Product-Service Systems for Increasing Customer Acceptance Concerning Perceived Complexity

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***Abstract*—This paper investigates the potential of product-service systems (PSS) to increase customer acceptance concerning perceived complexity. First, a literature review was conducted to investigate the influences of perceived complexity on the customer and user. We analyzed aspects like price complexity or availability of product information. Based on those aspects, we investigated if PSS-design supports to increase customer acceptance and we found three levels of PSS' potential: strategic issues, the business model and additional services. A case study from automotive industries applies our approach and three concepts to increase customer acceptance were built.**

Keywords—Product-service systems; product and service design; customer acceptance; perceived complexity; customer perception

I. INTRODUCTION

Product-Service Systems (PSS) are an opportunity to better meet customer requirements, to provide more sustainable products and to increase customer loyalty [1, 2]. PSS combine physical products and services to an integrated market offer. Beyond benefits and advantages for customers, many authors only focus upon providers' view on PSS [3, 4]. Researchers outline PSS' disadvantages for customers decreasing the customer acceptance [5-7]. E.g., customers perceive the lifecycle costs of PSS too high. However, PSS can have positive effects on the customer acceptance by lower total costs of ownership [8] or customizing [9].

In previous work [10], we identified aspects of customer acceptance, which are relevant for buyer purchase decisions. In this paper, we investigate the aspect *perceived complexity* on a more detailed level and we show how PSS can help to increase customer acceptance concerning the perceived complexity. For this, we first define customer acceptance. In attitude psychology, acceptance is defined as the basic affirmative attitude of acceptance-subjects, dependent on the context, the situation and the reference object [11, 12]. In terms of the customer acceptance, the acceptance-subject is the customer and the reference objects are products. The context and the situation is the purchase situation. However, this situation does not only focus the point of sale (POS). While marketing approaches aim at influencing the purchase situation and the customer, approaches from product design target the configuration of the product. In this work, we want to increase the customer acceptance by PSS-design. In this context, aspects of customer acceptance are issues of customers or products, which affect the customer acceptance in a negative or positive way. In some markets, user and customer are different individuals. In other markets, the user is the customer. Increasing both the customer acceptance and the user acceptance have positive effects on the purchase decisions. Even in those markets where user and customer are different individuals, users' perceptions are relevant for customers' purchase decisions. Therefore, we consider aspects relevant for both users and customers.

Many authors deal with perceived complexity. In the next section, we analyze the literature and build a model, which describes how perceived complexity influences the customers. However, we did not find any approaches in literature if PSS can increase those aspects described in the next section. We investigate this potential of PSS in the third section and show how a PSS must be designed to increase the customer acceptance. After that, we demonstrate a small case study where we applied our findings.

II. ASPECTS OF PERCEIVED COMPLEXITY

To better understand how perceived complexity affects the customer, we analyzed literature mainly from marketing and psychology. The identified aspects of perceived complexity were reviewed by three levels: First, the cause for the perceived complexity. Second, the perception and third, the consequences of perceived complexity. All aspects were illustrated on those three levels.

A. Price Complexity

According to Krämer [13], the price system contains all prices and price elements (e.g. prices for additional features, monthly fee) of all products. Krämer [13] defines three properties of a price system as the three dimensions of objective price complexity: The size of the price system, the configuration of numbers and the configuration of calculation types. The number of price elements determines the size of the price system. There are a vertical and a horizontal complexity of the price system size. The vertical size describes the parts the total price consists of, which might be the classification in fix and variable prices or surcharges to a basic price. The number of options, which are available for the customer for purchase, characterize the horizontal complexity. The configuration of numbers depends on the diversity of numbers and digits used for quantifying the prices. E.g. using both odd and even numbers increases the system's complexity. The configuration of calculation types depends on the difficulty of the calculation type [14] and on the

number of calculation steps. This third dimension seems to be more relevant for B2C-markets, where purchase decisions are made with less technical tools like a calculator compared to B2B-markets, which base the purchase decisions more on calculations and systematic analyses. Those dimensions cause the perceived complexity, which consists of stress caused by the price system, efforts for calculation and efforts for evaluation. Time pressure intensifies the dimensions. If understanding the price system requires too much information to handle, the processing capacities overload the customers and increase the stress caused by the price system. Buchholz [15] mentions the point perceived overloading of stimuli, which describes the situation that the customer has to handle too much product information. We summarize these points to "information overloading", which means that the customer receives too much information about the product and the prices. The efforts for calculation depend on the calculations needed for customers to get the relevant price. On a more abstract level, we describe this point as "efforts for information processing", as other aspects of complexity lead to this kind of perceived issue. It depends on both the objective price complexity and on the capabilities and tools of the customer. By evaluating alternatives, the customer tries to identify the offer, which fits the best to his requirements, and he tries to spend as less efforts as necessary in this evaluation process. The difficulties in the evaluation of alternatives determine the efforts for evaluation. These factors of perceived complexity result in the customer's position concerning the price fairness, reduction strategies (e.g. transferring the purchase decision to others) or in postponing or negating the purchase decision. Figure 1 shows the described factors of perceived complexity concerning the price complexity.

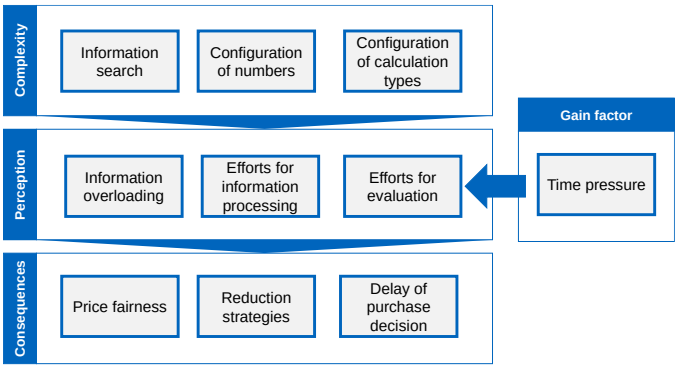

Fig. 1. Aspects of price complexity

B. *Complexity of Variants*

According to Buchholz [15], there are two causes responsible for perceived complexity regarding the variants: Number of variants and the diversity of variants. If the customer has too many product alternatives for choice, he perceives this as an overloading of stimuli. This can lead to reduction strategies or a delay of the purchase decision. According to figure 1, we classify this perception as information overloading, because the customer has to handle too much information of the alternatives. A too high number of variants can further cause a perceived unclarity of stimuli. This describes unclear or contradictory product information, which confuses the customer [16]. We classify this point to efforts for information processing because it is more affordable for the customer to handle this kind of information. The diversity of variants can cause perceived complexity, if the offered variants are similar to each other. As the customer has problems in distinguishing between different variants, he has a vague idea about the stimuli (belongs to efforts for information processing). Furthermore, it complicates the evaluation of alternatives, as customer must evaluate options to each other, which are similar for them. Figure 2 shows the described factors of perceived complexity concerning the complexity of variants.

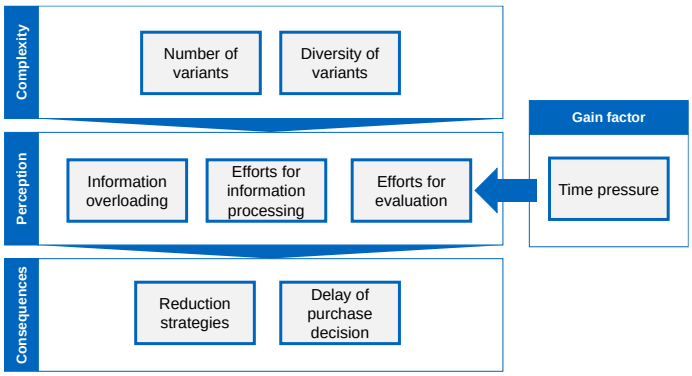

Fig. 2. Aspects of complexity of variants

C. *Usability*

Facing the usability, we consider two subjects: the product itself (i.e. the PSS) and the point of sale (POS). The product usability has an effect on the customer or user after the purchase, i.e. the usage phase. However, product usability is still essential for the purchase decision for the following reasons: If customers are pleased in using a product, they build trust and confidence to the company and they tend to buy same or similar products. Customers share their positive or negative experiences with their relatives, while negative experiences are more likely to be shard than positives experiences [17, 18]. Customers can perceive the product usability before the purchase if they have a chance to test the product.

Several authors deal with product usability and its effects on the customer [19-23]. All of them mention similar points, which are relevant for the customer perception. One essential aspect is the learnability. The first contact with the product means to learn how to use the product [19]. Designing the product easier and faster to understand accelerates the process of learning and understanding the product. Another point is the recognition of the product. It describes if users easily can remember the product and its usage. The (subjective) satisfaction describes if a product fulfills the individual expectation of a customer [19]. The product's errors and the error rate in using the product are other issues of usability [19, 20]. In this context, errors describe every kind of activity or event, which prevents to reach a wished condition. The effectivity of usage describes the level of accuracy and exactitude that a user can reach his goal [23]. The effectiveness of usage depicts this level of accuracy and exactitude compared to the user's effort in the usage phase. Woodson, et al. [24] state that users must be able to utilize products on a lowest level of stress and a highest level of efficiency [24]. Those described aspects of usability

are not only limited to the product, they are also applicable for the POS. If the purchase process on the POS is easily usable and perceived as uncomplicated, customers can faster pass through the purchase process. This is essential for online shops, because the competing shop and product is just one click away. All the issues described in the previous paragraph are also relevant for the POS. The issues of usability on the product or on the POS can result in reduction strategies or in postponing the purchase decision. Time pressure can increase the effects of those issues. The relevant issues of product usability and usability of POS are shown in figure 3.

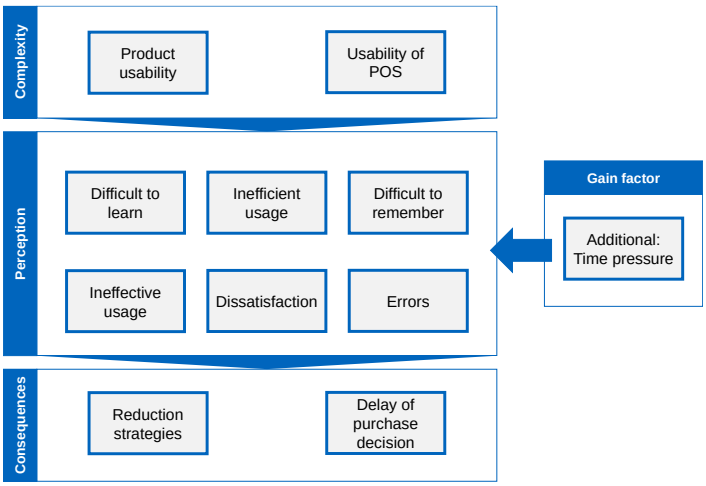

Fig. 3. Aspects of usability

D. Availability of Product Information

Considering the buyer decision process [25], availability of product information is an issue, which is relevant for the information search. If it is lacking in information about the product relevant for the purchase decision, customers cannot make decisions as they planned to make. Either they have to spend more efforts to obtain the missing information or they have to make a decision based on an insufficient information content.

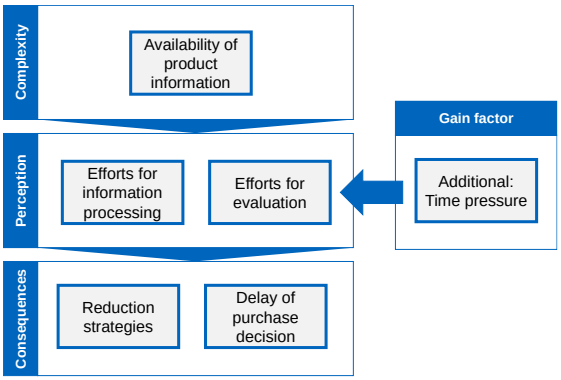

Fig. 4. Aspects of availability of product information

In the last case, evaluating the alternatives is more affordable. In literature, the effects of missing product information has not been widely studied yet. However, what we expect is that the availability of product information is relevant for the purchase decision if the information search requires a high level of cognitive performance. Impulsive or habitual purchase decisions are based on less cognitive processes. Those kinds of purchase decisions are less prone to the lack of product information. If customers have to decide under time pressure, the perceived complexity because of lacking product information might increase. A consequence might be reduction strategies if customers feel that they do not have enough information for a robust decision. If customers need time to collect the needed information or if they need more time to make a decision, they will delay the purchase decision. Figure 4 shows the described factors of availability of product information.

E. Processes in the Usage Phase

Other factors relevant for the perceived complexity are processes in the usage phase, which are necessary for making the product working. We identified three processes: administrative activities (e.g. obtain official approval for using a car), installation and maintenance. Those processes are necessary for running the product. As they imply an amount of complexity and as their complexity is not always visible for the customer at the purchase decision, they can lead to information overloading or customers have to spend efforts for information processing. Furthermore, performing those processes might be difficult to learn for the user and if they are processed insufficiently, they might cause inefficient usage. The additional factor time gains those effects. Like the availability of product information, the consequences of complex processes in the usage phase are reduction strategies or delaying the purchase decision. The described factors are shown in figure 5.

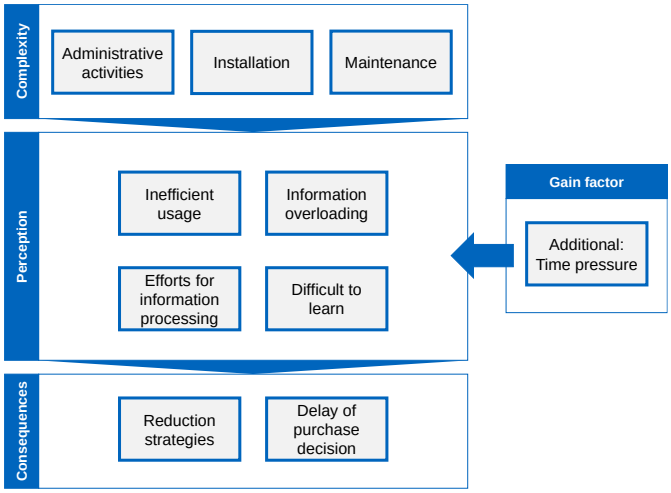

Fig. 5. Aspects of processes in the usage phase

F. Time Pressure

We see time pressure as a special factor, because it does not seem to be an own issue for perceived complexity. However, it seems to increase the effects of the factors causing perceived complexity described in the paragraphs before. Krämer [13] states that time pressure can lead to overload the customers; however, it cannot cause this overloading. Time pressure is only a gain factor and is only effective in combination with another factor causing perceived complexity. Also Buchholz [15] mentions that time pressure can lead to stimulus overload-

ing. The influence of time seems to be very relevant for the information search, evaluation of alternatives and purchase decision. The worsening ratio of information to be processed per time explains the negative effects of time pressure. According to Strohschneider [26], time pressure makes customers to shorten the information search and to decide based on less rational product information. Furthermore, the customers' emotions are more important for customers who experience time pressure. The consequences of time pressures are simplified decision-making, less conceived purchase decisions and delay of purchase decisions.

G. Conclusion

Figure 6 shows the causes of perceived complexity and the phases they appear in buyer decision process, defined by Kotler and Keller [25]. The phases "information search" and "evaluation of alternatives" seem to be sensible for most aspects of perceived complexity, while the problem recognition just has one aspect. However, we did not evaluate the weighting of the aspects. The aspect's relevance depends on the situation (e.g. product, customer). The number of aspects is not correlated to the relevance of aspects or of the phase in the buyer decision process.

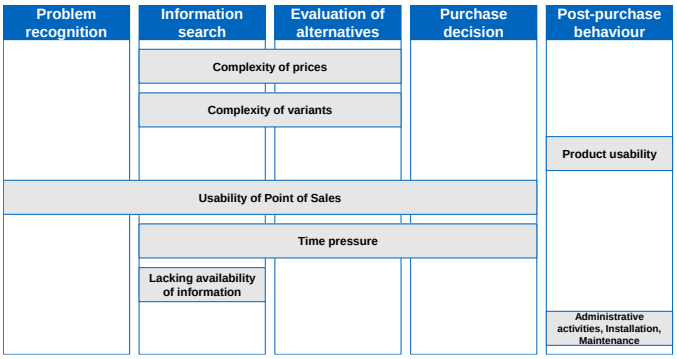

Fig. 6. Identified aspects in the buyer decision process

III. PSS for Influencing Perceived Complexity to Increase Customer Acceptance

In this section, we investigate if PSS are able to influence the aspects of perceived complexity. For this, we first outline the potential of PSS for increasing customer acceptance. We identified three levels, PSS are considered to increase customer acceptance. Then, we come up with three measures to influence aspects of perceived complexity and we suggest PSS-categories and services suitable for those aspects.

A. Potential of PSS to Increase Customer Acceptance

PSS is described as a market offer integrating tangible product parts and intangible services. Based on this definition, we claim three levels, which enable PSS to increase customer acceptance, compared to offering pure products.

The most abstract level is the **strategic level**. Switching from selling pure products to providing PSS can help the provider to reach strategic targets. E.g., PSS can increase customers' loyalty to the company [27], capture new market segments, or improve the corporate image concerning the sustainability [2]. PSS facilitate new **business models** [2]. We consider this potential of PSS as a second level of how PSS can increase customer acceptance. From the company's perspective, there are three main categories of providing PSS: product-oriented, use-oriented and result-oriented PSS [2]. Dependent on the market and customers, switching from product-oriented to use-oriented PSS might increase the customer acceptance. The third level is the most concrete level, the **additional offer of services**. Adding services to an existing PSS can help to influence purposefully single aspects of customer acceptance.

B. Potential to Influence Perceived Complexity

We identified three main mechanisms for increasing the customer acceptance concerning perceived complexity.

1. Influencing the cause for perceived complexity
2. Support the customer's processes
3. Undertake the customer's processes

In the following, we discuss how PSS can support to increase customer acceptance concerning perceived complexity using the described mechanisms. As the corporate strategy depends on much more factors and influences than the complexity perceived by customers, we only face the second and third level of the potential of PSS to increase customer acceptance.

C. Designing PSS to Increase Customer Acceptance by Influencing Perceived Complexity

PSS suit to influence the causes for perceived **price complexity** by reducing the number of situations where the customer has to deal with the price system. By combining service parts and tangible product parts to one market offer, customers do not have to evaluate those two parts in particular. Switching from product-oriented PSS to use-oriented or result-oriented PSS facilitates replacing the product after the first lifecycle without making a new offer to the customer. This implies that the provider undertakes the buyer purchase process for the subsequent product. Furthermore, companies can provide a consulting within the purchase process to support the customers in their purchase decisions. However, customer must trust the company to accept their consulting offers. To influence the perceived **complexity of variants**, PSS can help in a similar way. By switching to result-oriented PSS, it is the provider's task to select the best-fitting variant. Product-oriented consulting helps the customer to identify the most beneficial variant for him. Focusing the **product usability**, PSS can increase customer acceptance by additional services to make the product better and easier understandable for the user. To offer services like training courses makes the product easier to understand and might increase the efficiency of usage. Parts of the product usage, which decrease the product usability, might be packed in a service and undertook by the provider. We did not find suitable approaches how PSS can support for the **usability of the POS** and the **availability of product** information. Other levers like the marketing strategy or the sales network must consider these aspects. Perceived complexity arising from **processes in the usage phase** can be influenced by additional services supporting or undertaking the processes. The provider can exemplary undertake all administrative for the customer

within a use-oriented PSS. Also offering maintenance or installation can help to increase the customer acceptance.

IV. Case study: Tire pressure

To evaluate our results, we focused on a company from automotive industries and the tire pressure in cars. For reasons of efficient drive, safety and durability, the tire pressure must be in a certain range of pressure. However, the tire pressure depends on multiple external factors, like payload or temperature, and the pressure changes over time. To describe the application of our findings to this case, we first explain the initial situation. Then, we show which aspects of perceived complexity are relevant and we present three possible concepts, which are able to increase the customer acceptance.

A. Initial Situation

Because of problems occurring from tire pressure extending the recommended range, today's cars are equipped with sensors to measure the tire pressure. To facilitate the sensors function properly, the car users have to calibrate them after installation. If the sensors detect an inadequate condition of the pressure, a warning lamp in the control panel lights up to make the user start countermeasures. While users from European countries can handle those situations, users from Asian countries are not familiar with problems and consequences of inadequate tire pressure. This might be caused in different legal requirements, equipment at petrol stations and technical knowledge of users. Furthermore, Asian economies are more based on services. Car users from Asian countries expect the provider to handle the tire pressure and not the user, which is especially relevant for premium cars. In those countries, workshop-employees check and adjust the tire pressure at every visit. However, in-between the workshop visits, the tire pressure is not checked, which might cause the problems described before. The company of this case study considered to implement a user-friendly solution for handling the tire pressure. The vital point for this solution was to decide if the issue of tire pressure should be solved by a pure product solution (like in European markets), or within a service. For this, we prepared three possible concepts of PSS by considering aspects of the perceived complexity.

B. Perceived Complexity

In the following, we discuss how the European implementation of the tire pressure control system (TPCS) affects the perceived complexity of Asian customers. We identified those aspects in open interviews with employees from the focused company. As this system is just a part of the market offer car, which is confronting the customer, aspects like the complexity of price or the usability of POS are not relevant. Since the car has one variant of TPCS integrated, the complexity of variants is neither relevant. The effectivity of product usage is not given for Asian markets, because petrol stations in Asia lack of filling stations for tire pressure. Even though the warning lamp tells the user to adjust the pressure, users are not able to find and use a filling station. They have to visit a workshop to make sure tha they can use a filling station. This affects the efficiency of usage, because users do not accept the affords to find a workshop to adjust the pressure. Asian car users are not as familiar with using filling stations as European car users are. They first have to learn how to use a filling station, which might challenging for them. The errors arising from wrong usage (e.g. calibrating the desired pressure value) have essential effects for the safety. It might make sense to let experts undertake processes to reduce the probability for failure. Also, the maintenance of the TPCS and its sensors might be too complex for users, which requires the involvement of experts.

C. PSS for Increasing Customer Acceptance

To influence the aspects of perceived complexity, we built three PSS concepts. Figure 7 shows the first concept. This case is oriented on the European TPCS. If the tire pressure exceeds the adequate range, the warning lamp illuminates. After the user perceived the illuminating warning lamp, he visits a subsidiary of the company and let the service assistants check and adjust the tire pressure. Additionally, the company can gain more value by providing extra services.

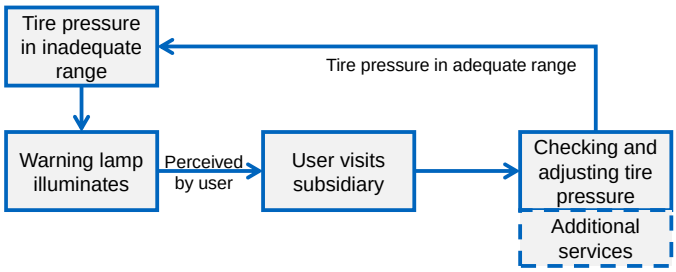

Fig. 7. PSS- cncept 1: User visits subsidiary

The second concept is depicted in figure 8 and it does not involve a warning lamp for the user. If the sensors detect the tire pressure being out of the adequate range, the system notifies the service assistant. The service assistant visits the user and his car and checks and adjusts the pressure. In this concept, the company is also able to offer additional services.

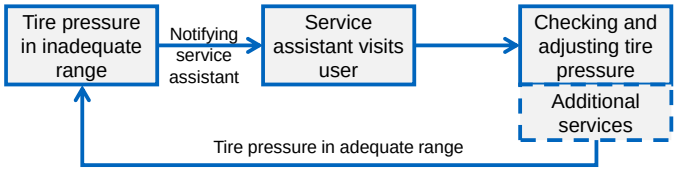

Fig. 8. PSS-concept 2: Service assistant visits user

Figure 9 illustrates the third concept. It aims at making the user able to adjust the tire pressure by himself. At the car's purchase, a portable compressor to adjust the tire pressure it put into the car.

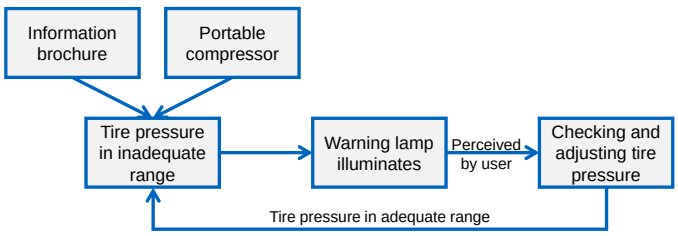

Fig. 9. PSS-concept 3: User responsible for tire pressure

Furthermore, the user receives an information brochure how to pump a tire or a service assistant explains the user this process and makes sure that the user completely understands to get along with the tire pressure.

Concerning the perceived complexity, we claim the second concept as the most suitable for the Asian market. The first concept still involves affords for the user, as he has to visit a subsidiary. Furthermore, users must be able to understand and interpret the warning lamp for the tire pressure. The third concept might fail because of the users' expectations. They are not willing to fix a problem with the tire pressure by themselves; they expect the company to care about it. Concept 2 means the least affords for the users and is most suitable for the perceived complexity. The responsibility for the tire pressure is transferred to the provider and users do not have to deal with it. We recommended this concept for implementation in Asian markets. However, we only considered the perceived complexity. We did not factor in the profitability of such a service. Compared to the other concepts, concept 2 means the highest affords for the provider, because it needs more service assistants. If customers are willing to pay more money for this kind of service is not investigated yet.

V. Conclusion

This paper shows a detailed model about the aspects influencing the customer acceptance. Based on this model, we proposed that PSS can affect those aspects and demonstrated this within a case study. Even though we did not ask real customers or users to proof the success of our approach, the case study showed that PSS are a reasonable approach to increase customer acceptance. Sometimes, like in the case study, configuring the tangible product part only does not support to increase customer acceptance. In those cases, offering additional services seems to be an appropriate approach. PSS have the potential to make products more usable and to improve user experiences. However, PSS cannot influence all aspects we identified from literature. Some of the aspects are issues for marketing and only adequate advertisement or marketing strategy can influence them. Other aspects are relevant for the product usability and there are other approaches from literature focusing usability or user experience, which might be more suitable to influence the product usability. The measures and recommendations how to design PSS for increasing customer acceptance are still quite abstract. In the future, we will work on a concept to provide concrete measures PSS-designers. Furthermore, we will also focus other issues from customer acceptance. Beyond perceived customer acceptance, other aspects like costs or prices, reliability or trust to the company are essential for buyer purchase decisions.

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