Digital Twins for Innovative Service and Business Models

Masterarbeit

zur Erlangung des akademischen Grades „Master of Science (M.Sc)" im Studiengang International Management an der Wirtschaftswissenschaftlichen Fakultät der Leibniz Universität Hannover

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Hannover, den 29.09.2017

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1 Introduction

1.1 Motivation and Relevance

Nowadays, we live in a fast changing world, which leads to changing conditions for humans and for companies as well. One fundamental driver of these changes, are the technology development. In the last few years, the conditions for operating business, changes faster than in the last century. This is based on the fact, that new technologies, such as old existing technologies are nowadays cheaper available at the market. One example this development, is the idea of autonomous driving cars. The idea is out of the 1930s. But in this decade, the technology wasn't affordable available at the market. Nowadays, it is possible. But the costs for the requested technology develops as well. For just a few years, the needed sensors cost round about US$75,000. In contrast, if a great car manufacturer wants to equip a car with sensor for autonomous driving, he can do that by investing less than US$250. Specially the digitalization, is not restricted to a certain region or industry. To name just one aspect, which helps to improve the trend of digitalization, are cloud-based services. Such an availability of technology, provide two impacts. On one side, this technology could be the opportunity for existing business models. In former times, business between business partners the communication was intense at human labor. The above-mentioned cloud services, ensure a less requested human labor for order coordination between business partners, which are available for other issues. But not just business and business models change by digitalization. Even new opportunities for whole business branches open. Characterizing for the digitalization and to make a competitive advantage out of the provided opportunities, is the speed of innovation and its adoption. Furthermore, the digitalization and the technical development provide more and more data, which could use for decision making by gathering and applying all related information. Such as internal state of the art information of machines or other resources and even external information like environmental and whether information. Since it is a natural intention of companies to improve their business workflows and use their resources more efficient, although the availability of information and seamless information workflow get use to improve doing business. One concept, which become more and more attention, are Digital Twins, where the could is a fundamental component (SAP 2017, pp. 2–7). Companies which apply Digital Twins, are able to increase their productivity by more than 10% (Siemens 2015a, pp. 8–9).

But like the example of the autonomous driving cars, the concept of Digital Twins is not really a novel one. The NASA applied this concept while the preparation of the Apollo program in the 1960's. They trained the landing on the moon every situation on earth, with a 1:1 duplicate of the space vehicles. These twins should simulate real conditions as accurately as possible (Rosen et al. 2015, p. 568).

1.2 Objective

Basic intention to write this paper, is to achieve the academic grade of Master of Science. Emphasis which should respect by a potential theme was innovative potential driver for ventures, which become a high influencer in the future. Personnel interested in the used and unused opportunities for existing and even new ventures. The perspective of entrepreneurship was a heartfelt wish. After a research of trends which influence ventures in the future to increase their operational efficiency and different personnel discussions, the main topic became Digital Twins. In combination with the heartfelt wish, the concrete theme was defined to "Digital Twins for Innovative Service and Business Models".

This paper is oriented to achieve three goals. First, this paper should provide an overview of existing theoretical concepts. In literature, there are still existing different concepts, which are applicable for companies. Nevertheless, these concepts differ in their intention and on components, which are essential for a running real-time Digital Twin. Therefore, a critical review of each concept and a total comparison shows what are differences and similarities. The following two objectives build the heart of this paper. To build up a link to the practice, an investigation of the market with current offered and applied Digital Twins follows. Further, these Digital Twins get investigate under the aspects of the business model canvas. This should provide an answer to the questions what are the benefits & challenges of Digital Twins and how companies can earn money with Digital Twins. The last objective of this paper are the unused opportunities. From business administrational point of view, new technologies open new chances for additional services & products or provide conditions for new branches. If Digital Twins could be the base for additional services or even the base for new branches, the last part tries to answer this question.

1.3 Structure of the Thesis

After the introduction follows theoretical backgrounds, which should ensure a common understanding for the essential key terms. These terms get use across all chapters and the argumentations and results are based on these definitions. Beginning with the IoT, which is the overall topic. Ongoing, elemental items of the IoT, such as cloud-computing, smart-machines and big data get defined. At the end of the theoretical background, there most important key terms get defined, such as the Digital Twin, business model canvas and the product lifecycle. Adjoining to the theoretical background, the in this paper underlying methodology get describe. Even when in some of the chapters, remarks are repeated. Than a literature review follows.

Within the literature review three theoretical concepts of the Digital Twin gets first described. Afterwards of the concept description, for each concept a critical review follows. At the end of the literature review, the three described concepts are compared. The comparison is divide in five sections, where the concepts have similarities and differences. The next part of this paper is the market review, which is the main part of this paper. Here were different on market existing Digital Twins described and investigate under the aspects of the business model canvas. Based on these results and findings, a search of opportunities for companies start, with the intention to find chances for additional services & products of even new business models. After the investigation of on market existing and offered Digital Twins, a research of opportunities starts, which open up by applying Digital Twins. This research is divide in three sections and were done different by service, product and the entrepreneurship perspective. At the end of this paper, the key findings and results of this paper gets summarized and an outlook were made. Focus of the outlook is the development within the product lifecycle and what are upcoming challenges by applying the Digital Twin. Although the global impact of the Digital Twin gets treaded, such as the change of the employee skills and national economic impacts.

2 Theoretical Background

In this chapter, you find basic definitions for a common understanding of arguments, definitions and results. The main share of the used literature is round about 5 years old, just basic papers are older.

2.1 Internet of Things

IoT or sometimes Internet of Objectives, can described as a network of objects we use every day. These objects have the capability to communicate with each other and armed with omnipresent intelligence. Therefore, the objects communicate will human and mechanic participants of the IoT. The target is to provide gains for the humans and quality of life (Xia et al. 2012, p. 1101).

Atzori et al. (2010, pp. 2788–2790) gives in their paper an overview of the characteristics and elements of the Internet of Things (IoT). Basically, the IoT connects objects to a global network together. To enable the communication between different objects, the IoT uses standardized communication protocols. One key driver of the IoT is the RFID technology, which is used for example for communication from machine to product. The RFID chip included in the product, is its own memory. If in an automated production line, the machines can read the data from the product. On this memory are

the photography, it becomes a great challenge to find models, which ensure an emotional outcome. These models should respect different tastes and need to consider trends. Further for outdoor photography, it seems to be a challenge to get a camera to the right location. But with a look through the technological development of drones, a Digital Twin for photography seems to be possible. A Digital Twin could be schedule a flight path, with the target to make pictures from a special building. Even the vibe of the picture could be predicting, if the Digital Twin has access to real-time whether data. In contrast to landscape photography, a Digital Twin becomes more reasonable, if the location doesn't change and the shooting process is standardized. For this case, business portraits could be an example, which were made in a studio. The model has to take place on a fixed chair. Sensors measure the carriage of the model. If the carriage needs to be optimized, the Digital Twin shows via flat screen or acoustic sound recommendations to optimize the carriage. Than additional sensors could deliver real-time data of the facial expression. When the Digital Twin recognize, that the model has a friendly facial expression, an order to the camera could send, to make the picture.

Hopefully it become clear, that by defining the beginning theoretic and the intention for what the Digital Twin should use, has an essential impact of the results and findings. Nowadays, the concept of Digital Twins seems to be future or only applicable by big companies, which have the needed resources, such as money, knowhow and technological. The last two mentioned examples should show, that this isn't true and most of us still use concept, which are closed to Digital Twins.

8   Conclusion/ Outlook

In this paper the upcoming trend of the Digital Twin, get considered in different ways. First, each of the key definitions were defined for a common understanding. Ongoing this topic were investigating from academic perspective with a literature review. In this chapter were three concepts with a different intention considered. Each of them were although critical reviewed and at the end of this chapter, the theoretical concepts get in comparison to each other. Than the perspective changes and it follows an investigation, what concepts of Digital Twin are already on market available. Here are the concepts of Global Electric, Siemens and SAP provide an overview what kind of Digital Twins are on market available. For each of them, the business model canvas gets applied, to create the fundamental for unused opportunities.

Even there are different concepts of the Digital Twin, all of them has the right of exist, which gets based on broad range of the intentions of the Digital Twins. Until now, there

is no general concept, which could handle all of them and it could estimate, that a complete concept, which is applicable on all intentions would not make sense.

In the future, the number of used Digital Twin will increase rapidly. Due to the ongoing technology development and the technology, which is cheaper available at the market. Such as the sensors for autonomous driving, smart machines will become cheaper and therefore, it is a lower financial barrier for companies to implement Digital Twins. Currently it is a competitive advantage to optimize their business workflows with a Digital Twin. Based on the technological development, this will become as standard. Caused is this on the nature of doing business to use available resources in a more efficient way. Therefore, more and more companies will apply Digital Twins, until Digital Twin are common and a disadvantage, if a company does not use one.

By the increase of Digital Twin, which were apply in business operation, the probability for new services, products and new business branches increase as well. As Facebook was a small company, no one could believe that social media marketing will be an important communication channel for companies. When Digital Twins are a common tool for companies, it is expectable that new special branches establish where the Digital Twin is the fundament.

However, Digital Twin are as well risky. From a national economy perspective, the Digital Twin are able to replace the great share of employees in a company, where processes could automate. This does not lead implicitly to unemployment, but the there will be a shift at the qualification of the employees, which requests more and more strategical and analytical capabilities.