Technology Acceptance in the Case of IoT Appliances

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Abstract: The Internet of Things (IoT) refers to the interconnectedness of physical objects, and works by equipping the latter with sensors and actuators as a means to connect to the Internet. The number of connected things has increased threefold over the past five years. Consequently, firms expect the IoT to become a source of new business models driven by technology. However, only a few early adopters have started to install and use IoT appliances on a frequent basis. So it is still unclear which factors drive technological acceptance of IoT appliances. Confronting this gap in current research, the present paper explores how IoT appliances are conceptually defined, which factors drive technological acceptance of IoT appliances, and how firms can use results in order to improve value propositions in corresponding business models. It is discovered that IoT appliance vendors need to support a broad focus as the potential buyers expose a large variety. As conclusions from this insight, the paper illustrates some flexible marketing strategies.

Keywords: Internet of Things, Business Models, Technology Acceptance, Smart Home, Digital Business Management, Digital Strategy, Marketing

1 Introduction

The Internet of Things (IoT) refers to the interconnectedness of physical objects, and works by equipping the latter with sensors, actuators as a means to connect to the Internet. By delivering this outcome, the goal is to develop new applications for consumers and to establish new business models for firms. Popular examples of IoT appliances are the monitoring of personal health by wearables, smart home solutions that allow users to control household technologies via mobile apps, greenhouses that adapt their internal climate to the monitored properties of the crops growing inside, smart grids which helps users make better energy use choices, and predictive analytics that helps companies maintain their machines without being on-site [Di15].

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The field of IoT is currently characterized by massive growth. The number of connected things has increased threefold over the past five years [Di13] and is estimated at 6.4 billion for 2016 [Ga15]. Consequently, firms expect IoT to become a source of new business models driven by technology. Cisco estimated that the global IoT market will generate $14 trillion in profit over the next decade [Bo13] while Gartner (2015) predicts that the total global economic added value for the IoT market will be around $3 trillion dollars in 2020 [Di15].

Given this development, firms need to transform their business models and offerings to meet rapidly changing customer needs and expectations. To date, only a few early adopters have started to install and use IoT appliances on a frequent basis. Therefore, it is still unclear which factors drive technology acceptance of IoT appliances and what level of acceptance has already been realized amongst consumers. The decision criteria employed by consumers for the usage of IoT appliances are often latent but may attain diversity in different consumer segments. Therefore, the linkage between corporate value propositions for IoT appliances and consumer expectations with regard to systems usage is at present vague.

Confronting this gap in current research, the present paper attempts to answer the following research questions: (1) How are IoT appliances conceptually defined? (2) Which factors drive the technological acceptance of IoT appliances? (3) How can firms use insights into technology acceptance to improve value propositions in corresponding business models?

The outlined questions are theoretically elucidated using technology acceptance theory. In order to operationalize the research framework for a specific user context, original user data was collected on smart home solutions, these being technologies that enable the interconnectedness of household appliances. Therefore, different factors for perceived usefulness and perceived ease of use for smart home appliances were investigated by means of a standardized online survey. Finally, the conceptual model of this research was tested using data from 161 consumer questionnaires. Results identified some important factors driving technology acceptance of IoT appliances in different consumer segments.

2 Theoretical Foundation

The term Internet of Things (IoT) was first introduced by Ashton (2009): “Today computers – and, therefore, the Internet – are almost wholly dependent on human beings for information. The problem is, people have limited time, attention and accuracy – all of which means they are not very good at capturing data about things in the real world. We need to empower computers with their own means of gathering information, so they can see, hear and smell the world for themselves”.

Nowadays IoT actually consist of “things” with sensors and actuators that are connected to the internet. Once they are connected to the internet, these are connected to each other

as well [CMM12]. So this shows that IT is already where Ashton (2009) wanted it to be: Things have the power to gather information with the help of sensors or actuators. That means that IoT is now a reality and companies need to be aware of this trend.

Taking the example of sensors, O'Leary (2013) states that "sensors could include location identifiers, such as global positioning system (GPS), and identification devices, such as radio-frequency identification (RFID) tags. So sensors help things to capture information such as the temperature around or the place where it is located. Additional to that, things are also aware of other smart devices in the surroundings. Sometimes a thing even wants to communicate with another thing" [O'L13]. "The IoT is currently going through a phase of rapid growth" [Di15]. Recently it was announced that bicycles will be able to communicate with traffic lights in order to ensure green light for them just to mention one of many new IoT applications that has the potential to increase humans' quality of life [Mi15]. Hence, IoT evokes great interest not only for companies but also for humans [Ro15].

The empirical background of this paper concentrates on smart home appliances, as a practical example of an IoT application. The concept behind smart home is quite simple. A given operation or task, typically performed manually by humans, is now executed automatically without any human involvement (Mi15). Home automation has been around for a few decades now, having started out by using clocks to close the house shutter at a given time. But today smart home technology can be controlled from just about everywhere, is able to handle much more sophisticated operations and, moreover, the price of smart devices has fallen (Mi15). These developments have led to increased interest in this technology. That is also why the smart home was picked as the topic of this research paper.

Nevertheless, consumers are still cautious about IoT applications like the smart home, because companies have not been able to convince their customers of all the benefits that go along with IoT. Against this background, it is essential for companies to know all the factors that are relevant (and also irrelevant) to their customers, in order to sell their IoT applications in a profitable manner.

A fruitful theoretical foundation for the exploration of user related factors in IoT business models is provided by technology acceptance theory [Da89]. The basic Technology Acceptance Model (TAM) describes the predictors and correlations for identifying the degree of utilization of technological systems. TAM is based on the socio-psychological Theory of Reasoned Action (TRA) as developed by Ajzen and Fishbein (1980). According to this theory, the user's attitude toward technological systems is determined by two factors. One is the perceived usefulness of the systems and the other is their perceived ease of use. Perceived usefulness covers a person's subjective evaluation in relation to whether the use of certain technology improves their work performance. Perceived ease of use measures a person's perception in relation to the effort going into learning how to use the new technology. Such factors might also be transferable to the user acceptance of IoT appliances.

The two predictors have a causal influence on the attitude of the user and intended behavior resulting from that. Thus, the actual system use can be derived from the causal chain set out in Figure 1. This yields a widespread model for studying the use of technology in the field of information systems. The success of the model reflects its comprehensibility and simple application, but the high level of reliability of the initial variables. This was demonstrated in a meta-analysis by King (2006). Therefore, a deeper evaluation of the application of the TAM in the context of IoT appliances is fruitful.

Following TAM, both initial factors for technology acceptance are influenced by so-called external variables. Typical external determining factors are the nature of the technological systems themselves as well as the availability and implementation of training courses for their use.

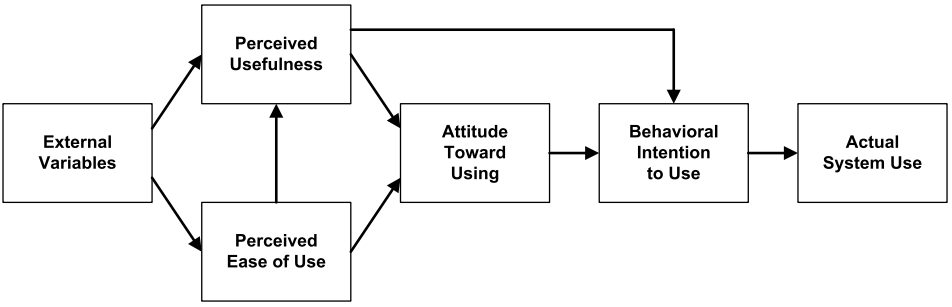

Fig. 1: Technology Acceptance Model [Da89]

Systematic analysis of available literature on TAM shows the high degree of proliferation of the approach. During analysis, scientific publications dating from 1995 to 2015 that are available in the EBSCO Business Source Complete, Emerald, ACM and IEEE databases were studied. Selected for analysis were scientific publications where the precise phrase "Technology Acceptance Model" features among the keywords. A search for especially this term was also conducted on Google Scholar. The results of the search indicate that the term TAM has been used in as many as 763 scientific publications as a "keyword" since 1995. Moreover, on Google Scholar, 21,700 documents can be found that use the precise phrase "Technology Acceptance Model." Further analysis of available literature in the context of this research focuses on the 763 scientific papers provided by keyword search. These papers were evaluated in terms of the external variables studied. The results of this evaluation exceed the scope of this paper. Nevertheless, key external variables for the perceived usefulness and ease of use refer, for example, to personal or individual traits (Sz93), organizational factors (Le06; Ra91) and technological aspects (AG02; Ch08). The core results of literature analysis of TAM were used to identify potential external variables affecting perceived usefulness or perceived ease of use in the context of IoT appliances. Finally, the results of this review yielded a testable conceptual model for user acceptance of IoT appliances with direct consumer data.

3 Conceptual Model

The conceptual model of this research is outlined in Figure 2, viz. the basic idea behind TAM, and additionally connects a group of external variables with perceived usefulness and perceived ease of use. Furthermore, consumer perceptions with regard to the expected causal relationships are tested with direct consumer data.

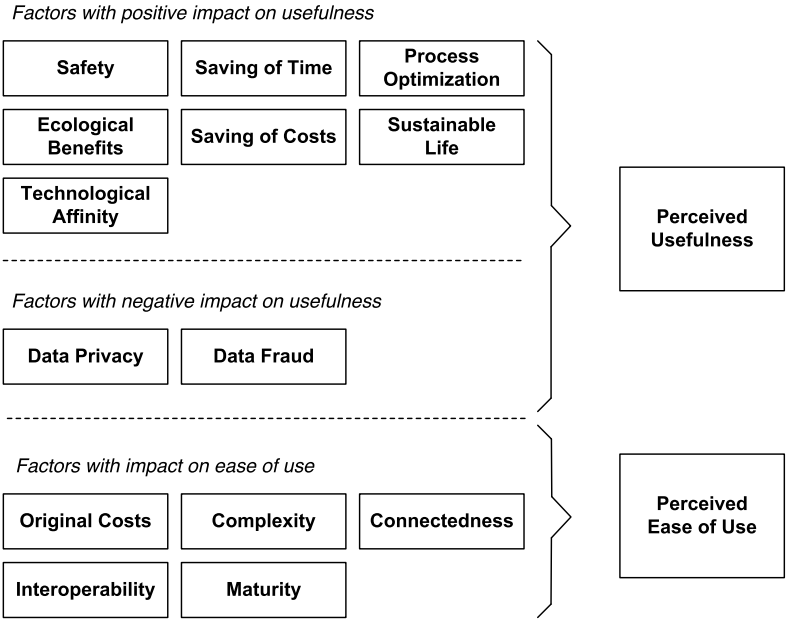

Fig. 2: Conceptual Framework

The outlined model describes potential external factors that might affect the actual system usage of IoT appliances. A detailed definition and description of these factors is presented in Table 1. Furthermore, the table provides information about literature sources for further descriptions of the single factors.

External Variable	Definition	Description	Sources
Complexity	Complexity of smart home systems for end customers is too high	Solutions are often too complex and, especially for technically challenged users, too difficult to understand.	Deloitte, 2013 Saito & Menga, 2015
Connectedness	Insufficient internet connection	Telecommunication companies need to provide sufficient broadband internet connectivity everywhere.	Capgemini Consulting, 2012
Data Fraud	Fear of hacker attacks	Potential customers are afraid of being hacked by criminals.	Andelfinger & Hänisch, 2015
Data Privacy	Data gathering and backup through active internet connectivity	One challenge for smart home is insufficient security concerning private data.	Knöpke, 2014 Saito & Menga, 2015
Ecological Benefits	Ecological sustainability through energy efficiency	Energy efficiency plays a major role in every household.	Icontrol Networks, 2015 Deloitte, 2013
Interoperability	Isolated applications by producers: Missing integration of platforms	Customers would prefer to buy all devices from a single smart home supplier offering integrated functionality.	Capgemini Consulting, 2012; Saito & Menga, 2015; Andelfinger & Hänisch, 2015
Maturity	Low level of technological maturity	The level of maturity of smart home technology is still insufficient.	Knöpke, 2014
Original Costs	High acquisition costs of smart home systems	The transparency of acquisition costs in smart home systems is very low for potential customers.	Deloitte, 2013 Saito & Menga, 2015 Kim& Shin, 2015
Process Optimization	Process optimization through intelligent interconnections.	User focus on the actual value of a smart home system rather than on technical details.	Deloitte, 2013 Andelfinger & Hänisch, 2015
Relative Advantage	User does not see any advantages	People state that they just do not see the need for smart home technology.	Knöpke, 2014 Kim& Shin, 2015
Safety	Increase in living safety through monitoring and remote control	Most of the customers say that personal and family safety is one of the top reasons to purchase a smart home system.	Icontrol Networks, 2015 Gao, 2014
Saving of Costs	Saving costs through energy efficiency	47% of potential customers are motivated to help the environment by greater energy efficiency.	Icontrol Networks, 2015
Saving of Time	Saving time due to flexible control options	57% of American smart home users state that they save 30 min. each day by smart home systems.	Coldwell Banker Real Estate LLC, 2015
Sustainable Life	Sustainable and ecologically-friendly life	Environmental consciousness is steadily increasing among potential customers.	Deloitte, 2013 Saito & Menga, 2015 Ahn, 2015
Technological Affinity	Enthusiasm for technology	Customers are excited about the potential in programming home settings and maintenance.	Hellfeld, 2016 Gao, 2014 Ahn, 2015

Tab. 1: Description of the motives for, and challenges awaiting, the use of smart home appliances

4 Method

TAM describes a process targeted at actual system usage, preselected factors, i.e. those based on existing literature, can influence technology acceptance both positively and negatively. Because companies are always looking for ways and means to increase usage, consumers need to prioritize and evaluate the factors involved. This would yield results obliging IoT suppliers to adjust their products and services.

To that end, this research provides a standardized questionnaire in order to test the formulated relationships on a large consumer sample. To ensure broad coverage, an online survey was launched on an internet platform called Questback. This tool is known for its easy availability and functionality, and represents a helpful live-tracking option. The questionnaire was made available online for ten days (from November 17th to December 1st, 2015). To reach as many participants as possible, the authors shared it via their personal social media accounts (Facebook, Twitter, Linked In, and Xing) and alkso with some Alumni groups who had requested to share it. Overall, this resulted in 146 completed questionnaires. 225 people accessed the survey, but closed it after a few seconds, what may be put down to a personal lack of interest. The participants needed 3 minutes and 58 seconds (median) to complete the survey with 12 questions.

Due to the decision to target the German speaking market only, the survey was published exclusively in German. All answers had to be given anonymously. The questionnaire was quantitatively designed to facilitate statistically valuable results. Some questions were given with predefined possible answers like yes or no. Others had to be answered by assigning an overall rating of the importance on a scale ranging from 1 (most important) to 7 (least important). Additionally, the participants had to sort the preselected motives and challenges developed out of TAM based on their personal priority. This was integrated to avoid a scenario where participants ranked factors equally. In order to give those surveyed an opportunity to make a qualitative statement, additional text fields were provided where additional factors could be mentioned on a voluntary basis. Through this device, factors could be discovered independent of the existing literature [RB10]. Furthermore, in order to reveal unpredicted relations, all participants were asked to respond with personal information like age, gender, household income, marital status, education, living standard, and household size. This information could then be used as control variables to generate segment-based analyses. The results were then presented based on segments.

The authors decided to structure the survey based on the following five building blocks: First, the participants were welcomed on a “landing page”. After that, people were asked about their current buying behavior regarding smart home devices. At this point, the attendees were split into those who were already aware of the smart home problematic and those who were not. To gain meaningful results about whether smart home technology influences the buying behavior of a participant, it was deemed necessary to ensure an overall understanding of the term “smart home”. So, if a participant stated that he has no current knowledge thereof, he was redirected to an official definition before returning to

the initial question. Within this building block, participants were additionally asked whether they already own such a device. The third building block focused on the evaluation of benefits and drawbacks of smart home systems.

To simplify this question and, additionally, to render the answers comparable, participants were invited to arrange seven possible answers via a drag and drop function, ranging from their highest to their lowest personal prioritization. If desired, participants were able to add further ideas and comments in a text field below the predefined answers. It should be mentioned that all questions were tagged with the instruction "must be answered"; however, it was also possible to proceed without arranging all of them. Consequently, the answers vary in the number of results posted. The fourth building block contained questions ranging from personal information to potentially identifying unpredicted correlations (e.g. between age and number of smart home devices).

5 Results

The key results of the outlined research are presented in different tables within the following paragraph. All of the numbers are based on total sample size. Subsequently presented are further findings reflecting for different segmentation approaches.

Inspecting the motives for the use of smart home presented in Table 4, one can recognize that there are two important issues for the end customer. On the one-hand, saving time due to flexible control options scores 3.09 points; and on the other, saving costs through energy efficiency scores 2.86 points. Beside these two, all other motives score between 3.92 and 4.45 points. No high variance was detected. This result reflects the trend in society towards more convenience in everyday life and the demand for a smarter home.

Would a smart home functionality influence your purchasing decision positively?

	Number	**Percentage**
Yes	75	46.58%
No	41	25.47%
I know nothing about smart home	45	27.95%
Total	**161**	

Tab. 2: The influence of smart home functionalities on personal purchasing decisions

Do you own smart home technologies in your household?

	Number	**Percentage**
Yes	20	12.42%
No	136	84.47%
I do not know	5	3.11%
Total	**161**	

Tab. 3: Adoption of smart home appliances

A different view results when the challenges are analyzed (Table 5). The variance of all items is found to be relatively high. High acquisition costs for smart home systems tend to be the greatest challenge for the end customer. No other challenge comes even close to its average score of 2.77. Therefore, this can be clearly seen as a key finding of this present research. Furthermore, three challenges received a very low score: users do not see any benefits, insufficient internet connection, and complexity of smart home systems for end customers was too high.

Furthermore, a data analysis with segmented samples was used to identify dependencies on the control variables. Therefore, one differentiation criterion is whether the responses came from participants younger than or exactly 30 years old or from older ones. To be able to compare the results, the margin of the average score was calculated. This analysis was conducted for both motives and challenges vis-à-vis the use of smart home systems. The authors determined key findings in both analyses. One can clearly recognize a huge gap in the importance of an increase in living security via monitoring and remote controls (2.73 compared to 4.35). Whereas the function is extremely highly valued by participants older than 30, younger people do not see the same advantages here. For instance, they would prefer process optimization via intelligent interconnectedness.

Ranking of the motives for use of smart home based on the online questionnaire (1=very important; 7=not important; sorted by average)

Function	Total	Average	Median	Deviation	Missing		1	2	3	4	5	6	7
Saving of Costs	132	2.89	3.00	1.56	24		28	32	34	15	15	4	4
Saving of Time	132	3.08	3.00	1.74	24		29	29	27	19	11	12	5
Safety	131	3.92	4.00	2.14	25		28	15	12	18	20	18	20
Ecological Benefits	122	3.93	4.00	1.89	34		14	19	19	24	18	12	16
Process Optimization	130	3.98	4.00	1.92	26		17	21	15	20	21	24	12
Sustainable Life	124	4.23	4.00	1.94	32		15	14	16	20	16	28	15
Technological Affinity	129	4.43	5.00	2.32	27		22	16	13	8	14	16	40

Tab. 4: Ranking of motives

Firms should highlight the fact that smart home devices enable better home safety. Especially when addressing potential buyers over 30, they should underline the benefits of making a house a safer place. One imaginable function is an integrated child lock system, which would enable parents to lock the oven via remote control from wherever. Additionally, firms should create a user-friendly experience, which means that all device

functionalities have to be designed in an easy and understandable way. Dependencies can also be found in the evaluation of challenges facing smart home. The older generation fears a lack of data privacy with a score of 2.60 and data fraud with 2.33. Additionally, system complexity has to be seen from different angles. Complexity is seen as less of a challenge by the younger than by the older generation.

Segmentation by gender leads to one key finding in the motives chart, with men ranking enthusiasm for technology more highly than women do. Actually this outcome was expected by the authors, but the gap of 1.8 points is definitely too great to be ignored. In contrast, women focused more on ecological sustainability through energy efficiency with 3.65 points and on a sustainable and environment-friendly life with 3.98 points. Men do not value the ecological aspects to a similar extent.

Ranking of the challenges for use of smart home based on the online questionnaire (1=very challenging; 7=not challenging; sorted by average)

Function	Total	Average	Median	Deviation	Missing		1	2	3	4	5	6	7	8
Original Costs	135	2.81	2.00	1.70	15		37	35	18	24	11	4	5	1
Data Privacy	122	3.17	3.00	1.90	28		25	30	24	15	11	7	7	3
Data Fraud	131	3.38	3.00	2.16	19		33	24	22	13	12	11	10	6
Interoperability	127	3.52	3.00	2.00	23		20	26	29	17	10	11	8	6
Maturity	119	4.05	4.00	1.98	31		16	14	17	24	15	19	10	4
Complexity	110	5.10	5.00	1.82	40		4	7	12	13	26	19	21	8
Connectedness	111	5.54	6.00	2.08	39		7	5	10	10	12	19	30	18
No Advantages	107	6.44	8.00	2.19	43		7	4	4	3	8	13	12	56

Tab. 5: Ranking of challenges

A 2,500€ home income after taxes marked the threshold for this segmentation. Interestingly – and therefore a key finding – both segments responded with the same tendency to all motives and challenges. No gap could be recognized.

There were no key findings for the segment of house owners and tenants. Solely the attitude toward increased living safety differed along expected lines. House owners tend to stress this motive (3.23), because a lack of safety can directly harm their private property. Tenants, on the contrary, do not consider this an important motive (4.29).

Another key finding derives from evaluation of the challenge that people worry about isolated solutions. Each segment underlines the missing integration of platforms. In none of the analyses, it appeared to be the biggest challenge, yet overall a clear tendency can be recognized. Although people are aware of the problems related to isolated solutions, it seems likely that they do not see the direct impact from the end customers' perspective.

6 Implications

Equal weighting of the motives for smart home implementation carried the implication that firms need to adopt a broad focus rather than prioritize. Based on this insight, a diverse marketing strategy needs to be developed to address a large variety of potential buyers. To pass the challenge of high acquisition costs, a new payment model could be helpful. Here there are two conceivable options: First, a so-called leasing model: a customer, for example, rents a subsidized washing machine and pays a monthly fee for two years. After that period, the customer gets a new device. The benefit to the customer is the free-of-charge replacement of outdated hardware by the latest technology after the minimum contract duration (similar to the mobile phone market) without huge one-off payments. A second model is based on the pay-as-you-go principle: The customer receives a washing machine, but he only pays a small amount for every washing cycle without purchasing the hardware itself ("smart home-as-a-service"). That could be called "hardware as a service". The resulting benefits are the same as for the previous payment model. To reduce the worry of being hacked or spied on, corporate marketing has to demonstrate that the company's systems are safe. For example, a thought-provoking TV spot based on a former security "hackathon" could reduce doubts on the safety of smart home devices. It would show that the firm has a positive learning culture in combination with only offering safe products. Another idea for making smart home products more secure is to integrate customer feedback; this might involve reporting potential security lacks to the manufacturer, thus making the customer a "member" of the company's problem solution team (co-creation). Firms could additionally try to design and issue globally standardized certificates (e.g. for data protection) either by themselves or with the aid of trustworthy partners.

Furthermore, in order to address men as well as women, customized products and applications need to be designed. Given that, men relate more to technical details and women focus more on ecological aspects, this difference should be reflected in product design. This is also true for different marketing approaches, addressing either men or women. Smart home firms need to collaborate with other providers to develop a standard, which, once in place, would deter isolated solutions. One approach is to find two or three partners on every continent with different focus areas. Moreover, an open source approach might be interesting. One can ensure not losing USPs by integrating restrictions. This could help accelerate the further development of smart home systems.

7 Limitations and further research directions

Although the present research has been performed with due diligence, some limitations in the survey results may be considered. The link to the survey page was shared only by the research team. Therefore, the audience reached by the survey is not a representative sample of overall society. The group of survey participants is predominantly situated in the middle or upper class, ranges in age between approx. twenty and forty, and possesses higher technical understanding than average.

Furthermore, the survey questions were grasped and answered subjectively, with room for interpretation left to individual respondents. This means the answers given are based on different principles and values; therefore, they are not completely comparable, while still offering a good estimate of the object of investigation.

However, this paper is best seen as a foundation for further research, marking a provisional point in the development of new ideas. It is advisable that recommended strategic initiatives be undertaken step by step and over a longer term, rather than by resorting to blind action and trying to undertake all at once.

Due to limitations on the surveyed social segments and the geographical scope, this research merely constitutes a beginning; there is a need to, obtain more representative data by thoroughly analyzing the relevant customer segments – both in overall society and in all relevant countries.

Another finding of the online survey takes the form of a recommendation, namely that strategic partnerships be entered into, e.g. for high-security products. The next step for smart home firms would be to identify and analyze potential partners. Beside potential partners, competitors in the smart home market are to be identified and accessed. As the borders between partners and competitors tend to blur in the digital world, it makes sense to analyze these stakeholders jointly.

Future investigations of smart home in general need to be matched with deeper insights into the specific IoT company and the industry targeted. Detailed inside information will enable more specific recommendations and tangible actions to be taken.

References

[AG02] Aiman-Smith, L.; Green, S. G.: Implementing new manufacturing technology: The related effects of technology characteristics and user learning activities. Academy of Management Journal 45(2), 421-430, 2002.

[AH15] Andelfinger, V.; Hänisch, T.: Internet der Dinge: Technik, Trends und Geschäftsmodelle. Wiesbaden: Springer Gabler, 2015.

[AF80] Ajzen, I.; Fishbein, M.: Understanding attitudes and predicting social behavior, 1980.

[AhM15] Ahn, M.; Kang, J.; Hustvedt, G.: A model of sustainable household technology acceptance. School of Family and Consumer Sciences, Texas State University, San Marcos, TX, USA, 2015.

[As09] Ashton, K.: That 'Internet of Things' Thing. RFID Journal, 2009, http://www.rfidjournal.com/articles/view?4986, Accessed: 16.11.2015.

[Bo13] Bort, J.: Cisco's John Chambers Has Found A New $14 Trillion Market. 2013. http://www.businessinsider.com/ciscos-john-chambers-has-found-a-new-14-trillion-market-2013-5, Accessed 10 05.2016.

[Ca12] Capgemini Consulting, Smart Home – Zukunftschancen verschiedener Industrien. 2009, https://www.de.capgemini.com/resource-file-access/resource/pdf/smart_home_-_zukunftschancen_verschiedener_industrien_0.pdf , Accessed 16.11.2015.

[Ch08] Chang, M. K.; Cheung, W.; Cheng, C. H.; Yeung, J. H.: Understanding ERP system adoption from the user's perspective. International Journal of Production Economics 113(2), 928-942, 2008.

[CMM12] Chui, M.; McGuire, T.; Manyika, J.: Why Big Data is the new competitive advantage. Ivey Business Journal 2012, http://iveybusinessjournal.com/publication/why-big-data-is-the-new-competitive-advantage/, Accessed 15.11.2015.

[Da89] Davis, F. D.; Bagozzi, R. P.; Warshaw, P. R.; User acceptance of computer technology: a comparison of two theoretical models. Management Science, 35(8), 982-1003, 1989.

[De13] Deloitte, Licht ins Dunkel – Erfolgsfaktoren für das Smart Home, 2013, http://www2.deloitte.com/content/dam/Deloitte/de/Documents/technology-media-telecommunications/TMT-Studie_Smart%20Home.pdf, Accessed: 15 11 2015.

[Di13] Digitimes: Internet of Things to provide new business opportunities and enable business model change. 2013. http://www.digitimes.com/supply_chain_window/story.asp?datepublish=2013/12/04&pages=PR&seq=202, Accessed 10.05.2016.

[Di15] Dijkman, R. M.; Sprenkels, B.; Peeters, T.; Janssen, A.: Business models for the Internet of Things. International Journal of Information Management, 35(6), 672-678, 2015.

[Ga15] Gartner: “Gartner Says 6.4 Billion Connected "Things" Will Be in Use in 2016, Up 30 Percent From 2015”. 2015, http://www.gartner.com/newsroom/id/3165317, Accessed 10.05.2016.

[He16] Hellfeld, S.: IoT 4.0 – Was kommt nach dem Internet of Things?. Informatik Aktuell, 2016. Available at: http://www.informatik aktuell.de/betrieb/netzwerke/iot-40-was-kommt-nach-dem-internet-der-dinge.html Accessed 05.04.2016

[IN15] Icontrol Networks: State of the Smart Home Report. 2015. Available at: http://www.icontrol.com/wp-content/uploads/2015/06/Smart_Home_Report_2015.pdf Accessed 14.11.2015

[KJK15] Ki Joon Kim Dong-Hee Shin: An acceptance model for smart watches. Internet Research, Vol. 25 Iss 4 pp. 527 – 541, 2015.

[KH06] King, W. R.; He, J.: A meta-analysis of the technology acceptance model. Information & Management 43(6), 740-755, 2006.

[Kn14] Knöpke, H.: Smart Home – Offene Plattformen werden sich durchsetzen. Deutsche Telekom, 2014, http://www.faz forum.com/industriegesellschaft2015/150304_FAF_Knoepke_Telekom.pdf, Accessed 15.11.2015.

[Le06] Lee, S. M.; Kim, I.; Rhee, S.; Trimi, S.: The role of exogenous factors in technology acceptance: The case of object-oriented technology. Information & Management 43(4), 469-480, 2006.

[LG14] Gao, L.; Bai, X.: A unified perspective on the factors Influencing consumer acceptance of internet of things technology. Asia Pacific Journal of Marketing and Logistics, Vol. 26 Iss 2 pp. 211 – 231, 2014.

[O’L13] O'Leary, D. E.: 'Big Data', the 'Internet of Things' and the 'Internet of Signs'. Intelligent System in Accounting. Finance and Management, 20 (1), pp. 53-65, 2013.

[Mi15] Miller, M.: The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World. Indianapolis: Que Publishing, 2015.

[Ra91] Ralph, W.: Help! The art of computer technical support. Addison Wesley Longman Publishing, 1991.

[Ro15] Rossi, B.: InformationAge. 2015’s most critical information technology trends. 2015, http://www.information-age.com/it-management/strategy-and-innovation/123458793/2015s-most-critical-information-technology-trends Accessed: 15.11.2015].

[RB10] Rubin, A.; Babbie, E.: Essential Research Methods for Social Work. 2nd ed. Belmont: Brooks/Cole Cengage Learning, 2010.

[SM15] Saito, N., Menga, D.: Ecological Design of Smart Home Networks: Technologies, Social Impact and Sustainability. Cambridge: Woodhead Publishing, 2015.

[Sz93] Szajna, B.: Determining information system usage: some issues and examples. Information & Management, 25(3), 147-154, 1993.

[TT95] Taylor, S.; Todd, P.: Assessing IT usage: The role of prior experience. MIS quarterly 19(4), 561-570, 1995.