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Decision-making process for Product Planning of Product-Service Systems

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Abstract

Due to the shift from products to services and the resulting gain of importance in planning product-service systems (PSS), a reliable decision process for the planning phase of PSS is essential. In this paper, we defined requirements for such a decision process by analyzing several decision processes for early stages of product and service development from literature. Interpreting their advantages and disadvantages reveals that none of the approaches fulfills all requirements needed for planning PSS. For this reason, we built a decision process by combining and extending elements of existing decision processes. The result is a process model, which facilitates to adapt requirements and characteristics several times. Unlike other approaches from literature, this process provides a higher customer integration, adaptable requirements list and it considers services, tangible products and PSS-infrastructure. To identify weaknesses and strengths of our decision process, we conducted a small case study. For this, a student team used this process for planning a rentable pedelec for tourists and commuters.

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Keywords: Decision making; product-service-systems; planning process; customer integration

1. Introduction

One challenge for product development is the change from solely tangible products to more immaterial goods, such as services [1]. This requires offering more than just a product, but opens new business models on the other side. This deferral is called the product-to-service-shift [2]. Combining products and services to a product-service system (PSS) enable companies to better meet customers' requirements, to increase customer connectivity and to focus on own core competencies [3]. Since developing PSS differs from developing stand-alone physical products or services (see section 3.1), the PSS-planning process has to be adjusted to the PSS-specific requirements for a planning process (see section 3.1). A PSS-planning process has to consider tangible components, service components, the merging infrastructure, the company's knowledge and competencies, and external factors [4]. For planning and developing PSS, they have to orient to the customers and their needs. This makes it necessary to raise the level of customer integration in the early phases of PSS-development, compared to the level of customer integration the developing stand-alone physical products or services.

In this paper, we develop a decision-making process for planning PSS. This process model shall describe the required decisions, the relevant information and the needed people and stakeholders to belong from the idea of a PSS to the PSS-concept. This PSS-concept models the product and service components as well as the connecting infrastructure. It represents the start of the development, which concretes the PSS-concept. To build such a decision process, we analyzed existing planning processes covering different perspectives from literature. As none of the considered approach is suitable to our requirements of PSS-planning processes, we advanced the best suiting approach [5] by transferring elements from other approaches. A student team tested the resulting planning process for planning a pedelec.

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2. Literature Review

For the literature review, we analyzed ten planning processes. We considered planning processes for PSS, for stand-alone physical products, and for stand-alone services. We analyzed the approaches in terms of how they facilitate to plan a customer-oriented PSS-concept. For this, we defined several criteria before the literature research:

The PSS-infrastructure enables the delivery of a PSS and includes its resources [6], like communication systems or energy supply. Planning the PSS-infrastructure has to be considered by our planning process (*Infrastructure considered*). Before building PSS-concepts, customers' requirements have to be considered, because a PSS orients to the customers. Decisions about the business model (e.g., eight PSS-types according to [7]) and how the company wants to make profit (high price for physical product, low prices for services or low price for physical product and high prices for services) must be made before building PSS-concepts (*Customer requirements before planning*). To meet the customer-oriented character of PSS, a PSS-planning process requires integrating the customers (*Customer integration*). A market-conform PSS uses the strengths of the providing company compared to competitive companies and considers the market environment. To meet those market requirements, the PSS-planning process have to include a market analysis *(Market analysis*). We analyzed and evaluated the approaches according to the described criteria. Table 1 shows the results of the literature review. During the literature research, we extended the list of criteria and defined requirements for our PSS-planning process (see section 3.1).

2.1. Considered approaches from literature

The planning process in VDI 2220 [8] focuses on stand-alone products. While this approach considers intern and extern factors and provides a suitable structure for the planning process (requirements, product definition, planning-surveillance), it lacks in continuous integration of customer requirements. Furthermore, it includes only business areas that the company is equipped with competences in [9] and neglects other business areas.

Gausemeier et al. [10] developed a strategic product planning process which emphasizes the relevance of the strategy. However, this approach considers the planning process on an abstract level and does not include services and the PSS-infrastructure.

The planning process in [11] takes the level of products' innovations into account and distinguishes between incremental and radical innovations. This approach does not consider services and has no option for customer integration and continuous adaption of requirements.

Van de Kar [12] designed his planning process mainly for services, the organizational infrastructure and technology architecture. This approach allows a high level of customer integration. However, the way of customer integration (e.g., meeting customers, testing phase at customers) makes huge efforts.

The approach of [13] is a planning process for products and services and includes the integration of physical product and service. However, this approach does not plan a PSS, it just combines product and service. A PSS is more than just the combination of a physical product and a service: As the physical product can only provided in combination with the service, both the physical product and the service have to be compatible to each other. Both types of components must have corresponding interfaces. This interlacing between physical product and service must be considered within the planning process, which is not provided by this approach [13].

Morelli [14] distinguishes between the solution space and the problem in his planning process. This process considers physical products as well as services. The late conduction of a market research and a lack of customer integration increase the probability of developing beyond the market.

The approach of Yang et al. [5] is a PSS-planning process, which allows changing the PSS-concept by iterations, if the concept does not meet the defined requirements. Even though the concepts are changeable, they do not consider adapting defined requirements during the planning process. Late adaptions of the concepts will be very expensive and affordable [15].

Tonelli et al. [16] developed an abstract procedure for defining PSS-strategies. They neglect the physical product part of the PSS and the connecting infrastructure.

The planning process of [17] includes the physical product components, the service components, as well as the connecting infrastructure. They consider all relevant external factors, however the customer is just regarded at the beginning and not at evaluating PSS-concepts.

Geum & Park [18] developed an approach which integrates all relevant elements of a PSS. While they describe the PSS-elements on a detailed level, they keep the processual part too abstract. Furthermore, they do not integrate a suitable market research.

2.2. Conclusion

Table 1 shows the considered planning processes and how they fulfill the identified criteria (see section 2.0)

We identified the planning process [5] as the most suitable approach for planning product-service systems: The abstraction level of process description of this approach is detailed enough to understand the whole planning process and abstract enough to apply this process to all kind of PSS. This planning process is a structured approach and it considers requirements from the very beginning and facilitates iterations.

Despite those strengths, we identified several weaknesses of this approach: However, as the phase "concept development" only considers services, this approach focuses services more than tangible products. The planning process does not consider the connecting infrastructure and the strong customer integration is missing.

To eliminate those weaknesses, we included parts of other planning processes to optimize the approach of [5]. For this, we first defined requirements for our PSS-planning process, which are based on the evaluation criteria of section 2.