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INTERNET OF THINGS AND CUSTOMER BENEFITS

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Abstract
Although internet of things (IoT) is already being used successfully and intensively in the business-to-business (B2B) sector and can be found under the term Industry 4.0 in particular, beneficial innovations in the business-to-consumer (B2C) sector have so far played only a subordinate role (cf. Bitkom 2015: 14–19; Platform Industrie 4.0 2014: 7–9). Overall, it should be noted that there is currently only a small number of value creation models for B2C compared to the much more diverse application areas and the resulting newer value creation in the B2B sector. Nevertheless, relevant studies and reports also predict a significant growth for IoT in the area of private consumers (cf. Initiative D21 2016: 24ff.; Kratzert et al. 2016: 3f.; Bitkom 2015: 3; Accenture 2014: 3). As a result, IoT will become increasingly relevant for end customers as part of sociological digitization. This study divides the IoT market for consumer devices based on the customer benefits and types of devices into four different segments: Time savings, security & control, health & wellbeing as well as status & entertainment. To assess these defined segments and to forecast the potential rollout speed, this study uses data of a two-staged Delphi-Survey with a total of 23 experts – mainly working in the telecommunications industry. The presented evidences in this paper are showing, especially devices within the segment for time saving use cases will rapidly diffuse through the consumer market. Followed by the segments of status and entertainment as well as the security & control, which both are not showing a significance for either a fast or slow rollout. Either way the findings clearly indicate, that devices for health and well-being, will potentially take a longer period of time to prevail in the market.
KEY WORDS: Internet of Things; Value Creation Models; Innovations; Customer Benefits; Delphi Method.

Introduction

Digitalization, commonly referred to as the "digital revolution", is one of the most important drivers of the cultural and economic transformation of the 21st century and will change the lives of all of us in the future. The growing number of mobile and stationary devices that are digitally connected via the Internet and among each other can be summarized as the "internet of things" (IoT). Behind this term lies the omnipresence of the Internet, which can experience its next evolutionary stage and create added value by connecting countless everyday objects, machines, buildings, vehicles or even man himself. Such a development would obviously also be a significant economic value driver. Even though IoT is already used in several branches of industry, especially in the automation of production and logistics, applications and markets for consumer-related devices currently show relatively low market penetration and significant growth.

Application areas for Internet of Things

The forecasted market development of IoT requires a corresponding technical infrastructure, which will act as a lever for the spread of IoT devices. Three important technological changes (e-sim, 5G, NB-IoT) in the telecommunications industry will favour this development within the next few years.

Figure 1 shows the forecast growth in IoT devices in Germany described above, subdivided according to the classes of devices currently available on the market. It is clear that Smart Home and Connected Cars in particular will become significantly more important in the coming years.

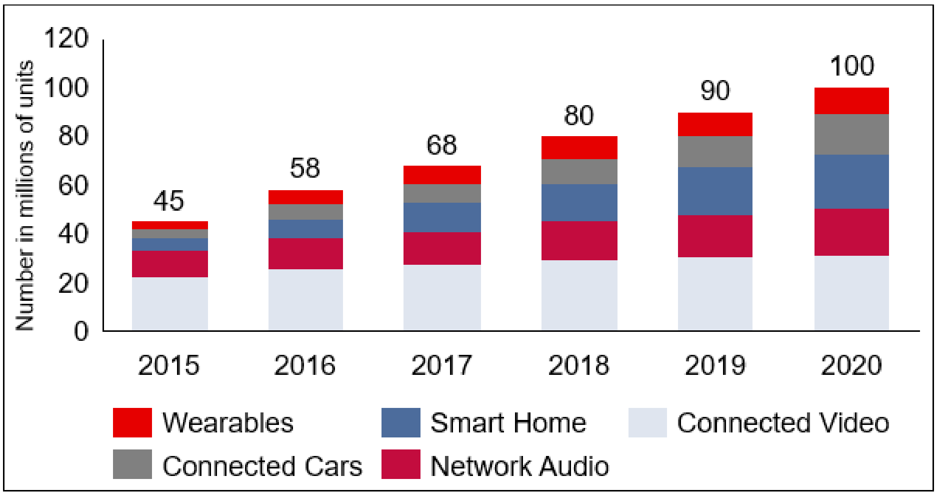

Fig. 1. Forecast for consumer IoT equipment inventory in Germany
Source: Own illustration based on Bitkom (2015)

Smart Home refers to applications and systems in living spaces and houses that are intended to increase the quality of life and living comfort of private individuals through networking with the Internet and among each other. In particular, objects from the areas of kitchen, sanitary, lighting, emergency equipment, home security as well as energy and water supply are connected. (cf. Strese et al. 2010: 8). The focus is on the automation of processes and additional security through new monitoring and locking systems. In 2018, smart home products already generated sales of around 2.8 billion euros in Germany and are expected to grow to around 7.3 billion euros in annual sales by 2023. (cf. Statista 2019). In principle, this part of IoT can be regarded as having the greatest growth potential within the next few years.

While digital technologies in the automotive sector have so far focused exclusively on storing and analyzing the internal data of the respective vehicle and thus ultimately optimizing its internal functions, the Connected Cars sector will open up numerous new application possibilities in the future. IoT will enable motor vehicles to communicate with the Internet and with each other. This will lead to a new generation of vehicles that will independently perform maintenance and checks, increase interior comfort, provide assistance with driving and parking, or ultimately take control of driving themselves. (cf. McKinsey & Company 2014: 11f.). Applications which are incorporated as electronic objects into clothing, accessories or medical devices and worn on the body can also be referred to as wearables. Due to the resulting variety of possibilities, various other subcategories of this subarea exist. Smartwatches, fitness bands, smart glasses, smart clothing and tracking devices can be differentiated, with smartwatches having by far the largest market penetration within the group of wearable owners with 62% and fitness bands with 45%. It can also be assumed that devices with medical functions in particular will become more attractive and gain market penetration. (cf. PricewaterhouseCoopers AG 2015: 5ff.).

Dimensions of new value creation models in the context of customer benefit

The term value creation model is defined heterogeneously within the current technical literature, analogous to the term value creation. (see Schuh 2011: 97; Zollenkop 2006: 40f; Nemeth 2011: 67). In addition, literature often uses the term "business model" synonymously. Bieger and Bickhoff define business models as a simplified description of the strategy and method for generating earnings of a profit-oriented company, which can show potential investors the usefulness of their commitment. (cf. Bieger et al. 2002: 35ff.). Osterwalder/Pigneur define a business model as a process that describes the reasons why a company creates, delivers and captures value. They combine the idea of value creation with that of the product life cycle. Particularly important is the value passed on from the company in question to the customer. The lifecycle of the product can be integrated into the company environment and thus illustrate the relationships with business partners. (cf. Osterwalder/Pigneur 2002: 2ff.) Afuah, on the other hand, focuses on the value creation activities of the company in question and describes business models as a bundle of activities that have to be limited according to the question of when and how they are carried out or configured. (cf. Afuah 2004: 10).

Both the Bieger, Bickhoff and Afuah elements mentioned above can be found in parts in Slywotzky's definition, which expands by the dimensions of the markets it serves and the products it offers. Business models are therefore the sum of all factors, how a company defines differentiating offers, allocates and configures its resources, chooses the market to be worked on, creates customer benefit and finally generates profit. (cf. Slywotzky 1996: 4). It becomes clear that business models can be described and delimited by the elements of product/market combination, implementation and configuration of value creation activities, and earnings mechanics.

From the point of view of the IoT market, Smarthome Services not only offer a corresponding market potential for the classic networking of electronic household appliances or other devices such as radiators, locking systems or surveillance cameras, but also for TV and telecommunications providers who are increasingly offering new services via access to the usability of information data and could thus generate new sources of income; in their Value Based Adapotion Model, they refer to the advantageous criteria of increasing user friendliness or enabling a secure lifestyle, which are guaranteed above all by the telecontrol function of household appliances. From the point of view of the identified device segments, factors such as time savings, safety and control can be derived.

The customer benefit is defined in this article as the degree to which the needs are satisfied. The satisfaction of a customer is directly related to the fulfilment of its needs. (cf. Meffert et al. 2015: 16). The first question that arises is which different forms of customer needs exist and how these can be addressed. With its eight consumer value types, Holbrook is establishing an essential basic concept on which a large number of further research projects are based (cf. Jahn/Drengner 2014: 37ff.). These value types differ in the dimensions self-oriented or externally oriented, extrinsic or intrinsic, active or passive. As a result, Holbrook subdivides the possible customer needs into efficiency, excellence, pleasure, status, prestige, ethics, spirituality and aesthetics. (cf. Holbrook 1999: 5). If one compares these value types with other theoretical concepts, it is striking that although the number of different types of needs per approach varies, a high degree of overlap with Holbrook's value types can be observed. (cf. Jahn/Drengner 2014: 40).

It is noticeable that customer needs can basically be divided into four heterogeneous clusters. The first cluster subsumes all the needs which, by saving time, enables a more efficient achievement of one's own goals. Wittko supplements this needs cluster with the additional features of security and control, which can also be classified as components of efficiency in the context of services. (cf. Wittko 2012: 273; Jahn/Drengner 2014: 40).

The second cluster deals with the quality of the product or service. If the quality takes on a correspondingly perceived form, this can also be seen as a form of satisfaction of needs. (cf. Jahn/Drengner 2014: 40). If a product or service leads to a positive emotional reaction on the part of the consumer, this is classified in the third need cluster. The fourth and last cluster is made up of needs that are met by the appreciation of the company or external persons towards the consumer. This can manifest itself, for example, through the social status ascribed to the customer as a benefit. (cf. Jahn/Drengner 2014: 41). When implementing innovative value-added models, the question arises as to what customer benefit the planned products and services provide for the consumer and to what extent these can be distinguished from homogeneous offers within the market and from other market segments outside the market by the perceived customer benefit. The clusters resulting from the value types and value dimensions described will therefore serve in the following as a basis for the delimitation of value creation models and lay a theoretical foundation for the analysis of new business models by IoT.

Spread of innovations

In the literature, there are various methodological foundations that examine the spread of innovations and provide explanatory approaches against the background of sociological factors for the emergence of new value-added models. An essential prerequisite for the successful introduction and spread of new value creation models is the acceptance by the customer. (cf. Schmidt 2009: 17). Whether and at what point innovative products and services are accepted by consumers depends on various factors (cf. Gatignon/Robertson 1985: 850; cf. Rogers 2003: 19f; Schmidt 2009: 17; Königstorfer/Gröppel-Klein 2008: 10). These factors are considered within the framework of diffusion theory and combined in a model to explain structural processes of innovation propagation. (cf. Rogers 2003: 19). Therefore, diffusion theory is regarded as an essential cornerstone of general acceptance research. (cf. Arnold/Klee 2016: 10). The chronological sequence of an innovation can have an effective influence, for example, if new products are introduced to the market at the right time or if existing innovation barriers are broken down. A corresponding customer benefit is also highly relevant and can be described by the type of innovation. However, the extent to which the existing customer benefit can also be perceived by the customer is directly related to the communication channels used.

Within the framework of diffusion theory, consumers can be described as adopters of innovations who decide between the direct purchase of a new product or service immediately after its market launch, a wait-and-see and weighing attitude or a fundamental rejection. (cf. Schmidt 2009: 17). Here the adopter goes through different phases, which can be summarized by the innovation decision process. Rogers names the phases knowledge, persuasion, decision, implementation and confirmation for the innovation decision process. (cf. Rogers 2003: 170; Arnold/Klee 2016: 18). However, since this paper does not examine the individual purchasing decision process of a value creation model, but rather the overarching sociological developments, a closer examination of these phases will be omitted at this point. Instead, the model of the diffusion process is suitable for analysing the spread of innovation within social systems. Depending on the percentage of market penetration, a distinction can be made between five categories of adopters (cf. Rogers 2003: 22). The aim of the categorisation is to bring together demanders with a homogeneous degree of innovation or willingness to accept innovations in a group and thus to gain a better understanding of the course of innovations.

Roger's approach is based on the assumption that each individual would adopt an innovation sooner or later. This can also be referred to as "pro-innovation bias (see Götze 2011: 29; Molesworth/Suortti 2002: 157). Within the relevant technical literature, however, there are condensing indications that the recording of barriers and resistances is also of great importance for the success of an innovation. (cf. O'Connor et al. 1990: 69; Molesworth/Suortti 2002: 157).

Empirical analysis for the prognosis of innovation diffusion

With regard to the research gaps with regard to the prognosis of the propagation of IoT innovations, this paper uses the technology preview approach. As a sub-area of futurology, technology foresight comprises various quantitative and qualitative methods for determining developments, trends or future needs. (cf. Steinmüller 1997: 97). The Delphi survey technique is particularly suitable for forecasting future developments. (cf. Saren/Brownlie 1983: 52). Depending on its design, the Delphi survey can therefore have a quantitative and a qualitative share or be exclusively of a quantitative or qualitative nature. It can therefore also be seen as a synthesis instrument between quantitative questioning and qualitative expert interviews or group discussions. (cf. Hienerth 2010: 9f.). Three predictive theses are to be drawn up for the fundamental acceptance of IoT as well as for each of the four identified business areas, which serve as evaluation criteria for predicting the spread of each of the models. The theses developed in this way are then combined in a questionnaire and extended by three normative questions. Normative questions are used to check the desirability of the realization of particularly critical theses (cf. Steinmüller 1997: 77).

Data analysis

The evaluation of the collected empirical data is carried out in the following by three iterative statistical procedural steps, which are based on procedural techniques of descriptive and inductive statistics. First of all, it should be noted that all predictive theses of the survey use a heterogeneous ordinal scale (the ordinal scale designates a scale form which is used to form ranks. However, the distances cannot be interpreted homogeneously). The number of answers per scale also varies. Although this makes sense with regard to the respective theses, it makes it more difficult to compare the theses with each other. Therefore, each of the theses is to be made comparable and homogenized through the use of indices. Indices aggregate a range of response options into a single measure by averaging the weighted individual values of each range (cf. Mosler/Schmid 2006: 125).

The weighting of the response categories is now a second and final preliminary consideration. In order to be able to weight the nominal scale accordingly, it is to be converted back into an ordinal scale. For this purpose, a numerical value is assigned to each characteristic, which expresses the distance dimension to the extreme value "Will not occur". The selected values should show the distance of the change between two positions and the weighting of these categories in the index. The values 0 (will not occur), 0.5 (will occur slowly), 1 (will occur shortly) and 2 (will occur rapidly) were therefore chosen for the ordinal scale and the weighting of the response categories. The distance measure was not chosen linearly in order to take into account the barriers to a rapid spread of innovations within the weighting. The corresponding indices can now be calculated from this.

Selected findings and interpretation

The first thesis out of fifteen thesis all in all deals with the temporal prognosos of the occurrence of a possible IoT everyday life. 78% of the experts stated that they expected this thesis to become reality by 2025.. 22%, on the other hand, believe that the thesis is likely to come into force by 2030 only. Furthermore, the second thesis asked about the number of IoT devices used in the future. It is noticeable that 22% of the respondents forecast a number of more than 20 IoT devices in use. In contrast, 26% predicted a number between zero and five, and 39% a number between six and ten devices. The third thesis predicts the extent to which IoT can develop new market segments with new technical products and innovative services. Thus, within the first survey wave, 74% of the experts agreed with the thesis with a value of four or five on the answer scale (five corresponds to full agreement). The vast majority of experts are therefore convinced that the new business models and a large number of new useful devices will be created by IoT for private consumers. The fourth thesis deals with the area-wide realization of vehicles with self-driving function. All the experts agreed that this technology diffuses between the years 2026 and 2035. Thesis 5 covers the automation of everyday commodities and the resulting time savings for private consumers (e.g. kitchen appliances). 78% of the experts agreed completely to the realization of the thesis in the first round, while 61% in the second round agreed with an approval rating of four. The six thesis dealt with decreasing importance of the smartphone as the universal device to control IoT appliances – substituted by intelligent automation and voice control. In the second round of the survey, 61% of experts agreed gave an approval rating of three. 39%, on the other hand, tended to disagree with the thesis with a value of 2.

Conclusions

The aim of this contribution is to illuminate the three formulated research questions holistically and thus to provide a first contribution to basic research for IoT as a new scientific field. This work is intended as an attempt to make the research field of Consumer-IoT accessible for further conceptual research and to give an initial outlook on future developments. The resulting IoT business models can be described by four essential dimensions and can be distinguished from other business models.

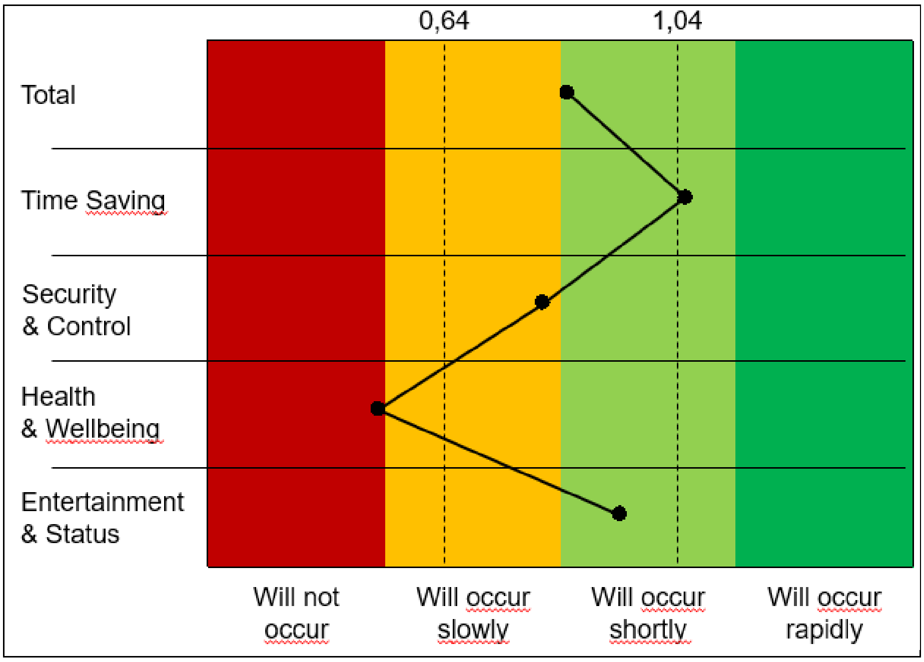

Fig. 2. Propagation velocity of IoT business models

Value creation models for IoT can therefore be defined by the sequence of activities described, a strategic form of product development or diversification, revenue sources from the combination of product, service and information as well as by the determined customer benefit of time savings, safety and control, health and wellbeing as well as status and entertainment.

The resulting typology of customer benefit also provides information on the differentiation between IoT business models. Accordingly, in contrast to current product clusters, customer benefit should be used as a heterogeneous criterion for differentiation, since it represents a central component of the success of IoT business models. In addition, the temporal spread of the business models identified in this way was predicted on the basis of an empirical survey. Overall, empirical research has shown that IoT will generally diffuse at a moderate rate within German society over the next few years. Business models that enable time-saving automation to be implemented and IoT devices with a focus on entertainment and status will expand at an above-average speed and thus realize new business models and revenue sources very quickly. In particular, technological automation in the areas of household appliances, domestic technology and automotive suggests a rapidly growing spread. On the other hand, medical and sports-related equipment from the health and wellbeing sector will diffuse very slowly or not at all and represent a relevant business model for companies. It is particularly up to the acting companies to successfully shape the new value chains and to concentrate on the relevant customer benefits of these innovative technologies in order to overcome the barriers on the demand side in order to be able to raise the numerous potentials.

Limitations and research outlook

The present study has limitations that offer various starting points for future research. Since this contribution covers a broad field of possible future technical innovations, a lack of clarity regarding the selection of the survey participants cannot be ruled out. It is advisable to examine the acceptance and spread of IoT business models by means of a representative customer survey within the framework of in-depth research. In addition, the study is based on identified value creation relationships and an identified typology of business models for IoT. This typology was derived on the basis of theoretical preliminary considerations and was therefore not empirically validated within this work.

The validity of the collected data is limited by the survey form of a Delphi survey, which allows estimations and forecasts, but does not aim at a value that can be operationalised - for a certain measurement criterion. The selection and participation of the experts in the Delphi survey indicate the representativeness of the population of all experts active in the economy and science who are reflected in the product and market development of IoT applications. However, a Delphi survey does not aim at representativeness either, but at the systematic recording of expert knowledge and expert assessments on a new business topic or trend. With regard to the reliability of the research approach, random errors are excluded or corrected with the repeated participation of the experts in the second survey error. On the other hand, a Delphi survey in terms of reproducibility of the data from the first round serves as a critical self-evaluation of his expert assessment and thus leads to a stronger objectification of the factors examined.

To test the business model types, a further empirical study is therefore recommended in order to determine the relevant customer benefit for IoT empirically and to supplement or change the identified typology if necessary. This should be done on the basis of a quantitative study to obtain a broad and representative sample.

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