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Focusing Aspects of Customer Acceptance for Planning Product-Service Systems – A Case Study from Construction Machines Industry

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Abstract

Aspects of customer acceptance describe reasons and issues that are relevant for customer decisions for or against purchasing a product. In previous works, we have built a model of those aspects that serves as a checklist for identifying relevant aspects. Furthermore, we have built a customer-oriented framework for planning and developing of Product-Service Systems (PSS). This framework models relations between customers, aspects of customer acceptance, and the PSS. PSS is considered as an approach to better meet customer requirements and to improve customer benefits from using a product. By adding services and integrating tangible product contents and intangible service contents to one market offer, PSS can be advantageous for the aspects of customer acceptance. The customer-oriented framework makes a PSS concept to focus on aspects of customer acceptance. In this work, we adapted and applied this framework for a case study in construction machine industries. This case study aimed on evaluating methods, models, and processes we built in previous work for increasing customer acceptance and to identify strengths, weaknesses, and potential for optimization of those methods, models, and processes.

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Keywords: Product-Service Systems; Customer Acceptance; Service Catalogue; Case Study

1. Introduction

Product-Service Systems (PSS) describe an approach combining tangible product elements and intangible service elements to an integrating system [1-3]. This system is more than just the coexistence of product and service elements, it enables providers to better meet customer requirements [4], to have less damaging effects on the environment [5], or to avoid product piracy [6]. However, the approach PSS itself cannot make magic, e.g. Tukker and Tischner [5] state that PSS are overestimated concerning the sustainability [5]. Especially for providing a higher value for customers, PSS must be orientated on the customers' needs and wishes. To facilitate PSS being accepted by customers, providers have to design PSS that focus on the customers. However, during last decades, PSS research has more focused on providers instead of focusing on customers [6]. Existing PSS design frameworks focusing on customers show methods for assessing customer satisfaction [7] or for orientating to customer values [8, 9]. Those methods might result into an increase of customer acceptance. However, these approaches do not link PSS elements to aspects of customer acceptance.

For enabling providers to increase customer acceptance using PSS, we built methods, processes, and models for supporting the design process in early stages of product development [3, 10-15]. Those supports serve as a reasonable basis to improve the design process for PSS concerning customer acceptance. However, we have not tested and evaluated those methods on a real case from industry. For this reason, we have conducted a case study in construction machines industry.

The case study was located in the sales department. This department was responsible for bundling a PSS offer for customers, composed of service and product elements. From this perspective, the sales department had to plan a PSS offer in cooperation with the design department and the customers. This case study revealed insights of the applicability of our framework and the benefits of using the list of aspects of customer acceptance for identifying aspects relevant for the customer. Furthermore, we show that PSS might be more

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suitable than products only for increasing customer acceptance by focusing on customer aspects, because the service part of PSS is easier changeable and adaptable than products elements.

In this paper, we first present the theoretical foundation (section 2), i.e. the approaches that we want to evaluate within the case study. Then, we show the procedure for increasing customer acceptance using PSS (section 3), the application of this procedure and a more detailed description of the case study (section 4). Section 5 concludes this work and presents the lessons learned of the case study.

2. Theoretical Foundation

In this chapter, we first discuss relevant approaches from literature dealing with PSS and customers. This is to locate our work in the research field. Then, we present the methods and models from previous work that we will use in the case study. At the end, we show the aims of the case study.

2.1. Other Approaches from literature

In a previous literature research of [12], we came to the conclusion, that frameworks from PSS research neglect the customer orientation. Most researchers mention only the relevance of customers and customer orientation in the design process, however, they do not provide measures for focusing on the customer [16-19]. Only Hussain, et al. [20] and Pezzotta, et al. [21] provide concrete concepts for customer orientation. Hussain, et al. [20] integrate data from the usage phase into earlier stages of product development, while Pezzotta, et al. [21] provide a method to adapt service parameters to customers. However, those approaches are helpful for the detailed service engineering; they do not provide a support for planning PSS.

In literature is a lack for design support for planning PSS that are oriented on customer acceptance [12]. This design support should be easy to understand for practitioners to make sure that they have a benefit for practical application. We aimed this gap and built several methods, models, and measures to support PSS planers in defining a customer oriented PSS.

2.2. Previous work

The previous work that is supposed to be evaluated in this work consists of the following parts: PSS planning process [14], model of customer acceptance [10], service catalogue [13] and the surrounding customer-oriented framework for PSS [12]. This framework consists of the layers customers (and customer situations), aspects of customer acceptance, and the solution layer [12]. The lowest layer, the customer layer, includes the customer or target groups and their situations or use cases. Dependent on the customers and their situations, aspects of customer acceptance influence their purchase decisions (customer aspects layer). For increasing customer acceptance, the PSS design has to influence positively those aspects. The PSS design is located on the upper layer, the solution layer. Taking the bottom-up approach that should be applied within this paper, relevant aspects of customer acceptance for the target group are identified and weighted. Based on these aspects, a suitable PSS will be designed. Beyond those three layers, the framework includes the strategy space that covers all three layers. This strategy space outlines that decisions on all of three layers depend on more than just focused objects, customer, customer aspects, and solutions. They also depend on the strategy and strategic influences.

For supporting this identification of relevant aspects of customer acceptance, we built a list of customer aspects, consisting of around 60 aspects allocated to eight categories: *Costs/Prices, Perceived Complexity, Unknown Needs, Interoperability, Reliability and Availability, Psychological Effects, Values and Beliefs,* and *Trust* [10, 11, 15]. This model serves as a checklist for identifying and rating relevant customer aspects for a customer group. For supporting the solution level, we built two element for supporting PSS planning. The first one is a decision-making process for PSS planning [14]. It mentions and organizes the activities necessary for PSS planning and structures them into three main decision points. This processual framework is for supporting companies in their PSS planning processes. The second support on the solution layer is the service catalogue [13]. This catalogue enables PSS planners to identify services for integrating them in their PSS. Connecting this service catalogue to the model of aspects of customer acceptance provides the identification of services that are suitable to aim on certain aspects of customer acceptance. These approaches from previous work do not support the direct integration of customers, the support the PSS design process to focus on customer acceptance.

Those approaches from previous work shall be tested in an industrial environment.

2.3. Aims of this work and the case study

The aim of this work is to adapt the approaches from previous work and to check their applicability and benefits. By applying the customer-oriented PSS framework, we check if the basic proceeding of improving PSS by focusing on customer aspects it reasonable. Using the model of customer acceptance in this case study might reveal aspects we have not considered in the model of customer acceptance yet. Furthermore, we want to check if the service catalogue will suggest new services for the PSS that are not offered yet. The PSS planning process should integrate the methods and models to a connected methodology. Since methods and models should support designers, we want to test the usability of them. If methods and models are note easy to understand and to use for practitioners, their visualization and usability must be improved. The main research questions are the following:

- Are the results from previous work easy to synthesize in an integrated procedure?
- Is this procedure applicable for industrial cases?
- Where do the methods and models have weak points?
- How and which parts of methods and models should be improved?

3. Procedure for Increasing Customer Acceptance

Figure 1 shows the procedure we applied for increasing the customer acceptance of PSS.

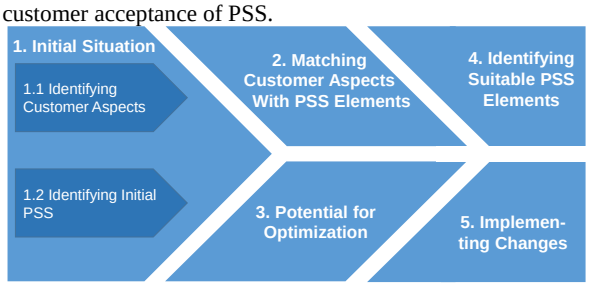

Fig. 1. Procedure for Increasing Customer Acceptance

The first step is to determine the current situation for the PSS and its customer acceptance. This includes the analysis of relevant customer aspects and of the initial PSS offer. The model of aspects of customer acceptance (see section 2.2) supports the step of identifying the aspects of customer acceptance that are relevant for the market, customers and PSS. Other supportive methods are surveys or interviews with sales managers, customers or users. The model of customer acceptance includes criteria that might influence purchase decisions and is not specified for a certain market or industry. For creating helpful surveys and interviews, this model has to be adapted to the existing conditions. Beyond identifying the aspects, a quantification of customer aspects yields more information which aspect the PSS should be optimized for.

For our considerations, only the customer-view of the PSS is relevant. For this reason, identifying the initial PSS means to acquire the service elements, product elements and the PSS offer modalities that are visible for the customer. Even though the PSS and the PSS business model consist of more domains, this step considers the customer perspective only. Dependent on the corporate context, this step can be accomplished by analyzing official market offers or product brochures. However, since the service and product departments of some companies are strictly separated, the whole PSS might not be visible by looking at official offers only. In this case, interviews with relevant departments might help to identify unknown services that are additionally offered to the product.

The second step is to match the identified customer acceptance aspects with the initial PSS offer. This matching evaluates the PSS concerning the customer acceptance for identifying potential for optimization. For this, relevant service and/or product elements are allocated to the customer aspects. Analyzing this allocation reveals a lack or an “over fulfillment” of customer aspects by the initial PSS. Extending this analysis by weighting the allocation by quantified customer aspects improves the quality of the analysis results. This step results in the identification of customer aspects that are insufficiently considered by the initial PSS. Those customer aspects serve as a potential for optimization.

The third step defines the degrees of freedom for the fourth step that is the actual improving of the PSS. This step discusses the customer aspects identified in the previous step. Furthermore, this step investigates the domains and elements of the initial PSS that can be adapted for improving. Dependent on the application only parts of the initial PSS are changeable. The goal of this step 3 is to define the aspects of step 4 and to define the adaptable PSS elements.

Step 4 creates a new concept for the initial PSS for increasing customer acceptance. Based on the domains for optimization, new service or product elements are identified and specified for the whole PSS offer. In this step, the service catalogue (see section 2.2) supports in finding services based on customer aspects or customer functions.

The last step implements the changes of the PSS that were identified in step 4. It integrates the changes in the whole company, e.g. service and/or development department, requirements list or sales and/or marketing department. Depending on the current phase of the PSS lifecycle and the dimension of the changes, this step is more or less affordable.

4. Case Study from Construction Machine Industries

The company we considered for the case study is working in the field of construction machines industries. This company plans to intensify the service share of its portfolio for differentiating from competing companies. The focus in this case study lies on a product that is developed, produced and marketed by the company.

4.1. Initial Situation

The first step of the identification of the initial situation was to acquire the whole product and service offer of the considered product. The product elements are depicted in the product brochure, while the service elements are more difficult to identify. As multiple departments (e.g. spare and parts department, after sales service department, finance department) offer relevant services, interviewing people from those departments revealed a list of services that are offered additionally to the tangible product. Those interviews were unstructured, only the service catalogue and product brochures were used as a support. The main services are shown in table 1.

Table 1. Services of the PSS offer.

Service	Description
Consulting	Supporting the customer before the purchase and during the usage phase. Before the purchase, consulters support the customer in identifying the most suitable product. During the usage phase, consulters might visit the customer at the machines locations for supporting and optimizing the product usage by the customer.
Online platform	Providing relevant data and information of machines, of their production status, and of the range of functions the customer has booked. Furthermore, it provides individual reporting, a remote service for producing machines and error notifications.
Technical hotline	Supporting the customer in identifying failures, ordering spare parts, and problem solving. Strong cooperation with after sales service department.
Training	Theoretical and practical trainings for machine operators and trainings of the production processes.
Financial consulting	Machines need a higher amount to be invested. This service provides consulting and transacting of financing. It includes to demonstrate ways and

	opportunities for financially weaker customers to get funding for a machine.
Renting	For customers who prefer to rent (use-oriented PSS) instead of buying a machine (product-oriented PSS), the company provides a renting service for machines and machine parts or tools.
Corporate fair	This fair is organized on the company's site for presenting new products and innovations to customers.

Beyond the identification of services, the relevant aspects of customer acceptance were identified in interviews with sales managers from several regions. They were asked, why people do not buy the products and the aspects were rated concerning their relevance. The interviews were semi-structured based on the model of customer acceptance. The results of those interviews are shown in figure 2. In this figure, the diameter of the bubble charts describes the sum of all mentioned aspects and their relevance.

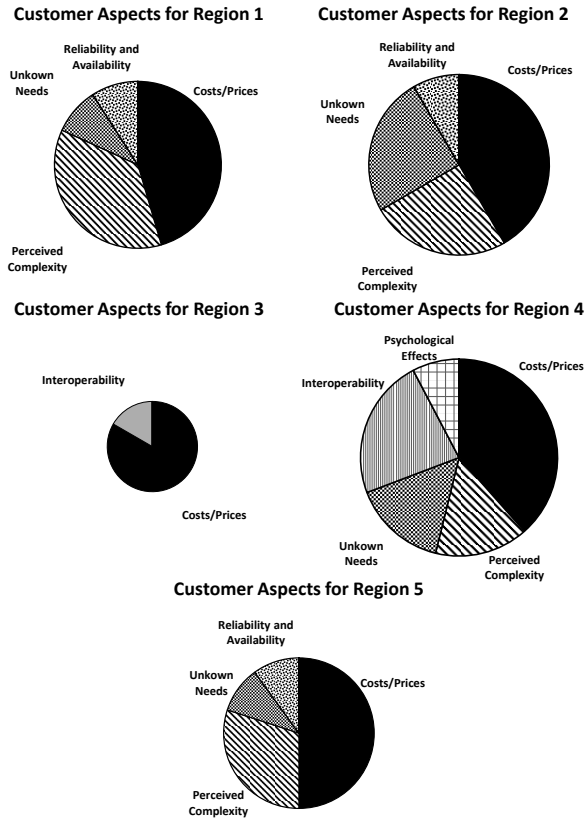

Fig. 2. Customer aspects and their relevance for all five regions

The interviews have revealed that the aspects *Values and Beliefs* and *Trust* were relevant for none of the regions. Since the company and its products are strong enough concerning these two aspects, the sales manager did not see them as relevant.

Only region 4 has considered psychological aspects as relevant. This might be caused in the nature of a B2B-market, especially for construction machines industry (high invests necessary): Since decisions for buying a machine must be well reasoned and more than one person has to make the decision, those decisions tends to be more based on facts instead of psychological biases.

Even though *Reliability and Availability* belong to the strengths of the company, three regions have mentioned them as relevant, because a few customers had a bad experience.

Interoperability was described as relevant for two regions. In those regions, the compatibility to competing machines and tools is essential, because machines and machines parts from various providers are used on construction sites.

The aspect *Unawareness of Needs* is for region 2 of higher relevance referring to the whole product. In regions 1, 4, and 5, it is only relevant for technical upgrades or functional extensions.

Perceived Complexity is relevant for region having a lower degree of education, because operating the machines requires a special training.

The most important aspect that was of highest importance was the aspect of *Costs/Prices*. While the company is offering products in the high-quality segment, the prices are correspondingly high.

4.2. Matching Customer Aspects with PSS Elements

After identifying services and customer aspects, elements from both elements were matched. As we wanted to identify which of the aspects is not considered by services, we allocated the aspects to the services. This allocation describes which services target on which customer aspects. The matching is shown in figure 3.

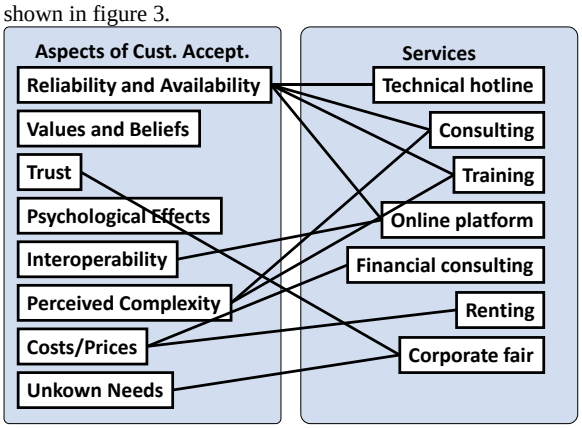

Fig. 3. Matching customer aspects to services

Based on this matching, we identify in the next step which of the aspects is not considered sufficiently by the current PSS offer.

4.3. Potential for Optimization

The matching in figure 3 has revealed that the current PSS offer already includes many services for the aspect *Reliability and Availability*. *Perceived Complexity* was considered as a quite important aspects, however, the current offer still lacks in considering specified options to meet this aspect. Another relevant aspect was *Unknown Needs*, especially concerning new features and technical upgrades. The corporate fair is one

option to handle this aspect, however, not all customers visit this fair and new or potential customers are not invited for this fair. Two services focus on the most important aspect *Costs/Prices*. However, this high importance requires a stronger consideration in the PSS offer. Even though the aspects *Interoperability*, *Trust*, *Psychological Effects*, and *Values and Beliefs* are aimed by only a few services, the relevance for further considerations was not given by the interviews with sales managers (see figure 2).

Concluding, the three aspects that should be considered in the following steps are *Perceived Complexity*, *Unknown Needs*, and *Costs/Prices.*

4.4. Identifying Suitable PSS Elements

Using the service catalogue [13] and based on the PSS categories [1], we identified service offers and solutions that might be suitable for increasing customer acceptance for the aspects *Perceived Complexity*, *Unknown Needs*, and *Costs/Prices*. In a brainstorming with the department "spare parts", options for improving the PSS offer were identified and detailed. The main solutions that were identified are shown in table 2.

Table 2. Solutions for increasing customer acceptance.

Solution	Description
All-round carefree package	This offer includes beyond the machine itself, all spare parts, expendable parts, and a guarantee for all core parts for a pre-defined time span. A condition for this offer is that the customer accepts a continuous mobile data collection on the machine. This data collection aims on identifying incorrect operations or misuse and on planning and operation services at a suitable time. Additionally, the customer can order part changes manually. This offer targets customers who are not able to handle the product usage by themselves.
	This solution might decrease the financial risks that are unforeseeable for new customers. Furthermore, it reduces the complexity of the maintenance processes for customers.
Reduced performance package	Customers having more experiences in product handling or having their own service department might prefer a reduced performance package. This contains the handling and exchange of parts that must be replaced after a pre-defined time span. The customer can order optionally service technicians.
	This offer supports customers in building their individual offer. They do not pay for service that they do not need or that they can perform by themselves.
Additional: Status reports as an early warning system	An additional option is a periodic status report including offers for repairs. This requires a data collection module on the machines for identifying necessary repairs on time. For increasing the motivation for using this option, the maintenance service might offered for a lower price. Damages that are early notified and repaired cannot cause consequential damages.
	This solution can help concerning unknown needs. The reports might also involve new features that are recommendable to use for a special use case.

The brainstorming resulted in solutions for all three fields of potential. However, this was just one of the first steps in improving the customer acceptance. The identified ideas were passed to other departments for developing and for building a holistic sales concept in cooperation with the sales department.

4.5. Preparing for Sales

To make sure that the changes of the PSS will be successfully launched in the market, a concept for sales managers was built. This concept was based on the PSS framework consisting of customer/situation layer, the layer of customer aspects, and the solution layer. The sales managers focused on selling additional features to customers. For this, the PSS framework was adapted from the bottom-up approach. This means that sales managers will ask customers for their special situations in using a construction engine. Based on the situation, sales managers will suggest a portfolio of customer values the customer can buy additionally, without telling the feature or the service behind the value. If the customer decides for a customer value, the sales manager will present him the feature or service that is necessary to provide the value and the price for the feature and the value. Applying the PSS framework led to a new concept for sales managers to increase customer acceptance.

5. Conclusions

To evaluate the benefit of the methods and models applied in this case study, we presented the new PSS offer to one of the company's managers to get his estimation of the new PSS compared to the existing one.

The adapted process, introduced in section 3, turned out to be beneficial for the considered case study, because the relevant steps and activities are included and also the sequence is based on a logical order. The identification of the current situation was essential for improving the PSS. Identifying the initial PSS and revealing all relevant services were not trivial, because the company consists of several organizations and departments and it was not clear what kind of services they offer and if those services are relevant for the case study. At this point, further methodical support might be helpful. As the case study was not a project for planning PSS but for improving PSS, we did not apply the decision points like they were proposed in the process model. Thus, we only noticed that the sequence of activities was reasonable for the case study and wider iterations were not necessary. However, we cannot make a statement about the structuring by decision points. The case study showed, that the PSS planning process is capable to integrate the tested methods and models, however, the connection between services and customer aspects is still missing for the methodical support.

The model of aspects of customer acceptance supported the interviews with sales managers and helped to identify relevant aspects. We started the interviews by just asking the managers without using the model about reasons for or against purchasing a construction machine of this company. In this situation, all the sales managers have only mentioned one point: the costs of purchase. They only considered this aspect as the only relevant reason. However, after introducing them into the model, they recognized much more points than just the costs that are relevant for their market. In those cases, the

model enabled managers for out-of-box thinking and helped them to see the reasons and causes for a lower customer acceptance. In this case study, we used the model of customer acceptance on a very abstract level to keep the interviews easy. However, using the more detailed aspects of customer acceptance would have revealed more aspects that are relevant. Our list of aspects of customer acceptance seems to be wide-ranging, because none of the sales managers has mentioned an aspect that is not included in our model of customer acceptance.

In this case study, also the service catalogue was considered on a more abstract level, not all detailed services were considered for finding new services. The catalogue supported in finding new services. However, the catalogue is quite detailed and practitioners might not have enough time to look over all services. It would be helpful to connect services and relevant customer aspects. This might provide suggestions of services that are suitable to the customer aspects identified in previous interviews.

The PSS framework was applied twice: it was the basis for the whole proceeding of improving the PSS based on aspects of customer acceptance. Additionally, the sales concept is based on the PSS framework. In both cases, the PSS framework turned out to be beneficial. However, we extended the customer layer to the layer including customers, customer situations and use cases, because aspects of customer acceptance can be relevant for customer situations or use cases and is not fixed to customers only.

Concluding, the methods and models we used for improving the PSS were helpful and beneficial for designers to apply. Interviews with the sales managers showed that they evaluate the new sales concept as advantageous for sales conversations. However, in applying the methods and models we realized that they are still difficult to understand and that designers need efforts and time for understanding the methods and models before they can use them. In future work we will improve the usability of methods and models. Furthermore, a basic matrix that connects services and customer aspects will be useful for designers, because this matrix facilitates an automatic pre-selection of suitable services after weighting the relevance of customer aspects.

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