Identification of the IPS² business model in the early stage of creation

E. Uhlmann, C. Stelzer

Institute for Machine Tools and Factory Management

Technische Universität Berlin, Pascalstraße 8-9, 10587 Berlin, Germany

uhlmann@iwf.tu-berlin.de

Abstract

Industrial Product - Service System (IPS²) delivers industrial, customized solutions. By the analysis of customer needs by the IPS² provider an IPS² business model is defined, which affects the entire lifecycle phases.

This paper gives a definition of an IPS² business model, presents identified influences for different business models, extract seven significant questions and describe a tool for the identification of suitable IPS² business models. In the early stage of the IPS² development the requirements of the customer are mainly fuzzy and have to be specified in the following phases. It is shown how the questions are designed concerning these facts.

Keywords

Industrial Product-Service Systems, IPS², IPS² development, IPS² business models, customer business needs

1 INTRODUCTION

Nowadays companies have to deal with globalization. This leads to new marketing opportunities for German machine tool manufacturers on the market for high-tech industrial solutions. Concurrent the market competition, especially by the People's Republic of China, increases. The German Engineering Federation (VDMA) reports for 2008 that China raised the position of the biggest machine tool manufacturer, previous to Germany and USA. The global depression is noticeable for German machine tool manufacturers since the middle of 2009 and the downturn of production is predicted with 10 to 20 percent.

The traditional way of a machine tool manufacturer is selling respectively with the machine tool only a physical product. Related and relevant services are "designed" as add-on for this product. The potential for a more service oriented design is mainly not utilized by the companies, especially for the young micro production technology branch.

In summary the companies have the possibility to ensure an existing competitive advantage of Germany as a location for industry by the consistent creation and use of innovative businesses. This demands a customized solution over the entire lifecycle of Industrial Product-Service Systems (IPS²).

Industrial Product-Service Systems offer the possibility to realize these requirements. By the customer orientation of an IPS², it is important to characterize the possible business model, which fulfills the customer needs best, in an early stage of the IPS² creation phase. The IPS² business model represents the customer information, e. g. problem, needs, and requirements and is the entire description of the IPS² with e. g. the customer-provider relation. As an input for the definition of an IPS² business model a literature research is done. The state of the art is the basis for the new IPS² business model definition, presented in the paper. With this definition and the defined IPS² lifecycle the procedure for the identification of the IPS² business model is shown. A special tool (see 5) with respect to the early phase of the IPS² lifecycle can help to identify an initial IPS² business model by the given customer needs.

2 INDUSTRIAL PRODUCT SERVICE SYSTEMS (IPS²)

2.1 Introduction of PSS and IPS²

The term of Product-Service System (PSS) is used especially for the B2C market and focus on sustainability of such a system. An example for PSS is a cell phone with contractual use options, like flat rate and/or data packet volume. Whereas IPS² is related to the B2B market. By covering the industrial market, the requirements of IPS² are much higher than on PSS. The volume of B2B transactions is much higher than for B2C. Typical supply chains and industrial standards have to be taken into account, when delivering IPS².

2.2 Characteristics of IPS²

An IPS², as well as a PSS, is characterized by a combination of tangible product [1], [2] and intangible service shares [3] including the immanent software via the complete lifecycle to fulfill the customer needs [4], [5]. The IPS² provider offers a customized solution in terms of an IPS² business model to the customer [4].

To realize this IPS² in an adequate way it is important to capture the IPS² business model, which fits best the customer needs, in an early stage of IPS² creation. By these it is necessary to have the possibility to characterize the target IPS². Therefore the definition of relevant IPS² characteristics is needed.

The IPS² exhibits the following characteristics:

- Heterogeneity of shares,
- Integration of shares,
- Level of individualization and
- Possibility of substitution of both shares.

With these characteristics the possibility to fulfill the customer needs with an IPS² is given.

The *heterogeneity* describes the composition of an IPS² with product and service shares [6]. The level of heterogeneity in an IPS² solution can be differentiated by

- Number of different product and service shares and

- Diverseness of product and service shares.

With rising and/or larger variety of product and service shares the heterogeneity increases.

The specific possibility of the fulfillment of the customer needs leads to the *integration* of shares [7], [8]. For a methodic realization different dimensions can be taken into account:

- Dimension of potential,
- Dimension of process,
- Dimension of result and
- Dimension of market.

These dimensions are considered in the presented IPS² business model. The dimensions of potential, process and result can be used for a phase related definition of services [9].

The level of *individualization* [6], [8] of IPS² is enabling a customer specific solution. The individualization is described on the one hand by the individualization of disposal and otherwise on the variability of the IPS² share combinations. The level of individualization for the shares can range from standardization to individualization. Therefore a individual IPS² share can be combined concerning the customer needs.

Three characteristics for "hybrid systems" are defined by vom Brocke [10]:

- Heterogeneity,
- Coexistence and
- Competition.

Coexistence and competition are summarized under the *substitutability* of product and services shares. The substitutability of IPS² shares can result in a solution of product shares, service shares or among product and service shares. The initialization for this substitutability is that at least one customer need is identified, which can be fulfilled by a product and/or a service share.

The definition and the elements of an IPS² business model have to be given by the consideration of these characteristics of IPS².

3 IPS² BUSINESS MODELS

3.1 Definition of Business Models

To reduce the complexity of the solution range and to ensure an effective and efficient creation of IPS² the early knowledge about the customer specific IPS² business model is needed.

By analyzing the customer needs an IPS² business model can be identified by the IPS² provider [11]. The presented IPS² business model methodology is a basis for the IPS² provider to characterize the customer needs and to describe its customized realization depending on the IPS² business model. The business model combines all relevant elements of the IPS². That must contain e. g. the needed processes with the attached resources, product and service shares and the form of contract.

A literature research concerning existing business model definitions and descriptions are basis for the IPS² business model. The given definitions of business models are dealing mainly with e-business and digital market [12], [13]. Because of that fact the usability of such definitions in the context of IPS² has to be checked and a definition for IPS² business model must be given. Tukker reported about a business model definition for PSS [14]. The research results in the use of business model elements of Stählers definition [15] for the IPS² business model. These elements are also corresponding with the elements of a considered PSS business model [14].

3.2 IPS² Business Model

The IPS² business model is therefore defined by the following elements:

- Value Configuration,
- Value Proposition and
- Revenue Model.

Looking on an exemplary detailed IPS², these elements can be characterized.

The *value configuration* is mainly process oriented and deals with the generation of value for the customer. The IPS² provider and also his network partners use the value configuration, which generates costs that have to be covered by the IPS² revenue, to sell the IPS² value proposition. This "process" can contain different stakeholders with e. g. roles and responsibilities.

The *value proposition* describes which value the customer and IPS² provider has, by delivering a customized IPS². This value includes the constellation of network partners that bring the value proposition on the market.

The sources for the revenues of an IPS² for the IPS² provider are defined by the *revenue model*. Also the prospective revenues are named and thereby the potential of the sustainability of this IPS² is given. The revenue model includes contractual and government agreements between the IPS² provider and the customer and also between the IPS² provider and his network partners [4].

Three exemplary business models can be described [5], [11]. The IPS² specification can vary between function, availability or result oriented IPS² business models. The IPS² business models differ in the risks and the resultant responsibilities for the IPS² shares between IPS² provider and customer. This information is an important input for the entire IPS² lifecycle and especially for the service delivery.

Function (Product) Oriented IPS² Business Model

The *function* of a technical system is characterized by the transfer of element input under the provision of special parameters into element output. By this the task, which the system and the resulting IPS² should fulfill, is identifiable. Both elements can be built up of material, energy and information. Therefore it is possible that different subsystems, e. g. machine tool components, can realize this function. In a function oriented IPS² business model the undertaking to sell is the function of the IPS², which is guaranteed by the IPS² provider. The IPS² composed of all product and function related service shares with required employees are under the ownership and responsibility of the customer. In this business model the IPS² provider plans additional service shares in advance. This can realize a short response time between customer request and IPS² provider answer. The IPS² provider can deliver the service with needed resources as scheduled or by request. This service delivery can be carried out by the customer or the IPS² provider and his network partners [4]. By this delivery the responsibility can shift from the customer to the IPS² provider side.

Availability (Use) Oriented IPS² Business Model

The *availability* of a technical system is defined as the probability or dimension, in which the system is able to reach specific requirements in a fixed period [16]. By the agreement between customer and IPS² provider the period with downtimes is defined. Because of these requirements availability is an important economic parameter for the IPS² and the IPS² provider has to

guarantee this by e .g. optimizing his service process delivery [4]. The availability is also a quality criterion of the technical system, e. g. the production with a machine tool without technical defect.

For an availability oriented IPS² business model the product shares are under ownership of customer and the availability relevant service shares are generally at IPS² provider side. The IPS² provider must provide all services with all needed resources to obtain the factor "availability". A condition monitoring system can inform the IPS² provider about the status of e. g. the wear of relevant product shares of the IPS². Thereby the service delivery can be triggered and carried out by IPS² provider. In this IPS² business model the time scheduling for service delivery has to integrate customer and IPS² provider with relevant network partners.

Result Oriented IPS² Business Model

A *result* is characterized as the output of a process. This process can be built up e.g. by activities and actions.

The customer has no ownership of product shares in a result oriented IPS² business model and pays only for the defined result of the IPS², e. g. for work piece quality and quantity. Therefore the responsibilities for all service and product shares are in the ownership and responsibility of the IPS² provider. In this case the IPS² provider can decide if he can accept downtimes or if he has to build up e. g. new production resources.

4 IPS² LIFECYCLE

4.1 Definition of IPS² Lifecycle

The IPS² lifecycle can be divided in three main steps:

1.) Creation of IPS²,

2.) Operation of IPS² and

3.) End of IPS².

The first and second steps are subdivided in several other steps. The main characteristic for the IPS² operation phase is the parallelism of processes of use of the IPS² product shares and delivery of the IPS² service shares. In the IPS² creation phase a much more sequential progression can be used.

The IPS² creation phase is built up by the planning and development phase of an IPS² (Figure 1).

For IPS² creation, especially in the IPS² planning phase, the specification of the IPS² business model is necessary. During idea generation the solution space for IPS² shares can be reduced by knowing the IPS² business model which fits best the customer needs. This is important to speed up the IPS² creation phase and thereby to optimize the relevant processes at the IPS² provider side.

4.2 Influences of the IPS² Lifecycle at the Business Model Elements

With the given definition of the IPS² business model elements (see 3.2) and the IPS² lifecycle it is important to name the interdependencies between IPS² business model and IPS² lifecycle. The different IPS² lifecycle phases have an impact on the IPS² business model elements and detail them. The questions concerning the
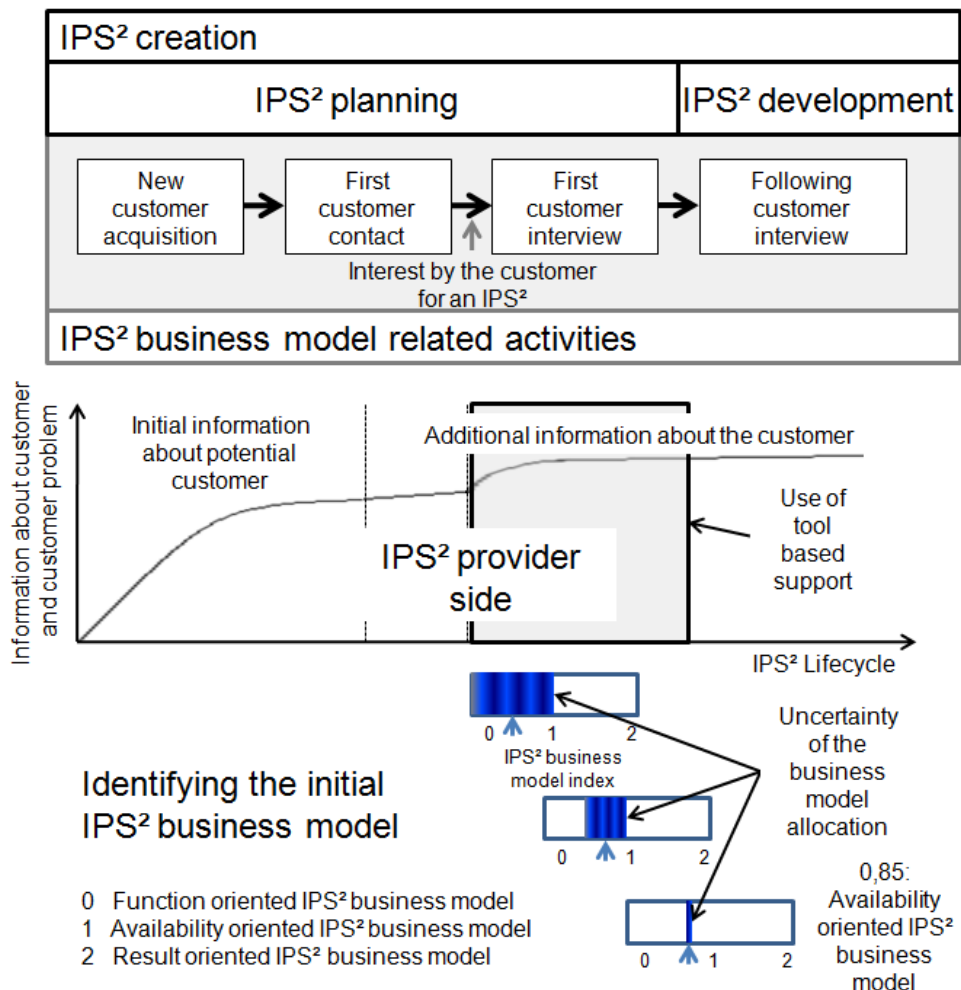

Figure 1: Information Flow and Uncertainty Reduction

IPS² business model, which have to be answered by the customer, have to deal with this fact.

The concretion of the IPS² business model element *value configuration* can be started with the planning phase of an IPS². The idea generation creates potential requirements for the IPS², so that an initial IPS² network is noticeable. By this the initial *value proposition* is defined. The relevant input for this model element is given in the development phase. The *revenue model* can mainly be determined after the creation phase of the IPS², when the value configuration and the value proposition are detailed. The value configuration is important for the implementation and setup of the IPS² shares and the needed potentials for the use of IPS² at the beginning of the IPS² operation phase.

5 TOOL TO IDENTIFY AN INITIAL IPS² BUSINESS MODEL

5.1 Information Flow

To ensure the identification of an initial IPS² business model a software tool is designed. The tool provides seven questions to characterize the target IPS² business model for a specific customer in an early phase of the IPS² lifecycle. In this phase the information search begins and the given information is mainly unspecific. Beside the IPS² lifecycle (see 4) the IPS² business model related activities by the IPS² provider can be named (Figure 1). These activities are needed to identify and detail the IPS² business model.

The information is related to customer and customer needs (customer problems). The acquisition of this information can be separated into four main process steps (Figure 1), whereas this information is detailed and transformed to customer needs. By the information about the customer, it is possible to characterize the customer processes with e. g. resources for the definition of the IPS² business model element "value configuration".

In the first step the potential customer is identified and the initial customer information is collected by the IPS² provider. The amount of information arises by this investigation and can be used for a preparation of the first interview, which is the second process step (Figure 1).

The next step is the first, direct customer contact, which ends the customer acquisition process. This can be done by an interview via e. g. telephone, but mostly by customer visit of the IPS² provider. This contact affords more information, but the rise of information quantity is, because of the effective information search at the first step, lower (Figure 1).

After this step the letter of intent for an IPS² can be given by the customer. This will enable the following process steps and starts the real IPS² planning phase. A second interview can bring more detailed information of the customer problem and the tool can be used to characterize in a first prognosis an initial IPS² business model. In this process phase the prognosis for an IPS² business model is uncertain (Figure 2).

By the following interviews this uncertainty can be cleared and the collected information can now be related to the IPS² lifecycle phase. For example the questions now refer to the IPS² planning phase and aim at detailing a specific IPS² product share.

5.2 Graphical User Interface and Navigation

The software tool for the identification of an initial IPS² business model has a graphical user interface (GUI) to interact with the user. The user can be the customer or the interviewer of the IPS² provider (Figure 2).

The tool is platform independent and no installation has to be done. The requirement to run this tool is an installed web browser. By Hyper Text Markup Language (html) the design for the tool is created as a website and the data volume is therefore low. This affects an easy exchange of the tool.

The compatibility of the tool with different web Browsers is given. Logos and icons are integrated in the tool (Figure 2). To analyze the questions JavaScript is used.

The answers can be given by a sequence of seven questions. Each answer is related to one IPS² business model. The questions are verbalized in an adequate and precise way, so that all possible answers are relevant and
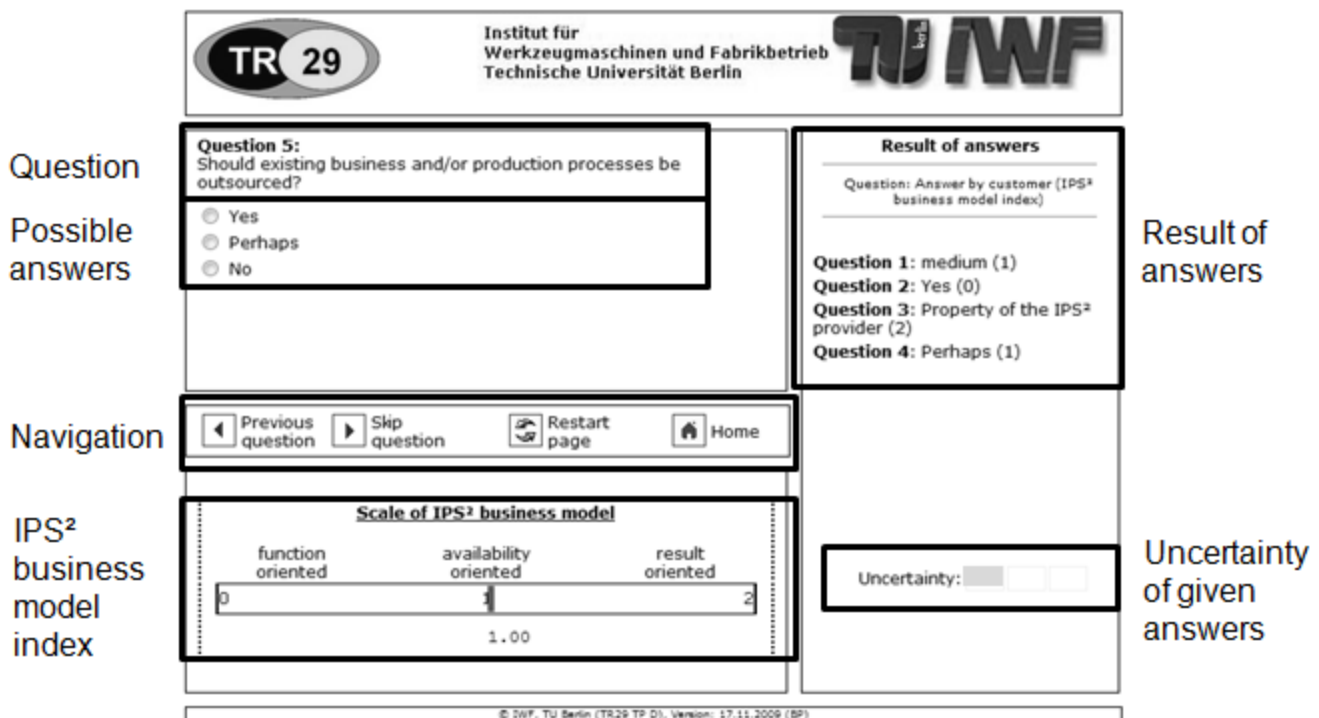

Figure 2: Graphical User Interface of the Business Model Identification Tool

can be answered by the customer. By the chosen scaling of the answers an equipartition is achieved.

For the first five questions three possible answers are given (Figure 2) and especially related to an IPS² business model. The last two questions are used to stabilize the IPS² business model index in the way the customer has answered the previous five questions (see also Figure 1).

A toolbar for the navigation is implemented (Figure 2). The user of this tool can navigate between the different pages by using the *previous question* or *skip question* button. By skipping the question it is not used for the prognosis of the IPS² business model. The tool user has the possibility at any time of tool use to answer these skipped questions, as well as to change given answers. The *restart question* will clear all data and start the tool with question 1. With the *home* button the tool user reaches the first webpage, where links to other tools are presented.

To identify the initial IPS² business model a scale is designed. The general scale range from

0   Function oriented IPS² business model,

1   Availability oriented IPS² business model to

2   Result oriented IPS² business model (see also Figure 1).

This scale is used to codify the given answers and to calculate the resulting IPS² business model index.

As an overview of answering status and to see e.g. skipped questions, a table of answers is presented.

Three questions have the possible answer "perhaps", so that this can be identified as an uncertainty of the customer. This uncertainty of the given answers is shown by a little view box (Figure 2).

5.3   Questions and Functionality

As mentioned above the questions can be answered by IPS² provider or directly by customer.

The seven questions were developed in a special workshop of the research project TR 29 concerning different influences of the IPS² business model (see 3.2). Result of the workshop was a list of 38 attributes with different characteristics for the three IPS² business models. This information was used to create the seven questions.

The stabilization of the IPS² business model index by the last two questions was done by a rule-based operation for the answer possibility *No*. The IPS² business model index of the previous five answers is used as algorithm input. If the IPS² business model index of the first five answers is related to a function oriented IPS² business model, a non existing network of supplier (question six) do not lead to a full loading of the question. Typically a non existing network of supplier characterizes the result oriented IPS² business model. Summarized, the index for this answer possibility is set dynamically concerning the result of the previous answers.

By answering with a *Perhaps* an uncertainty index is set (Figure 2), so that the IPS² provider can react to dispel the uncertainty.

The questions can be summarized with the following attributes:

- First question (I): Customer skills,
- Second question (II): Customer will to buildup skills,
- Third question (III): Property rights at the IPS²,
- Fourth question (IV): Human resources for the IPS²,
- Fifth question (V): Outsourcing of production and/or business processes,
- Sixth question (VI): Existing network of suppliers and

- Seventh question (VII): Process monitoring.

The answers have different importance on the IPS² business model and can be related to the three elements of the IPS² business model (see 3.2):

- Value Configuration: (I), (II), (IV), (V), (VII);
- Value Proposition: (I), (II), (III), (VI), (VII) and
- Revenue model: (III).

This leads to the possibility to match the answers with the IPS² business model.

To get some information about relevant service shares some answer possibilities are linked with suitable services. The services, which are automatically chosen by this relation, are summarized on the result page of this tool (Figure 3).
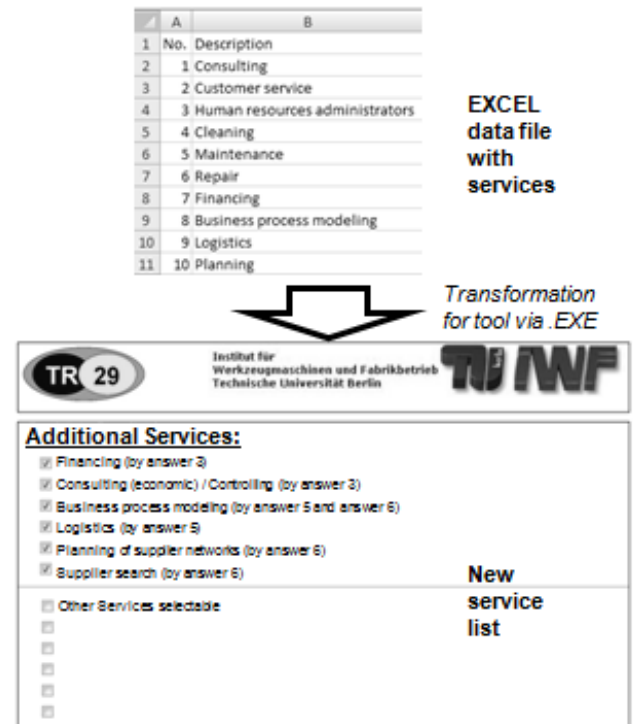

Figure 3: Update of Service Data

As a result of the tool the customer related IPS² business model index for the answers and the result of the questions is presented after the tool use. The resulting IPS² business model is specified.

The research project SFB/TR 29 has developed different tools, which can use the results of the tool. The tool in turn is now implemented in a support system for the IPS² creation called assistance system [17].

The determined information is prepared as an input for two IPS² relevant methods in the IPS² planning phase:

- Layer Method [18] and
- IPS² Compass [19].

The Layer Method purpose is to support the planning and development of IPS². It can help to clarify the design task and to derive requirements for IPS² development.

The IPS² Compass describes the influence of collected customer needs for the decision between make or buy and manual or automated. The IPS² Compass points in the direction of this decision (e.g. automated). The IPS² Compass can be used to characterize the resulting revenue model.

For the IPS² Compass the answers are also related with the answer possibilities. The attributes, which have to be linked to the answer possibilities, are:

- Make,
- Buy,
- Manual and
- Automated.

Because of these specific requirements of the IPS² compass not all answer possibilities have an influence on the customized IPS² Compass.

5.4 Service Data Update

With the result of a survey suggested services are listed. A manual selection of the automatically chosen services can be done by the user (Figure 3).

To implement existing, external lists of services a special update function is programmed for the tool. An excel file with services' descriptions can be used as an input for the tool (Figure 3). The transformation to an html page is done by an executable file. An easy and dynamical update of new service lists is thereby possible.

With the requirement that the tool has to run as a local application, a server language, like php, isn't appropriate, because for these languages the local data access is forbidden. Therefore the update of the service list is done via a separate application, which is programmed in C++. The application creates a source code by the new service data list. Also the additional services are selectable (Figure 3).

A comparison of services automatically derived by the answers and additional services is done. That procedure eliminates doublings of displayed service.

6 SUMMARY

Industrial Product-Service Systems are a customized solution for the industrial sector. The characteristics of an IPS² can be linked to these requirements and have to be taken into account by identifying the IPS² business model.

Coming from the definitions of PSS this paper presents the characteristics of an IPS² and their resulting IPS² business model definition.

Three exemplary IPS² business models were named and can be used in the IPS² lifecycle. The identification which IPS² business model fits best with the customer needs is an important task for the IPS² provider. Therefore a tool with specific questions is programmed to identify an initial IPS² business model in the early stage of development by the answers of the customer.

The answers are classified to the given IPS² business model elements to point out the influences of the answers on the IPS² business model elements *Value Configuration*, *Value Proposition* and *Revenue model.*

The procedure for the analysis of the answers and the results are shown. An IPS² business model index represents the IPS² business model.

With the tool the IPS² provider can be supported to optimize the customized IPS² creation and thereby use the innovative potentials of the integrated product and service Creation and use for the market of machine tool manufacturer.

In the future the evaluation of the tool by industrial partners is planned.

7 ACKNOWLEDGMENTS

8 REFERENCES

[1] Kuhlmann, A., Sauter, W., 2009, Allgemeine Betriebswirtschaftslehre, TEIA Lehrbuch Verlag, Berlin.

[2] Rösner, J., 1998, Service: ein strategischer Erfolgsfaktor von Industrieunternehmen?, Steuer- und Wirtschaftsverlag Hamburg, Hamburg.

[3] Corsten, H., 2001, Dienstleistungsmanagement, Lehr- und Handbücher der Betriebswirtschaftslehre, 4. Auflage, R. Oldenbourg Verlag, München.

[4] Uhlmann, E., Meier, H., Stelzer, C., Geisert, C. Völker, O., Krug, C., 2009, Dynamic IPS² Networks and Operation Based on Software Agents, CIRP IPS² Conference (CIRP Industrial Product-Service Systems), 1-2 April 2009, p. 305-310, Cranfield, UK, ISBN 978-0-9557436-5-8.

[5] Baines, T. S., Lightfoot, H. W., Evans, S., Neely, A., Greenough, R., Peppard, J., Roy, R., Shehab, E., Braganza, A., Tiwari, A., Alcock, J. R., Angus, J. P., Bastl, M., Cousens, A., Irving, P., Johnson, M., Kingston, J., Lockett, H., Martinez, V., Michele, P., Tranfield, D., Walton, I. M., Wilson, H., 2007, State-of-the-art in product-service systems, Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture, Professional Engineering Publishing, Volume 221, Number 10 / 2007, p. 1543-1552, ISSN 0954-4054.

[6] Benkenstein, M., Güthoff, J., 1996, Typologisierung von Dienstleistungen. Zeitschrift für Betriebswirtschaft, 66, p. 1493-1510.

[7] Engelhardt, W., Kleinaltenkamp, M., Reckenfelderbäumer, M., 1993, Leistungsbündel als Absatzobjekt – Ein Ansatz zur Überwindung der Dichotomie von Sach- und Dienstleistungen, Zeitschrift für betriebswirtschaftliche Forschung, 45. Jahrgang 1993 – Heft 12, ZfbF, Lengerich/Westf..

[8] Downar, Peter, 2003, Vermarktung industrieller Dienstleistungen – Strategien, Prozesse, Strukturen, Deutscher Universitäts-Verlag/GWV Fachverlage GmbH, Wiesbaden.

[9] Hilke, W., 1989, Grundprobleme und Entwicklungstendenzen des Dienstleistungsmarketing, In: W. Hilke (Eds.), Dienstleistungsmarketing, Gabler Verlag, Wiesbaden.

[10] vom Brocke, J., 2007, Serviceorientierte Architekturen: SOA – Management und Controlling von Geschäftsprozessen, Verlag Vahlen, München.

[11] Müller, P., Stelzer, C., Geisert, C., Uhlmann, E, Knothe, T., 2008, Kernprozesse hybrider Leistungsbündel, wt Werkstattstechnik online, 7-8/2008, p. 581-586, Springer, ISSN 1436-4980.

[12] Timmers, P., 1998, Business Models for Electronic Markets, Journal on Electronic Markets, 8(2), p. 3-8.

[13] Osterwalder, A., 2004, The business model ontology – A proposition in a design science approach, doctoral thesis, l'Université de Lausanne.

[14] Tukker, A., Tischner, U., 2004, New business for old Europe product-service development as a means to enhance competitiveness and eco-efficiency, final report of suspronet (Sustainable Product-Service co-design Network).

[15] Stähler, P., 2001, Geschäftsmodelle in der digitalen Ökonomie, 2. Auflage, EUL Verlag, Lohmar.

[16] Guideline VDI 3423, 2002, Technical availability of machines and production lines Terms, definitions, determination of time periods and calculation, Beuth Verlag, Berlin.

[17] Uhlmann, E., Bochnig, H., 2009, Computer Aided IPS² Development, Second International Seminar on IPS², p. 31-36, Berlin, Shaker, ISBN 978-3-8322-8473-2.

[18] Müller, P., Kebir, N., Stark, R., Blessing, L., 2009, PSS Layer Method – Application to microenergy systems, In: Sakao, T.; Lindahl, M. (Eds.), Introduction to Product/Service-System Design, p. 3-30, ISBN 978-1-84882-908-4.

[19] Rese, M.; Karger, M.; Strotmann, W.-C., 2007, Welche hybriden Leistungsbündel für welche Kunden, wt Werkstattstechnik online, 7-8/2007, p. 533-537, Springer, ISSN