

Product-Service Systems across Life Cycle

## “Systematization of IPS<sup>2</sup> Diversification Potentials using Product Lifecycle Data”

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### Abstract

Feedback management systems retrieve information and assist the developing of new product generations. However not only product data like sensor data or maintenance reports but also activities surrounding a customer can lead to an identification of demands connected to the providers' product. Therefore an approach is needed that extends existing feedback management systems as it creates added value for the customer as well as an expansion of benefits for the provider. This paper presents a morphology that defines and systemizes the necessary dependencies between an IPS<sup>2</sup>-provider and his customer in order to enable the IPS<sup>2</sup>-provider to offer value added services based on product diversification.

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### 1. Motivation

Industrial Product Service Systems (IPS<sup>2</sup>) are defined as combinations of products and services with high customer life cycle orientation [1] and require the extension of value creation networks consisting of a manufacturer as well as suppliers and service partners [2].

To provide a certain value to the customer is a main goal of IPS<sup>2</sup>-providing companies. However the difficulty can be understood by a distinction between the life cycle perspectives of the IPS<sup>2</sup>-provider and the customer. As from the perspective of the IPS<sup>2</sup>-provider the product life cycle starts with product development, followed by product manufacturing, servicing and remanufacturing. On the other hand the customers' life cycle consists of the product purchase, usage and disposal. Considering the high customer life cycle orientation, the IPS<sup>2</sup>-provider is forced to design physical products optimized for manufacturability, servicing and remanufacturing in combination with non-physical services that support customers during product purchase, usage and disposal [3].

In order to be able to provide a certain value to the customer knowledge needs to be generated about correlations between product and service shares to fulfil the required needs and demands, as IPS<sup>2</sup> are always individual solutions and boundaries between product and service can be blurry. This knowledge is essential for a successful integration of products and services whose dependencies tend to be very complex and not always known. The source of this knowledge is IPS<sup>2</sup> life cycle data, especially from the customers' life cycle. The retrieval of the IPS<sup>2</sup> product- and process data can be done with means of information technology and processed to knowledge in an appropriate form [4]. This feedback knowledge can be used in terms of optimizing existing product and service shares to fulfill needs and demands of the customer. However products and services usually only cater for a certain purpose. An expansion of benefits might be achieved by not only focusing on the activities surrounding a physical product or service but by focusing on the activities surrounding their customers. This can lead to new product development ideas or at least to a better understanding of the customers' needs. Apart from

the value created by the IPS<sup>2</sup>-provider there are often activities before, during and after the use of the product whose demands are just as essential to the customer [5].

As an example from the agricultural industry harvesters are provided with sensors to detect the amount of crop and GPS-position of the machine. Apart from harvesting an IPS<sup>2</sup>-providing company also offers a seeding-plan for the coming year as it identifies spots with low amounts of crop. The company adds value to the customer by analyzing retrieved information from an existing IPS<sup>2</sup>, although the offered service does not affect the initial business solution. Therefore feedback data can be the basis for a company to either optimize existing products and services but also to expand benefits in terms of adding value to products and services that build up on the initially provided solution but is simultaneously of different subjection. As IPS<sup>2</sup> include the providers' as well as the customers' life cycle perspective feedback data can be constantly exchanged and the value is constantly evaluated why IPS<sup>2</sup> suit for further investigations.

**2. Related Work**

This section presents an overview of current research work and describes the distinction between the new approach and existing solutions.

*2.1. Product diversification*

Product diversification is one possible way on how to classify strategies with which an IPS<sup>2</sup>-provider can create further value for the customer given the feedback data from the customers' life cycle phase. As described in chapter one this can lead to further added value to a cooperation between an IPS<sup>2</sup>-provider and a customer as the generated product service system has a higher customer reference. However this knowledge can also be used in different IPS<sup>2</sup> with different partners. Ansoff classified four possible growth strategies for enterprises (market penetration, product development, market development and diversification) in regard to new or existing products and markets. Figure 1 shows business growth regarding products and markets.

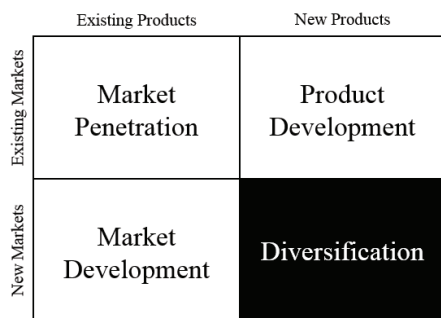


Figure 1. Adapted from the Ansoff Matrix [6].

As for the diversification, which is described by entering new markets with new products, there are three possible types of strategies regarding an IPS<sup>2</sup> [7]:

- (1) Horizontal diversification can be considered as the introduction of new products that do not contribute to any of the existing products but still can be handled with existing know-how and experience in technology, finance and marketing.
- (2) Vertical diversification can be described as an expansion of the production in depth, as for example concerning products with different kinds of quality or components, parts and materials where new know-how is needed.
- (3) Lateral diversification means to move beyond the confines of the industry a certain company belongs, which clearly opens an endless range of possible ways to diversify. While horizontal and vertical diversification are restrictive or limited to a specific field of interest, lateral diversification is everything that exceeds these limits.

*2.2. Management Approach for Feedback-Information*

Feedback-Management in IPS<sup>2</sup> has been subject to a lot of research lately. It allows a constant level of fulfilment of the customers' requests and demands and is therefore the key to value creation. Table 1 shows different approaches on feedback management in IPS<sup>2</sup>. They are classified regarding the related objects as well as the life cycle phase which is affected. Furthermore the goal and the input types are outlined, where the field data refers to e.g. product sensor data or service data.

Table 1. Feedback Management in IPS<sup>2</sup>

Method	Object	Life cycle phase	Goal	Input types
PUI FDA [8]	industrial product	design	improved product	field / service data
PSS KIM [9]	industrial product	design	improved product	service data
CIP PSS [10]	capital goods	design	improved product and service	field / service data
PSM [4]	industrial product	usage	improved product reliability and forecasting	service data
OBN [11]	mass products	design	improved product	field / service data
Virtual Maintenance [12]	maintenance service	usage	improved product reliability and forecasting	field data
VLCU [13]	industrial product	usage	improved availability and forecasting	field / service data
C-L PLM [14]	smart product	design	improved product and service	field / service data

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