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# Agile guideline for development of smart services in manufacturing enterprises with support of artificial intelligence

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**Abstract.** The shift from product-oriented to service-oriented business requires a rethink, especially in traditional companies in the mechanical and plant engineering industry. This guideline for the development of Smart Services is intended to illustrate the complexity and thus improve their handling, supporting the planning and modelling of a Smart Service. The Design Thinking Process is the first step in understanding the challenges associated with the reorientation of the business and in designing appropriate solutions. In the second step, an important part of the rethinking process of companies is the proactive development, revision or complete redesign of their business models. The third part of this guideline is the concept of agile service engineering with support of artificial intelligence, which can be understood as a link between the design thinking process and business model development and can be used as a management tool.

**Keywords:** Smart Service, Design Thinking, Business Model, Agile Service Engineering, Artificial Intelligence

## 1 Introduction

This guideline describes the step-by-step development of Smart Services, especially in manufacturing sector. The term "Smart Services" refers to data-based, individually configurable service offerings consisting of services, digital services and products that are organized and provided via integrated platforms [1]

It is becoming increasingly important to offer suitable Smart Services to complement the products of manufacturing enterprises. Therefor an integrated development and subsequent management of these Smart Services is of central importance. Figure 01 illustrates the essential elements of this guideline for the development of Smart Services on the basis of the 3 phases:

- Design Thinking [2,3,4],
- Business model [5] and

- Agile Service Engineering [6].

When a Smart Service is developed, both the three phases and the sub-processes in these phases can be repeated iteratively. Each of these three phases is already iteratively in progress. Especially in Design Thinking and agile Service Engineering, the iterative approach is a core element of the process model. The development of alternatives also plays an important role in business model modeling. In the approach presented in this paper, the possibilities of iteration are limited (dark grey arrows) due to small and medium-sized companies.

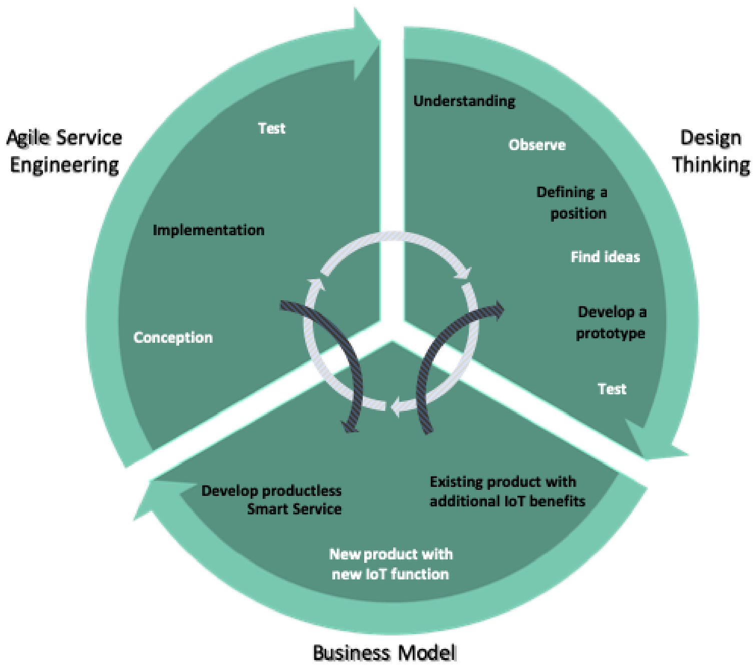


**Fig. 1.** The 3 essential components in the development of Smart Services with their respective phases

The individual phases are described below and are illustrated with examples.

## 2 Design Thinking

Plattner et al. [2] propose the 6 phases understanding, observing, defining a position, finding ideas, developing a prototype and testing, which are assigned to Design Thinking and shown in Figure 01. These 6 phases are described below.

- Understanding
  - One possibility for this phase are expert interviews. Iterations are desired here.
- Observe
  - One possible tool is to use unknown test customers who document the user experience.
- Defining a position
  - The Institute of Design at Stanford provides a good overview of possible methods [3] like Customer Journey Map.
- Find ideas
  - The classical tool for this is brainstorming [4].
- Develop a prototype
  - Prototypes are to be used to create solutions that are comprehensible to the user in order to receive feedback from customers [4]. Prototypes are something haptic, such as Lego.
- Test
  - What do the testers particularly like? What wishes do they express? Which questions are asked? Do the testers have new or additional ideas?

## 3 Develop new business models

The development of new business models is based on innovative, smart products and services, which will increase added value and thus significant growth for companies in the future. The creation of data-driven business models is the core of the development of strategies for IoT.

"Business model" should be understood as the mapping of the performance system of a company or part of a company. In a simplified form, it describes how the company creates customer value through saleable products and services, what resources it needs to do so and how the service is provided [6]. If the products are "smart" and can collect data, this also means that companies can offer their customers added value beyond the actual product benefits: Smart services can be created in this way. As a result, business models are no longer limited to a pure product orientation, but are also data and service driven [1, 7, 8, 9]

When developing new business models in IoT, there are various options for companies, especially in the relationship between existing or newly developed products and the associated Smart Services, which are briefly described below. For introduction, three possible options of business models are presented here, which are particularly suitable for SMEs and are easy to implement.

**Existing product with additional IoT benefits**

Here, products that are already established on the market and have possibly been used in the same way for some time are supplemented with IoT features, thus creating additional benefits. This variant represents the lowest level of IoT business models. This model uses the data generated by the purchase and use of a product to offer a new product or an addition to the original product. This allows completely new products to be developed or existing products to be improved. Therefor an innovative value proposition can be created, whereby previously unfamiliar customer groups can also be tapped, for example, by IoT services with agreed savings targets, Services to prevent machine/system failures, analysis and optimization solution for reducing consumption, data as a separate business, etc.

"Heidelberg Prinect" is a suitable case study and is briefly described below.

**Case Study »Heidelberg Prinect«**

"Heidelberg Prinect" offers intelligent machines that autonomously organize and run standardized print processes. This requires the harmonious interaction of six key factors: involving customers, reduce touchpoints, increase productivity and runtime, reduce waste and inventory, optimize consistency and repeatability and business intelligence. Fig. 02 illustrates the concept of Heidelberg Prinect.

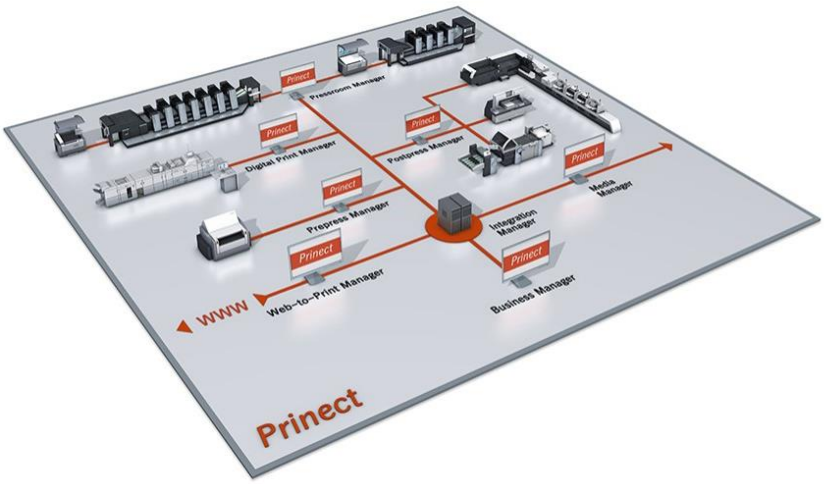


**Fig. 2.** Concept of Smart Service “Heidelberg Prinect” [10]

**New product with new IoT function**

Here, new products are developed that would not exist without the possibilities of IoT. In other words, a company uses the technologies of IoT to generate an innovative product that is fully equipped with new IoT functions. Companies previously unfamiliar with the industry can thereby establish disruptive innovations in markets previously unknown to them. Example: sale of new products with IoT function, sale of sensors for data acquisition, purchase of IoT applications in the "App Store" of an ecosystem

The "Trumpf Axoom Eco-System" represents a suitable case study [11].

**Develop productless Smart Services**

Many enterprises use agile methods in development of productless Smart Services. There are a number of different methods that can be used. They have some elements in common: they develop a service in small steps that are not planned in advance. To develop a new Smart Service it is necessary to use iterative cycles, this means that the results are tested and evaluated and the results of the tests are incorporated into the next interactive cycle. Furthermore, they are strongly user-centric, so the wishes and reactions of the users are considered at every stage of development.

Considerations of customer processes, the design of a digital ecosystem and the optimization of usability and user experience are also of great importance in the development of a Smart Service. Companies can use data to supplement completely productless Smart Services. Sensor data-based optimization of services, subscription for data analysis software solutions (SaaS models) and revenue share of the platform operator for applications on the platform are just some examples of productless Smart Services.

In order to develop a sustainable business model it is necessary to define a marketing strategy from a business management perspective. The determination of the clientele should be separated from the consideration of the users. Not every user group is automatically a customer group and willing to pay for the Smart Service - and even if the willingness to pay is positive, pricing is not always optimal, since in addition to relative willingness to pay indirect network effects must also be considered. This can be observed especially in Smart Services.

The market launch strategy starts with the definition of a problem or a user or customer group. Through agile development, in which the hypotheses are gradually captured and tested, a service can be developed with very high accuracy, which is also demanded by users and paid for by the clientele. At the same time, in order to prepare the actual market launch, the marketing and sales concept must be developed and implemented on the basis of the value proposition. This should be as iterative as product development. However, other factors are also decisive. Thus, it must be examined which (potential) competitors offer or will offer similar services in the future and whether they offer advantages from the point of view of the target person (price, use, access, range of functions, image, etc.).

This knowledge can be used to further develop and adapt the service or value proposition. The "DigitalClone" from Sentient Science is a suitable example for productless Smart Service [12].

## 4 Agile Service Engineering

One possible approach to manage the Smart Service is agile service engineering. This can be described by the three phases of conception, implementation and test, which in turn can be assigned to the three levels of business model management, smart service management and network management. These three levels contain a total of 12 development modules for the three phases of conception, implementation and test [13, 14, 15, 16].

Fig. 05 shows the three phases of agile service engineering with their respective 4 development modules.

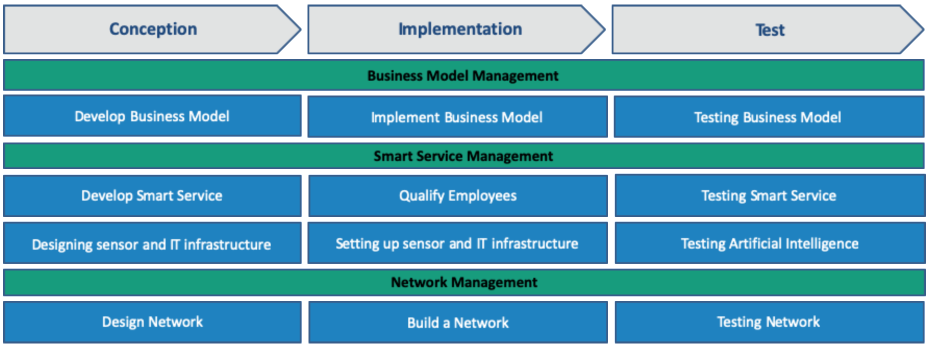


**Fig. 3.** 3 Phases of agile service engineering [17]

The entire process is therefore not only focused on the Smart Service alone, but aims at the Smart Service as a holistic solution. As a result, the levels of business model management and network management are also considered. Each of the three phases contains four development modules.

Artificial Intelligence is part of the Smart Service Management. In a study by Fraunhofer IAO [18], companies that already have experience in using AI-applications were interviewed. The vast majority of the AI-applications were assigned to the provision of services (59 percent). Customer support (39 percent) and manufacturing (18 percent) follow at a considerable distance. If marketing and sales are added to the first two areas, an astonishingly high number of applications in which a high level of customer reference and possibly even direct customer integration can be assumed. From this it can be concluded that the use of artificial intelligence in companies does not only affect their own managers and employees, but to a large extent also the customers of the companies.

The study revealed basic AI-functionalities used by the respective applications. Data and information extraction are used most frequently (78 percent), followed by data-based forecasting (59 percent) and decision support and automation (51 percent).

**Case Study »Heidelberg Prinect Production Manager«**

To take the example of the Heidelberg Prinect from Chapter 3, the "Prinect Production Manager" - a new usage concept in the form of a rental model of the Prinect business intelligence platform - can be used as an example of agile service engineering. The Production Manager enables print shops of all sizes to use all the integration functions of the Prinect production workflow exactly as they need it. Customers can use all the Smart Service functions at any time. However, they do not pay for the licenses for the individual components but only for the actual monthly data consumption, which is calculated in m². The user fee also includes all automatic software updates so that the workflow is always up to date. While the necessary hardware is installed on the customer's premises, parts of the selected Prinect components are cloud-based.

"The digitalization of all processes is not a question of company size. If a print shop wants to remain competitive, it needs to address the issue," says Anthony Thirlby, Head of Prinect at Heidelberg. "It's about developing a digital business model that focuses on end customer requirements in terms of quality, flexibility, productivity, availability and delivery reliability. This can only be achieved with digitized, largely autonomous processes that enable print shop operators to focus on their customers.

## 5 Summary

The shift from product-oriented to service-oriented business requires a rethink, especially in traditional companies in the manufacturing industry. This guide for the development of Smart Services supported by Artificial Intelligence is intended to illustrate the complexity and thus improve their handling, supporting the planning and modelling of a Smart Service.

The Design Thinking process is important for understanding the challenges associated with the reorientation of the business and in designing appropriate solutions. Building on the Design Thinking process the proactive development, revision or complete redesign of their business models is an important part of the rethinking process of companies, that want to remain competitive and take advantage of the opportunities offered by IoT. The concept of agile service engineering as a management tool to manage the Smart Service can be understood as a link between the design thinking process and business model development.

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