes and the systems of the provider are of particular importance [8].

An own modelling language was developed in a project (GEMINI) for the specification of the current value creation [21]. The language is used to

model the current product-side as well as the service-side value network. The current value network includes the partner network, the production system, and the current organizational structure of the company [13].

Information and communication technology, product-related and service-related value networks are closely connected in the context of product-service-systems. In order for companies of the manufacturing industry sector to be able to operate successfully in the future, it is necessary to map the enormous effects and complex relationships. Therefore, a principle solution for value networks is required, which describes the basic structure and the mode of operation. It forms the basis for the structuring, development and analysis of value networks, and supports the operationalization of product-service-systems [4].

Impact on value creation

At the beginning, the requirements for the future value network have to be derived. The requirements support the later specification of the individual value network elements and serve as an important starting point in the implementation planning. The requirements result from the areas shown in Figure 2: product concept, service concept, existing value network and company-specific general conditions of business planning.

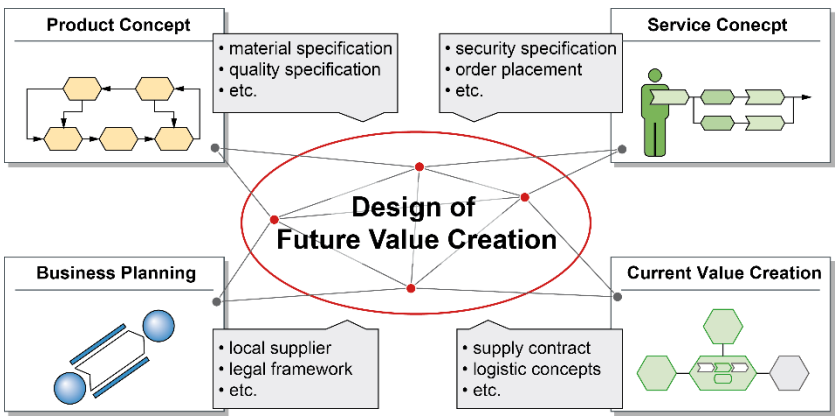

Figure 2: Areas from which requirements for the design of the future value network arise

The requirements from the product and the service concept result from the planning and conception of the smart services. These include, among other things, specifications for the communication between the individual components of the service concept and corresponding organizational units of the value network. Requirements from the field of product conception describe certain assemblies or components which are necessary for the implementation

of the service. This might be the need for a WLAN interface and certain sensors in the system if it should trigger a reorder of consumables. Requirements from the existing value network are regarding suppliers or partners. In the example it is about how to use the existing logistics for the fast delivery of consumables.

Requirements from the area of business planning are derived from the corporate mission statement or the strategy. Examples might be to use the existing service partners to perform the new service even it would be more profitable to change this. Another example is the exclusive use of cloud server located in a certain countries which are used to collect the data around the system. Each requirement is specified by attributes and their characteristics and collected in a list of requirements.

In the analysis of the impact, the implications of future smart services must be examined for the existing value network. The focus is on the identification of value creation processes that result from the change to product-service-systems. The basis of the future value network are the already existing value creation processes and activities. These have historically grown and enable a company's current value creation [13]. In order to be able to offer individually configurable product-service-systems, these processes must be modified and adapted. This adaption called the digital transformation [2]. Two dimensions must be taken into account: (1) the change of the customer value and (2) the resulting design of the future value creation [9], [22].

The mentioned example of the automatic reordering of consumables, has a clear benefit: The customers no longer has to worry about the procurement, but automatically receives the consumables he needs. However, the resulting changes in the value creation are not clear. In addition to logistical changes affecting shipping or storage, there are changes in the payment model or in relation to intermediaries like the supplier of the detergent. In addition to the direct impact, other processes are often indirectly influenced. An automated reordering of consumables leads to changes in the customer service. While the traditional, mainly mechanical product had to be maintained, service competences in the area of internet-based communication have to be set up. By a failure of the communication components, the smart product would lose its new value proposition.

Different causal chains result, which lead to changes in the existing value creation. These complex relationships must be systematically identified and analyzed in order to be able to design future value creation. In a first approach, the new product and service functions must be compared with the individual activities of the current value creation. The functions can be supplemented by information from the list of requirements. This particularly applies to requirements that are not determined by the service or product concept. These primarily include requirements from business planning, e.g. the already mentioned preferring of local cloud provider. The individual functions,

requirements and value creation activities must be evaluated against one another (Figure 3) in order to identify those value creation activities that are particularly affected by changes. For each pair, it should be determined whether and how strongly the impact of the "new" function on the existing value creation activity is. The concerned activities must then be considered in more detail, since they are of great importance in the subsequent design of the new value creation. In further steps such value creation activities and areas are identified, which are influenced by the changed activities. A suitable method for identification is the direct and indirect influence analysis [7]. The influence of a value creation activity on the other activities is assessed. A distinction is made between no, weak, medium and strong impact. As a result, value creation activities can be identified, which are strongly influenced by the affected activities. The combination of the areas leads to the already mentioned causal chains. For detailed analysis and specification the mentioned modeling language from the project GEMINI can be used [21].

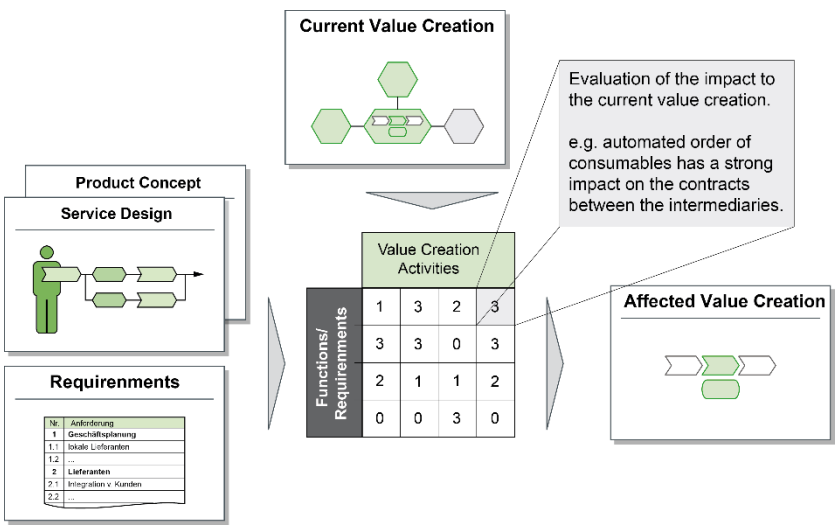

Figure 3: Assess the impact of the product service concept on the existing value added

Implementation planning

Particularly for small companies, the adjustments are very complex and difficult to implement. This is partly due to a lack of competencies in new fields (such as data analytics) and the complex implementation of the necessary changes. Therefore so-called standard specification are available for the implementation. These fulfill recurring functions and comprise all necessary processes, organizational units and their relationships [5]. For example the reordering of consumables always need the measurement of the

consumption and inventory stock regardless of whether the consumable are detergent or coffee beans. Standard specifications are based on existing value-creation solutions. For this, a large number of known examples are analyzed and their characteristics are defined in the standard specification. They serve as a kind of best practice. The design of value creation is based on the life cycle of the designed product-service-system. Different specifications of the value creation are assigned to individual life cycle phases. Thus the value network in the development phase is clearly different from the use phase, since different competences are required. In this context, the creation of a common development roadmap is suggested. The roadmap allows to visualize and plan the various steps.

Summary

Smart Services have the potential to secure customer interfaces permanently and profitably. This is particularly necessary when new competitors (esp. platform providers) try to occupy this interface. For example if an automatic reordering of detergent is implemented and the detergent is also an own brand, there is an ongoing value stream and customer contact over the whole lifecycle. And if a payment-model like pay per use is implemented with these services, the costumer interface is even better protected. For example a logistic platform cannot interpose itself as a provider of detergent like Amazon Dash. The development and implementation of product-service-systems, which contain smart Services, requires a new approach in four areas. When designing smart services, the necessary value networks have to be considered at an early stage as an integral part of the service due to the Uno-Acto principle. Furthermore, smart services are partly functions of a technical system that performs a service. This changes the approach in the design of product-service-systems and requires an integrative consideration of product, service and value creation. It becomes clear that the impact on the value creation are often profound and cannot always be identified immediately.

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