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Smart Services

Stöhr, Carsten[a]; Janssen, Monika[a]; Niemann, Jörg[a]; Reich, Benedikt[a]

[a]*Department Business Administration and Mechanical Engineering, University of Applied Sciences Düsseldorf, Münsterstraße 156, 40476 Düsseldorf, Germany*

Abstract

Industry 4.0, Smart Products, Smart Data – But what do we make out of it now?
The past years intelligent systems and products were developed. They are connected to each other and react rapidly to specific situations. Thus, they produce a huge amount of data. To collect those data there is software provided which visualizes it. Beyond that software which is able to analyze the data in order to improve performances and systems exists. Today the point is reached where the potential is almost fully exhausted. Therefore, this article deals with the upcoming trend of Smart Services. The development of Smart Services will be illustrated at the lowest stage/level of the technical infrastructure, followed by the existence of Smart Products and the application of Smart Data. As those are the requirements needed for the implementation of Smart Services, they are clarified by specific scenarios.

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1. Smart Services - what's new?

A Smart Service is a digital service that reacts on collected and analyzed data based on networked, intelligent technical systems and platforms. In contrast to the technology of Industry 4.0 which can exist in just one specific sector, Smart Services require cross-functional areas. These areas provide services which respond to analyzed data of other areas. Areas can be different departments in one company or more typically different companies which function as players in a network. The following figure describes the relation of the interaction between the different players and the technological progress and the resulting product of Smart Services. In contrast to normal products, "Smart Products" are products or components with embedded systems, which can collect, communicate and network data (Jasperneite & Pöppelbuß).

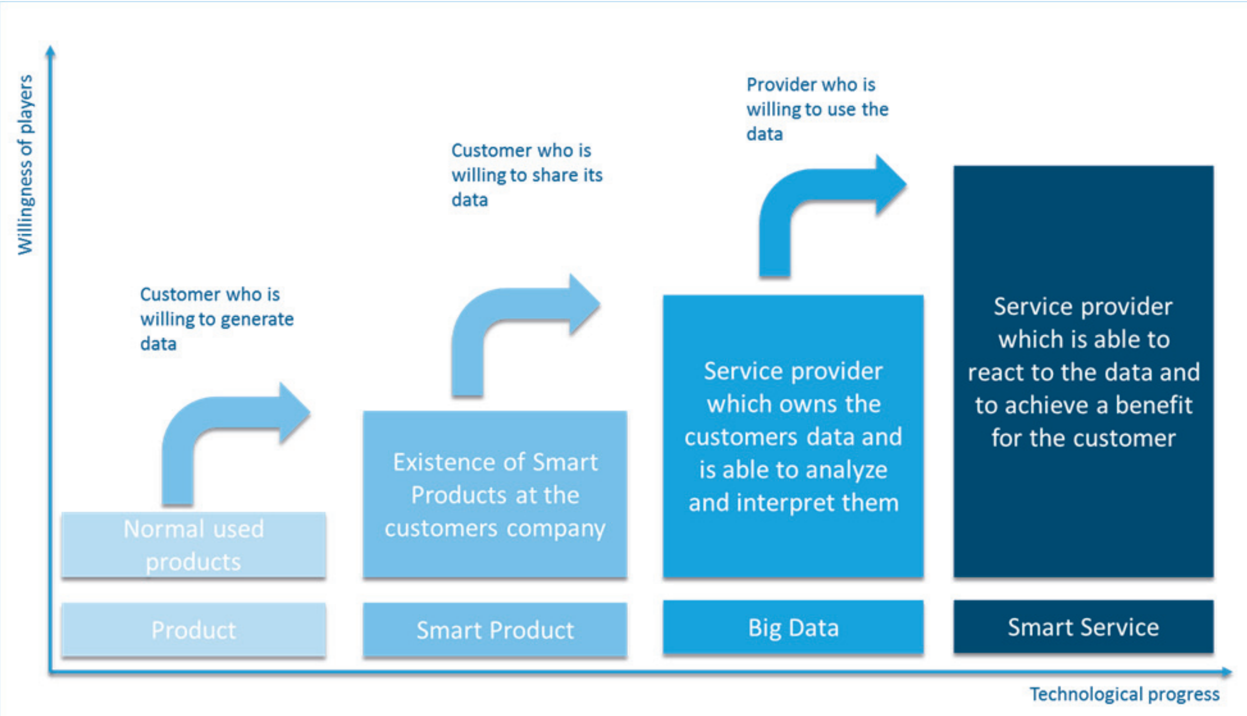

Figure 1: Requierments for Smart Service

In dealing with Smart Services there need to be clearly defined premises. One of them is the usage orientation. The added value needs to be in focus as well as adapted to specific situations and contexts. The average customer activities must not be interrupted but must completely be understood to integrate the value-added activities. A further premise is the availability of Smart Data. In order to generate the data, Smart Products are used. Thus, status and usage data can be collected continuously. The data are combined in real-time from various sources. This allows to make forecasts for future situations. Smart Services are marketed and accessed through digital platforms. They are available to the customer at any place and time. The digital access offers fast release cycles and is well scalable for providers. (Pöppelbuß)

2. Program of "Smart Service Welt"

Germany has set itself the goal of becoming the number one country in Europe in digital growth. Throughout the first future project "Industry 4.0", Germany has already taken a major step towards this direction in order to tap the potential of this new form of industrialization as the first country. The second future project "Smart Service Welt" is now focusing on the value chains that emerge from Smart Products in Industry 4.0 after they left the factory. Intelligent products combine physical and digital services to Smart Services. They are provided flexibly and as required. The single vendor with its classic products and services is no longer in focus. The focus will be on the consumer and their expectation always receiving the right combination of products and services. In the future, companies must increase their cooperation beyond industry and sectoral boundaries. Furthermore, the product and service portfolio must be expanded and/or adapted consistently and continuously. (Arbeitskreis Smart Service Welt, 2014)

3. How to develop Smart Services?

The development of Smart Services depends on the fact in which industry its applied to. In the communication media or trade industry an advanced stage of maturity level in new digital business models can be found because these industries are close to the digital world. The maturity level of industries like energy and the industrial production is very low. These industries have a high potential in developing new digital business models and Smart Services. The maturity level of the various industries is illustrated in Figure 2. (Arbeitskreis Smart Service Welt, 2014)

What is needed to develop Smart Services and to create new digital business models?

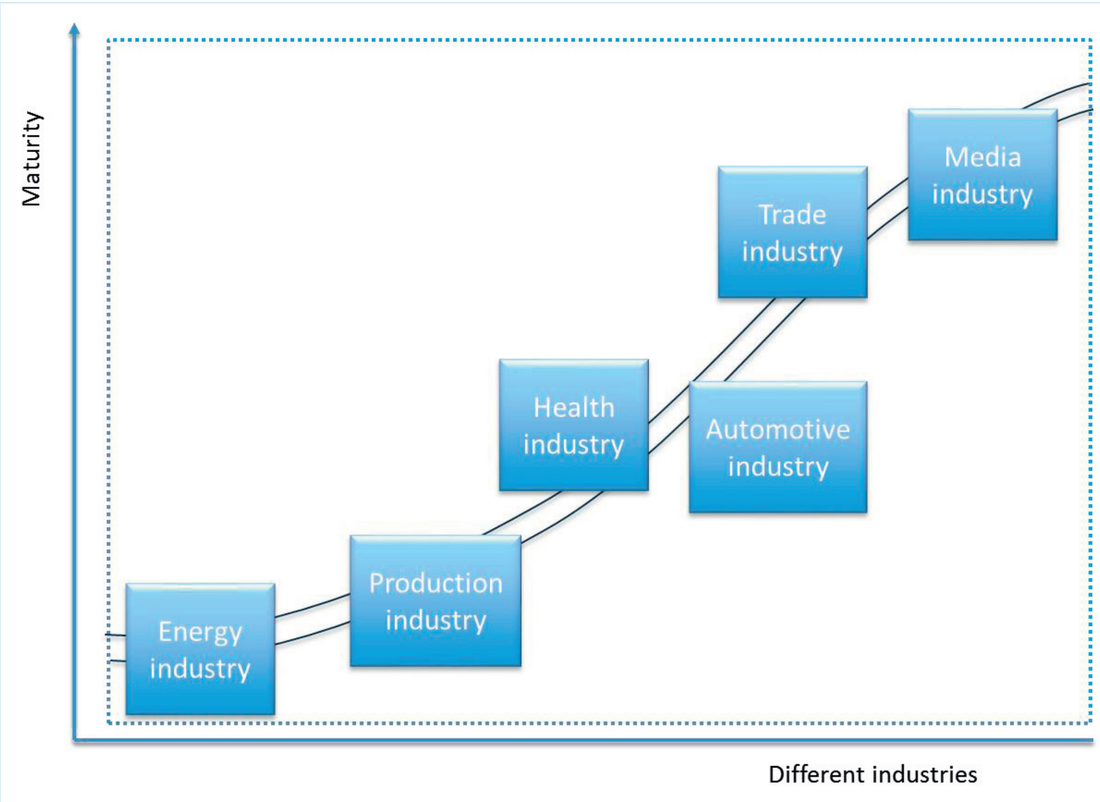

Figure 2: Maturity in the different industries (Accenture Dienstleistungen GmbH)

The basis of Smart Services is an abundance of data. These data are information concerning the area of life or the area of work. The goal is to supply a digital service to the customer that is attuned to the customer benefit. This new way of creating new business models and additional services to the physical product should be minted by a digitalization and a development which is organized in an intelligent network. The Internet of Things (IoT) takes a main role and connects the data and services of the physical products with the digital network (Fleisch and Mattern, 2005). This creates a new digital infrastructure. (Arbeitskreis Smart Service Welt, 2014) The infrastructure can be shown in a four-layer-model. This model is shown in Figure 3.

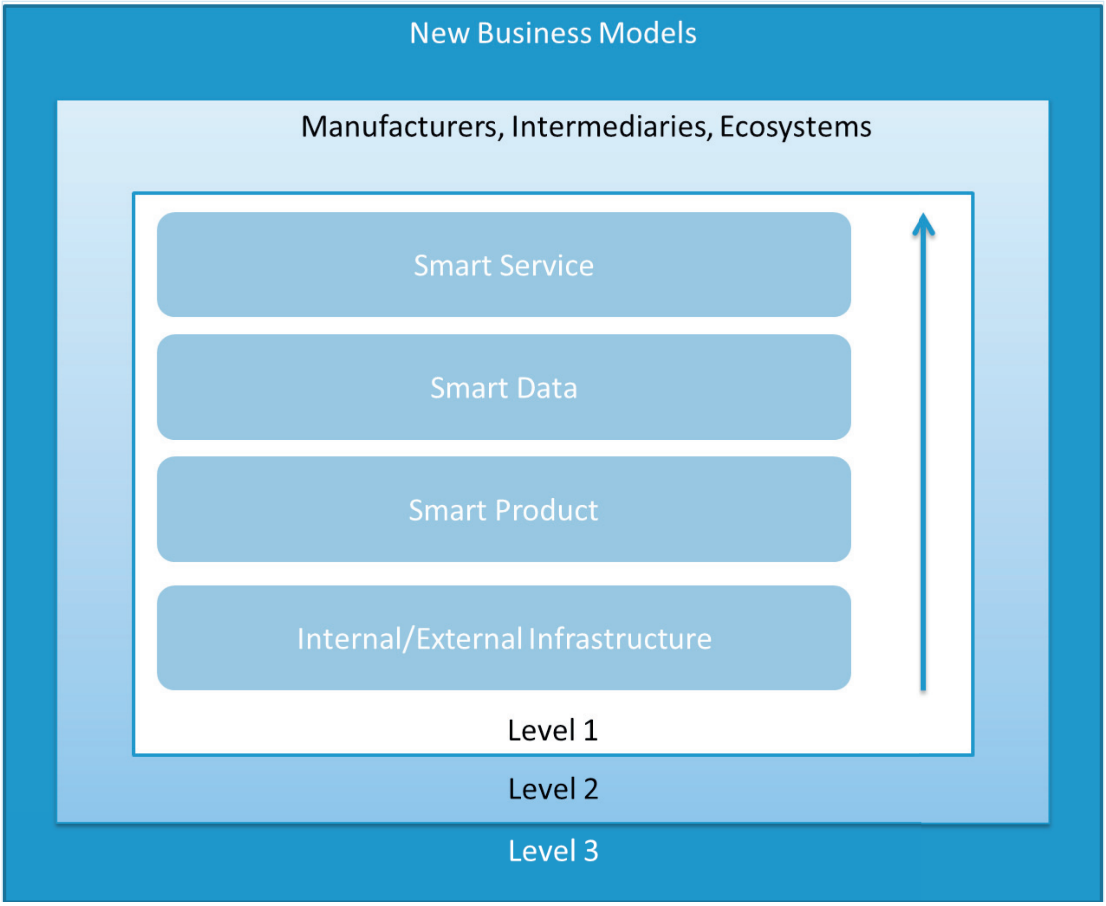

Figure 3: Four-layer model (Arbeitskreis Smart Service Welt, 2014)

The lowest stage of this model is the ***technical infrastructure***. Two requirements are existing in this stage. The first one is the internal infrastructure. Nowadays the information and communication technology (ICT) makes it easy to connect the physical products and services with the digital world. The second one is the external infrastructure. It is necessary to have a high-speed connection to deal with the abundance of data.

The following stage is the ***connected physical platform*.** This platform is created by all intelligent products which are related to the internet (Smart Products). Every single connected device can be understood as a hub in the internet that generates new data. These single hubs build a new connected network with an abundance of data. These connected devices can be a mobile, car or a machine that is used in the production process.

The ***software defined platform*** is the second stage of the model. At this level, the available data should be extracted and analysed to connect the basic information to new knowledge (Smart Data). This can be done by a traditional hosting or by using a cloud.

The last stage is the ***service platform***. With these platform, the digital and physical services can be connected for every single customer. This can be a connection of cars with the gas stations, to lead the driver immediately to the next gas station if the car transmits the information that the fuel tank runs dry. However, to make this work all the information should be connected within a digital ecosystem, where the companies combine and transfer their knowledge.

This infrastructure shall be the basis to reveal a strategy for building Smart Services. For the development of

Smart Services, it is essential – like for every new business idea – to analyse which benefit can be created for the customer when using the product or service. (Arbeitskreis Smart Service Welt, 2014)

Step 1: The first step represents stage four and three of the four-layer-model. Intelligent products (Smart Products) are needed to generate information and create Smart Services that fulfil the customers value. Therefore, sensors and cyber-physical-systems are necessary (CPS) (Bruhn and Hadwich, 2016). The CPS is a network of informatics and software technical components with mechanical and electronical parts which communicate by a data infrastructure like the internet. The sensors and actuators make it possible to detect and handle the environment and incorporated data. With this, the digital and physical object fuse together. The goal must be to sell the use of the product instead of just selling the product itself. (Arbeitskreis Smart Service Welt, 2014; Suh *et al.*, 2014)

Example: A supplier which produces assemblies for the automotive industry can equip the needed materials with tracking technologies and an infrastructure at the production which allows to handle the tracked information and make it accessible. Thereby, the materials can be tracked through every single production step, makingit possible to record the quality information and store it directly at the production part. A more broadly application area can be found in the gapless tracking of internal commodity flow in order to optimize the supplier and production network. The company can monitor the delivered parts in detail. It allows to track the quantity and kind of the product without manual labour and mostly in an accurate way. If the company has installed an information reading device in the goods receiving area, they are able to control the next production step by giving information on the incoming goods.

The technology that can be used for tracking is e.g. a barcode or a radio frequency identification (RFID). However, the RFID (smart labels) is compared to the barcode the more advantageous technology. The smart labels operate without an own energy supply, are designed in a small size and can read or write up to hundreds of bits in a range of thirty meters. The reading process can be done without any visual contact between the transmitter and the receiver. In addition, the smart labels are weatherproofed and insensitive to dirt so that they can be placed on mostly every material. The information that can be stored on this chip contains data about the size and weight of the product, but also production data like the cutting speed. (Jones and Chung, op. 2008; Clampitt, 2007)

Step 2: The mass of data (Big Data) that is collected by Smart Products must be analysed in real time with information extracting methods and intelligent algorithms to generate new knowledge. The real-time data collection here is very important, otherwise the reality is not shown and customer needs cannot be satisfied. This new knowledge is called Smart Data. A very relevant and important source in analysing the information is the cloud respectively the cloud-computing (Furht, 2010). (Iafrate, 2015)

The cloud-computing is a further development of the traditional hosting. It is characterized by a high failure safety as well as a high flexibility and therefore it is the most advantageous technology. An additional advantage is that the data can be multiply stored at different locations to reduce the risk of data loss. The flexibility is given because the user can match the needed service with the changed requirements. In the cloud, the user can easily add more data memory or more computing performance. In the traditional hosting, the user must change the hardware manually on his own, which costs a lot of time and money. Another advantage compared to the traditional hosting, is the payment model "pay per use". The user of the cloud only has to pay for the actual used service e.g. internal memory, computing power or data volume. The cloud-computing building is a tool with different services for data collection and handling over the internet. These services are classified by the Institute of Standards and Technology (NIST) into three different service models. These are "Infrastructure as a Service (IaaS)", "Software as a Service (SaaS)" and "Platform as a Service (Paas)". With this, the customer can use this service which generate the most benefit and fulfils the requirements. Examples for different services can be a data memory, software, server system, hardware or computing power. (El-Osery and Prevost, 2015)

Example: The supplier who equipped the assemblies with the RFID chips can use the information about the consumed materials (the RFID infrastructure must be installed by the Original Equipment Manufacturer (OEM) as well) by the OEM to analyse the consumer behaviour. With this, the supplier can create a new service for the material supply. This Smart Service reduces the effort needed for the order process by the OEM, so that the supplier or who? can only focus on the consumption of the materials. Another service that the supplier can add and offer is a quality analysis of the used materials. By analysing the cutting speed better material selection or a better setting for the process in order to optimize the production can be reached. To sum up, there are many possibilities of creating Smart Services by using Smart Products.

Step 3: The information can be stored in a common platform (service platform). With this the information of different Smart Products can be used to generate new digital service and business models leading to an optimization e.g of the whole supply chain. (Arbeitskreis Smart Service Welt, 2014)

Example: The service platform consists of all stakeholder of this business. This includes the supplier company, who produces the assemblies for the automotive industry, the OEM themselves and the producer of the machine tool for the production. If they publish all the necessary information and it is tracked by the Smart Product of this platform, a high-performance increase over the whole supply chain can be realized. With the tracked data of the RFID chip and the tracked data of the machine they can optimize the production. They can also analyse if the machine has to be maintained or if the setting for the machine, to handle the materials of the supplier needs to be adopted. With this the supplier and the machine tool producer can create a Smart Service for maintenance and additionally an optimization of the production by setting up e.g. the cutting speed can be reached.

4. Outlook

Exploding data volumes in cloud computing costs a lot of money. The solution shall be an innovative approach, the so-called fog computing. By 2020, 50 billion devices will be connected to the Internet of Things. This produces an enormous amount of data, raising the question: Where to go with all the data? In general, performance capacity costs money. Fog computing counteracts the enormous amounts of data on an intermediate level. Data will not be as previously unprocessed loaded into the cloud, but processed loaded into the cloud. Metaphorically speaking, the chaff is separated from the wheat at fog computing. By reducing the amount of data, a faster data exchange becomes possible. This allows real-time data to be generated and processed. In today's fast-moving times, Smart Services need to be able to respond immediately to changing situations. The response to real-time data plays a significant role for Smart Services. Smart Services should be linked to the fog computing technology in the future in order to avoid too high latent times of cloud computing. (Deutsche Messe)

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