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UDK: 658.62:659.113.25 **Research paper**

Developing Product-Service Systems with InnoFunc®

Lena Wagner
Doctoral Candidate, Graduate School of Excellence advanced Manufacturing Engineering (GSaME), Nobelstraße 12, 70569 Stuttgart, Germany, Lena.Wagner@gsame.uni-stuttgart.de

David Baureis
Doctoral Candidate, Graduate School of Excellence advanced Manufacturing Engineering (GSaME), Nobelstraße 12, 70569 Stuttgart, Germany, David. Baureis@gsame.uni-stuttgart.de

Joachim Warschat
Professor for Technology and Innovation Management of Fernuniversität in Hagen/Head of Business Unit Technology and Innovation Management, Fraunhofer IAO, Nobelstraße 12, 70569 Stuttgart, Joachim.Warschat@iao.fraunhofer.de

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Abstract
In times of globalization and saturated markets, requirements change significantly. A possibility to adapt to this can be found in the integration of products and services into so called Product-Service Systems (PSS). Migrating from a manufacturing company to a solution provider raises different challenges though, especially in the early phases of product development. The strategic question if an implementation of PSS is an appropriate step for a company has to be evaluated carefully. Therefore it is necessary to approximate this problem with a well-defined holistic approach which includes not only generating ideas but also identifying the needed competences.

This paper introduces the InnoFunc®-approach for developing PSS successfully in the early phases and identifying the needed competences.

Key words: *Early Phases, Functional Analysis, InnoFunc®, Product-Service Systems (PSS).*

1. INTRODUCTION

The competitive environment for manufacturing companies has changed fundamentally, due to globalization and saturated markets. Tangible products turn increasingly into commodities. Consequently, the potential for differentiation through a focus on technical product properties is becoming more and more obsolete. In such an environment a focus on the integration of products and services into so called Product-Service Systems (PSS), where the focus is still at the product, can be a sufficient strategic approach for differentiation against competitors. PSS generate solutions that are oriented on the customers' requirements. Such solution oriented products (systems) require intensive customer-provider relationships which generate barriers to market entry and consequently create competitive advantages [1].

Nevertheless, the implementation of a combined product and service strategy causes a set of new challenges for a manufacturing company. The majority of literature sees the main challenge in the cultural shift that goes along with the development of PSS. The focus of the customer shifts from the product to the use of the product respectively the service which the product provides [2].

Another, more concrete, challenge through the implementation of PSS is located in the product development process. PSS require a simultaneous determining planning of products and services [3]. This implies an integrated planning approach, which is especially crucial through the fact that service-development presume different methodologies and skills than a traditional product development.

However, there is still a lack of product development methods for PSS [4].

This paper presents the InnoFunc®-approach, which aims to symbiotically develop PSS in the early phases of product development. The approach highlights idea generation for PSS and the required competences that are necessary to provide these PSS. Consequently the research question is: how can the development of PSS be supported in the early phases of product development? The idea generation and the competences have to be incorporated into an approach. Focusing on the competence, which can be crucial for a strategic decision when a company has to decide whether to implement a PSS or not. To outline the framework of the approach the two modules of the approach are introduced first, after that the focus is on the competences the characteristics of PSS. Analogue to the work of Zellner [5] the resulting requirements for the companies' architecture and functions are pointed out as the next step. Based on them, the needed competences are developed and "translated" into functions, exemplarily for one required competence, to

support a combined development of products and services right from the start.

Therefore the paper is structured as follows: in section 2 the InnoFunc®-approach with the two modules is presented. Product–Service Systems with their characteristics are defined in section 3. The resulting requirements for the company's architecture and functions are discussed in section 4. Section 5 is dedicated to the competences that are necessary to meet the resulting requirements, discussed in section 4. Section 6 gives a conclusion and discusses the needs of future research.

The paper is addressed to companies that are on their way to a solution-provider. If companies want a holistic approach for the development of PSS and to proof, in terms of their competences, if PSS are a manageable option for them, the InnoFunc®-approach is one possibility. Furthermore the demonstrating of the competences is important for the PSS development process especially for the early phases. On the one hand special competences are necessary to develop PSS and on the other hand the development process of PSS has to address product attributes to the corresponding competences.

2. INNOFUNC®-APPROACH

Objective of the InnoFunc®-approach was to develop a systematic method for idea generation for PSS and the identification of the necessary (organizational) competences to offer these PSS. Basis for InnoFunc® is the functional analysis [6], [7]. InnoFunc® consists of two modules InnoCube, the module for the systematic generation of product ideas for PSS and InnoComp, the module for the identification of necessary (organizational) competences for the supply of the previously developed product idea for a PSS. InnoFunc® focuses on the early phases of product development, because in this phase it is possible to develop PSS in a holistic and symbiotic way [8].

2.1 InnoCube

The InnoCube module represents, in comparison to existing approaches in literature, one possibility for companies to quickly and easily implement PSS by integrating the market and technology side. The operationalization of the synchronization between market pull and technology push by adjusting the functional analysis of PSS and the development of InnoCube together with the versatility of the modular approach is the novelty of InnoCube. The introduction of three abstraction levels (abstraction level, intermediate level and detail level) and three newly developed functional classes, allow a symbiotic development of PSS in the early phases. The approach is based on the problem-solving process [9] and includes an intense examination of the problem. The use of functional language, which is based on the functional analysis according to VDI 2803 [7], provides a language which can be easily used, especially with other disciplines or cross-divisional. With the development of new classes of functions, on the one hand, the market function in which the problems and needs of the market can be covered, and on the other hand, the solution functions, which represent both technical and service-oriented solutions, a synchronization of the two directions of innovation, market pull vs. technology push, can be created, captured in the offering functions.

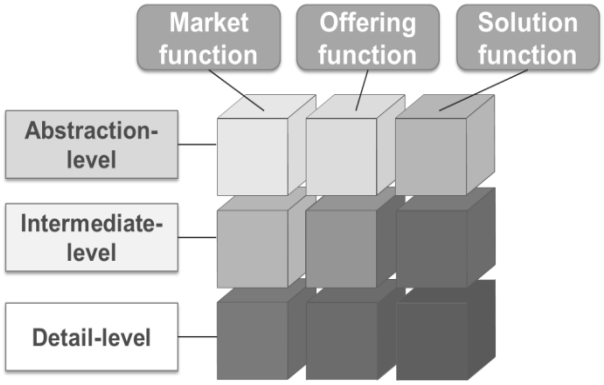

Figure 1: First InnoCube-Matrix

With the developed classes of functions it is possible within the InnoCube-approach, to generate new ideas for PSS holistically, i.e. both parts market pull as well as technology push can be considered. Finally this balanced view of the problem/need of the market with the necessary technology and services will be transferred. In addition to the functional classes three abstraction levels have been introduced within InnoCube-approach, the level of abstraction, the intermediate-level and the detail-level. These three abstraction levels provide in each of the classes of functions the possibility to either go into more detail or zoom out to get the abstract view. Thus, the three functional classes form together with the three abstraction levels nine cubes (see Fig. 1).

These nine cubes are the first matrix of InnoCube-approach and contain the current, internal view. This view is current because in the first matrix an existing product can be dealt with and opportunities are identified for improvement. In addition to this first matrix there are two other matrices, which are composed of the three functional classes and the three abstraction levels.

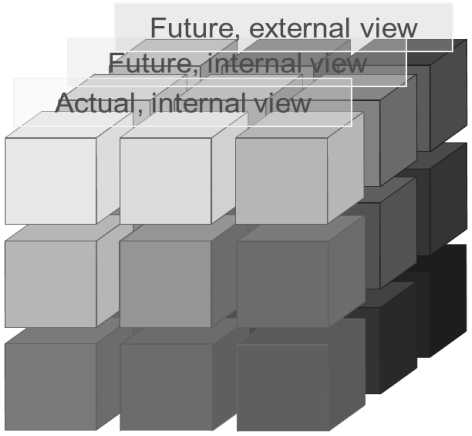

Figure 2: The complete InnoCube

There are, however, two additional perspectives, of the future vision, these are internal and external. Using these two matrices ideas for new products are

developed by the inclusion of two points of views, the integration of an internal and an external group. This is achieved by the systematic segmentation of the levels and the structured approach. Particularly through the integration of an external perspective, it is possible to break through the existing structures of thoughts within the company and open up to new ideas. After generating ideas in all three matrices the generated functions are evaluated by selected group members. The evaluation is made with a utility analysis, whereby different criteria are defined. With the evaluated functions different product scenarios are built. These are the basis for the following module.

2.2 InnoComp

The generated ideas from the module InnoCube are the input for the second module –InnoComp. The main objective of the module InnoComp is the identification of the competences that are required to offer the product ideas generated in the module InnoCube.

One of the main issues that the research on required competence is facing is the operationalization of the term ‘competence’. The term ‘competence’ tends to be vague and uncertain in its implementation [10].

The module InnoComp meets the requirement of an appropriate operationalization of the term ‘competence’ through the orientation on the concrete product idea. Within this logic the module InnoComp is based on the systematic of the functional analysis [6]. The functional analysis differentiates between user oriented functions and product oriented functions. User oriented functions describe the expected or performed actions that are required to meet individual customer needs. The user oriented functions are therefore focused on the market and the customers and formulate the customer needs focused on a special product. The product oriented functions describe on the other hand the effects of the product, which are necessary to meet the requirements of the user oriented functions. As a result, the user oriented functions are the foundation of the product oriented functions. The user oriented functions describe ‘what’ the product oriented functions have to fulfil. The product oriented functions describe ‘how’ the fulfilment is done. The module InnoComp is following this logic.

For the identification of the required competences the resulting requirements that (would) resolve through the implementation of the product idea (generated in module InnoCube) are defined as a first step. These requirements are pictured through the so called company oriented functions. The company oriented functions define ‘how’ the company has to act to ensure the product oriented functions. Consequently the analysis of the company oriented functions is a requirement analysis. Requirement analysis defines the attributes and actions that are necessary for a special achievement of objectives [11].

The requirements that (would) result through a potential implementation of the product idea are mainly linked to the special characteristics of the (PSS) product idea. The characteristics combine the general characteristics of PSS and the individual characteristics of the individual PSS (product idea).

To avoid the fuzziness that competences often have within an implementation in a real world context, the module InnoComp has to be holistic and integrative. While doing this, a structure or a categorization of the requirements is necessary. For this a differentiation can be done through the perspective of a firm’s resources. 10 different resources through which the requirements can be distinguished can be differentiated [12]:

- Human capital
- Management team
- Customer relationships
- Physical capital
- Organizational capital
- Technology
- Reputation
- Intellectual capital
- Financial Resources
- Corporate culture

As soon as the requirements for the 10 resource categories are conducted, the competences that are necessary to meet the requirements have to be identified. Within the module InnoComp the competences are expressed through the so called competence based functions. They picture the organizational skills for the objective oriented use of the available resources. The competence oriented functions describe ‘how’ the company oriented functions can be ensured.

The output of the module InnoComp are for the implementation of the product idea the required competences, expressed in competence oriented functions. The competence oriented functions are derived from the company oriented functions which express requirements resulting through a potential implementation of the product idea.

3. PSS

The InnoFunc®-approach is especially for developing Product-Service Systems. This section gives an overview what is different and what is special about PSS.

3.1 Definition of a PSS

The theoretical concept of Product-Service Systems was developed in Europe (especially in Scandinavia and the Netherlands) in the late 1990s [13].

The first formal and generally accepted definition was made by Goedkoop et al. [14] in 1999 [2]. According to this definition a PSS is a “marketable set of products and services capable of jointly fulfilling a user’s need. The Product-Service System is provided by either a single company or by an alliance of companies” [14].

Since then, most authors adopted this definition, including this paper. Consequently the key heterogeneous elements of a PSS are the three following [2]:

- A Product: the tangible part of the PSS, that is (at least short term) storable. A separate production and consumption and a customer independent production are possible. An example for the product in the PSS context is a machine tool.

- A Service: an activity, that creates a value for the customer. The service is the intangible part of the PSS. A service is, differently to the above described product, not storable. Furthermore the service is also not moveable. A simultaneous production and consumption and also a customer dependent production are inherent in the system. An example for a service that is embedded in a PSS could be the maintenance for the machine tool or the production with it.
- The System: the collection of elements (product(s) and service(s)) including their interdependences and relations.

3.2 Benefits of a PSS

Manufacturing companies can have a broad set of benefits through PSS implementation.

From a strategic point of view, the benefit through PSS is a potential for differentiation against competitors [15]. A PSS can be a sufficient alternative to standardization and mass production [2].

Consumers of Product-Service Systems benefit from an individualized diversified solution, developed for their own special requirements. PSS provide consumers added value through the high level of individualization. Furthermore PSS ensure a high level of flexibility for the consumers, because services imply a high level of flexibility by nature and therefore can be adapted to changing requirements, needs and conditions. Besides, there are also benefits for the environment and consequently for governments and society. The adoption of a PSS strategy can lead to a reduction of resource consumption because PSS introduce alternative concepts of product use, for example a car sharing concept [16].

3.3 Characteristics of a PSS

The integration of the heterogeneous constituent parts of services and products into a PSS leads to specific characteristics that differ as a whole significantly from the characteristics of traditional products or services.

- The relationship between the customer and the company changes fundamentally in the context of a PSS implementation. The integration of the external factor customer, the first specific characteristic, driven through the service component, is imperative for creating a PSS. But the integration of the external factor customer is not limited to the creation process. The customer has also to be integrated in the product development process to ensure customer oriented solutions. Consequently the development and creation processes of a PSS have to be driven by internal (e.g. the product) and external factors (e.g. customers), whereas the creation of traditional products are mainly driven by internal factors [17].
- The integration of the external factor customer also implies the second characteristic, the individualization potential of a PSS. The more specific the PSS is organized, the higher is the level of integration [18]. The prerequisite for a customer individual PSS is the capability to combine products and services in a flexible customer specific way [19]. The combinations of products and services should be as standardized as possible, but also as individual as necessary. Therefore the services can be decomposed into ‘front-office’ and ‘back-office’ activities. The front-office activities require the presence of the PSS customer, whereas the back-office activities can be without the customer [20]. This differentiation is required to ensure a unified image for the customer through the front office activities whereas the back office activities can save money through the highest possible level of standardization [15].
- The third characteristic is the heterogeneity of the constituent elements service and product [18]. The heterogeneity of the products and services is described in 2.1.
- Another characteristic of PSS is the technical integration of the involved product(s) and service(s). In this context technical integration means the functional connection of products and services. The more product-specific the service is, the higher the level of integration must be. The level of the technical integration indicates the intensity of the interdependencies of the involved product(s) and service(s).
- The fifth characteristic is the individual problem solution potential of a PSS. Product-Service Systems shift the focus from the product to the service that the product delivers. The PSS is thereby focused on the individual customer’s needs respectively problems and has the potential to solve them [19].
- The sixth and last characteristic is a result of the above described characteristics. The variety of characteristics, caused through the heterogeneous constituent elements product(s) and service(s) and their interdependencies, leads to a higher level of complexity, which causes challenges for the involved actors.

To prepare an appropriate base for the functional analysis with its two types of functions, the characteristics are already divided in the following requirements that are product driven and requirements that are consumer driven.

The characteristics individualization potential and individual problem solution potential are, because of their direct link to the PSS customer respectively consumer, characteristics that are driven by the PSS customer or consumer.

The characteristics heterogeneity of the constituent elements, technical integration and higher level of complexity, on the other hand, are driven by the PSS as a product due to their direct link to the product attributes.

The characteristic integration of the external factor customer is taking up a special position. It is on the one hand customer driven because the meeting of the customer requirements are ensured through this

characteristic and on the other hand the characteristic is product driven, because it takes place in the product development process. Consequently this characteristic is part of both categories (see Figure 3).

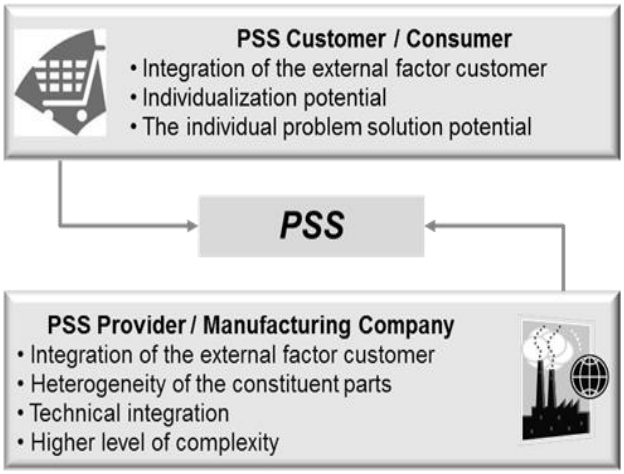

Figure 3: Functional differentiation of the characteristics

4. RESULTING REQUIREMENTS

The above described six specific characteristics of Product-Service Systems lead to resulting requirements for manufacturing companies that offer PSS. The question if a manufacturing company can meet this requirement is essential for the strategic decision of whether to implement Product-Service Systems or not. Besides, the requirements are also very important for the PSS development process, especially in the Fuzzy Front End (FFE) because a mistake in the FFE can have essential consequences for the total success of the developed PSS.

In the following special requirements will be deduced from the above described characteristics (see Figure 4).

The deduction follows, analogue to Zellner [5], the content related nearness.

- The characteristics individualization potential and individual problem solution potential result in the requirement customer orientation. The PSS has to target directly the customer's individual requirements. A PSS is not focused on the product only; it is focused on the service that it provides to solve the individual customer's problem. The PSS provider, therefore has to forecast and evaluate the individual requirements. Consequently the customer-provider relationship has to be intensive and efficient to ensure an individual solution [5].

The second deduced requirement results from the characteristics heterogeneity of the constituent parts and technical integration. These cause the requirement to combine product(s) and service(s). The customer individualized combination of services and products, involved in a PSS, is one of the biggest challenges within a PSS implementation. The customer's requirements and problems determine the level of technical integration. The heterogeneity of the constituent elements requires thereby often a cultural shift for manufacturing companies [15].

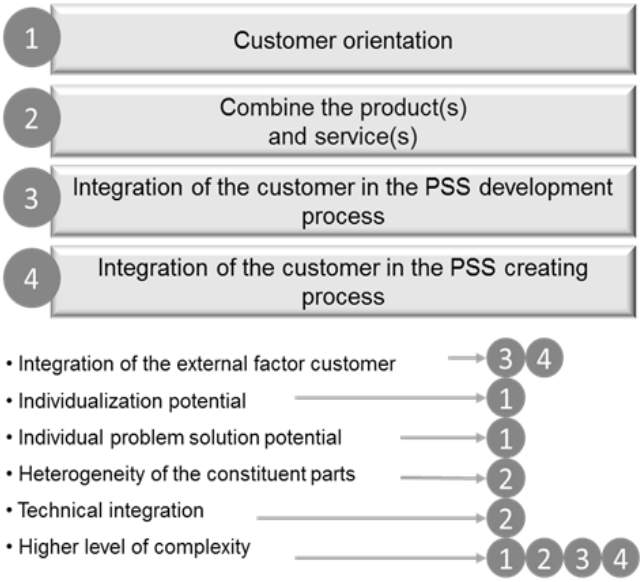

Figure 4: Resulting Requirements

- The characteristic integration of the external factor customer leads to the requirement for the integration of the customer(s) in the PSS development process. The PSS provider has to directly address the customer's requirements. It is therefore imperative to integrate the customer already in the PSS development process, because the customer knows best, what the customer requires. Nevertheless, it is consequently necessary, that the PSS customer knows exactly what requirements and problems he has [5].
- The integration of the customer(s) in the PSS creating process is the next requirement that the characteristic requirement of the external factor customer causes. This requirement goes along with the intangible element service of the PSS, because the value adding processes of a service does require the customer (see 3.1). The integration of the customer in the PSS creating process does though change the management routines. It is for example impossible to launch a quality control before the customer receives the output. It is furthermore necessary to have appropriate trained employees for the customer contact.

The characteristic higher level of complexity has repercussions on all of the above discussed requirements and is therefore not further expatiated. The requirements 'customer orientation' and 'integration of the customer in the PSS creating process' are PSS customer/consumer driven, because they address directly the customer benefit.

The requirements to 'combine product(s) and service(s)' and 'integration of the customer in the PSS development process' are product driven. The requirement 'combine product(s) and service(s)' determines the need to combine the product and service to an appropriate customer individual PSS. The requirement 'integration of the customer in the PSS development process' ensures that the product (PSS) is made for the individual requirements of the customer (see Figure 5).

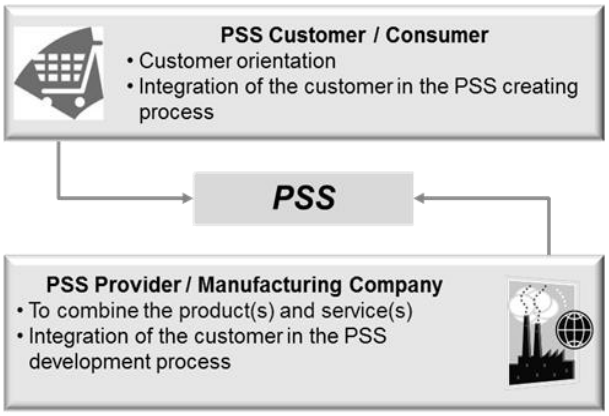

Figure 5: Functional differentiation of the requirements

5. REQUIRED COMPETENCES

The above mentioned requirements describe what challenges a PSS implementation causes. The PSS implementing company needs special competences to meet those requirements. From a theoretical point of view, competences are located in the resource based view. The resource based view describes the competitive advantage of a company through its resources and competences. Competences mean in this context the ability to meet the requirements respectively the power to do whatever is necessary to meet them [12]. In the following required competences are deduced from the above discussed requirements (see Figure 6).

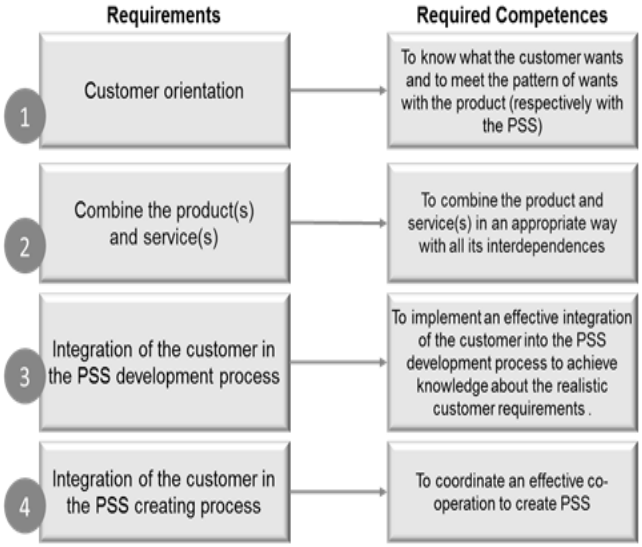

Figure 6: Required Competences

- The requirement ‘customer orientation’ leads for the PSS implementing company to the required competence that the management has to know what the customer wants. Furthermore, the company has to meet the pattern of wants with the product (respectively with the PSS). The customer has to change its external position and be an active part in the PSS value creation. Every PSS should be a customer individual solution for the customer’s needs. Therefore the companies can implement a good and sustainable relationship to lead-customers, for improving the contact and with it the knowledge about the needs of their customers.
- The requirement ‘combine the product(s) and service(s)’ cause that the company has to combine the product and service(s) in an appropriate way with all its interdependences. The customer requirements can be met by the tangible part or the intangible. The PSS provider has to combine both constituent parts as effectively and cost reduced as possible. Thereby the provider has to take the heterogeneous characteristic of both elements into account. To give an example, the need for mobility could either be satisfied through a more tangible oriented PSS like the sale of a car including a maintenance contract or through an intangible one like a car sharing business model. The competence to develop products and services symbiotically right from the beginning is important for companies. If a company has this competence, especially in the Fuzzy Front End, meeting the needs of the customer with a “complete solution” (product and service) is easier.
- The requirement ‘integration of the customer in the PSS development process’ forces the company to find the right balance between the integration of their customer in the PSS development process to identify the needs of the customer and to adapt services or features of the product and also to test the PSS during the development, but on the other hand not to integrate the customer too deep into the process, to be totally conditioned by the own customers. Here companies should develop a balanced integration, for example with customer workshops or by visiting customers using the product and finding out what problems occur during the use.
- The requirement ‘integration of the customer in the PSS creating process’ leads to the necessity that companies have to coordinate an effective co-operation to create PSS. Through the intangible element of the PSS, the service, this required competence is obvious. The consumer takes part of the value adding processes and sees the service output without a quality control. This competence leads to a critical aspect. The customer has a direct awareness of mistakes. But if a company has a good lead-customer relationship services can be tested in an early phase and improved for all customers.

The competences to know what the customer wants and to meet the pattern of wants with the PSS and to implement an effective integration of the customer into the PSS development process to achieve knowledge about the realistic customer requirements are customer-/consumer- driven. Those competences manifest directly the customer’s use of the PSS. The competences to combine the product and service(s) in an appropriate way with all its interdependences and to coordinate an effective co-operation to create PSS, on the other hand, are product driven. The combination of the service(s) and product result in the specific customer oriented PSS. The integration of the customer’s influence the PSS directly as well.

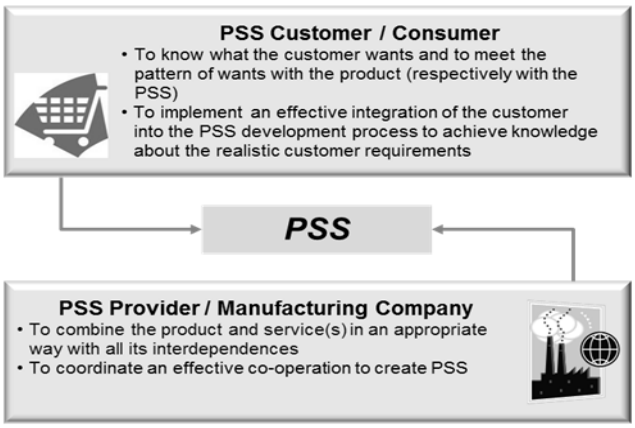

Figure 7: Functional differentiation of the competences

If the company can fulfil the requirements and required competences the ability to meet the needs of the customer with a PSS decides upon the survival of the company. To better match the needs of the customer with the development of PSS a method is needed to support the development right from the start. Therefore in the following one possible solution is explained. Using functional analysis to identify the needs of the customer and to describe the functions on both sides to define the requirements of the product and the services is the idea of this paper. The focus lies on the very early phases of a symbiotically development of products and services by describing them with functions. In the following the approach is described.

5.1 Functional analysis

Functional analysis is one possible solution to describe the functions a future product should fulfil to meet the needs of the customer. This paper follows the idea to define the needs of the customers on the one side and the functions of the product on the other side by functional description.

The development of a product is influenced by market claims and the actual state of the art from side of technology. Design and development of products are changing faster regarding shortening product-life-cycles. Within the VDI 2221 [21], which is a standard of German engineers, a general design process is described, which should support engineers with a systematic methodology. This standard subdivides the development process in smaller working lots. The whole process is sub-divided into seven working steps. One of these working steps (the second one) is for identifying functions this is a hint to the importance of functional analysis within the design process.

Depending on the different ways of thinking employees working in the development process tend to describe in different ways. Engineers trend to describe relations between the input and output of technical problems. Mostly a solution independent formulation of a function is used, e.g. clean disk [22].

Within the DIN standard 1325-1 [6] two types of functions are defined. The first is the function related to the user and the second is the function related to the product. Spielberg [23] named these two functions scope-function (“Zweckfunktion”) and system-function (“Systemfunktion”). Heubach [24] put this into an aim-mean (“Zweck-Mittel”) combination and defined the two types of functions. Scope-functions are related to the user and demonstrate the expected and effected value of a product. They also fulfil one special part of user needs. System-functions are product-related functions, which are fulfilled by the interaction of the effect of one special part of the product or the fulfilment of user-related functions. Scope-functions are described by object-verb-terms, e.g. clean disk. This description has to be as abstract as possible to find the technical solution for this user-related function [24].

With these both kinds of functions a concurrent development right from the start is possible. However, the company has probably still difficulties to match the functions from both sides. There the future research will work on to identify a procedure to match the functions from product and from customer side and match them into a combined PSS solution.

5.2 Example for a functional description of a PSS

In the following one example is exemplarily described for a PSS. The idea is to build a whole functional analysis description for PSS, but this is future work. Here is now a first example.

Looking at business to business (B2B) relations a combined development of PSS right from the start could be a competitive advantage for the company. This example is built for a company producing manufacturing machinery. On the customer side, for example, there is the need of an immediately repair-service if a machine breaks down. In this example the customer need can be described by the function “enable production”, which is an object-verb-term. This is the scope-function of the example and is as well at a very abstract level. For the customer a breakdown can cause a high amount of money by holding time.

The other side is the side of the company building the machines. If the company wants to offer PSS, the main goal should be to keep the maintenance work as low as possible and to offer its customers a secure production. Therefore the company’s function is “guarantee production”. In the described system this is the system-function.

Bring these two functions together in a well-developed PSS is the aim. One possible solution could be to develop an analyzing- software recognizing the abrasion of the machine parts and an intelligent connected service-team to support the customer-company by fulfilling the guarantee production.

If companies, which want to offer PSS, manage to match the two function sides, scope-function and system-function in a good way. It is possible to survive the current market challenges.

6. CONCLUSION AND OUTLOOK

This paper gives an overview of the InnoFunc®-approach including the two modules InnoCube and InnoComp. The InnoFunc®-approach was successfully tested with two companies.

This paper describes the required competences for a PSS offer and breaks them down for operationalization to functions, which is the basis of a functional analysis.

The outline of the required competences shows that a PSS implementation is an ambitious and demanding strategic approach. The shift towards services is a global trend, but it is not necessarily always the appropriate solution for every manufacturing company.

The deduction of the competences through the characteristics and the resulting requirements in combination with the translation of the competences into functions is a good approach to operationalize the elusive term “competence”. This paper gives one example of the translation into functions.

This paper builds on the two different defined functions, system-functions and scope-functions, and is using them to identify the needs of the customers on the one side and the functions of the product on the other side. For further research the translation has to be more structured and detailed, to build a complete PSS functional analysis. Furthermore the characteristics and the resulting requirements have to also be more detailed and categorized in future work.

By supporting teams to get a better idea of new PSS and necessary competences with a systematic approach the InnoFunc®-approach can assist, but a limitation to this approach is that it’s success depends on the team doing the idea generation. According to this the InnoFunc®-approach just can help to find first ideas of a new function or an approach but the detailing of descriptions really depends on the whole team, the participants and the moderator.

The InnoFunc®-approach can help companies to identify new ideas for PSS in a very early phase including the identification of necessary competences. The knowledge about the required competences can help companies that have to evaluate if a PSS implementation is the appropriate approach for them and their resources, besides their outline helps to focus the PSS development process, especially in the important early phases.

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Razvoj sistema proizvod-usluga pomoću InnoFunc®

Lena Wagner, David Baureis, Joachim Warschat

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Rezime

U vremenu globalizacije i zasićenih tržišta, zahtevi se značajno menjaju. Mogućnost prilagođavanja ovim okolnostima može da se pronađe u integraciji proizvoda i usluga u tzv. sisteme proizvoda i usluga (Product-Service Systems – PSS). Prelazak sa proizvodnog preduzeća na isporučioca rešenja donosi različite izazove, naročito u ranim fazama razvoja proizvoda. Strateško pitanje da li je implementacija PSS-a odgovarajući korak za kompaniju mora da bude oprezno evaluirano. Stoga je neophodno približiti ovaj problem dobro defiisanim holističkim pristupom koji uključuje, ne samo generisanje ideja, već i identifikovanje potrebnih kompetencija.

Ovaj rad predstavlja InnoFunc® pristup za uspešan razvoj PSS-a u ranim fazama i identifikovanje potrebnih kompetencija.

Ključne reči: *Rane faze, Funkcionalna analiza, InnoFunc®, Sistemi proizvoda i usluga (Product-Service Systems - PSS).*