The Internet of Things (IoT): What is the potential of Internet of Things Applications for Consumer Marketing?

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ABSTRACT

This paper illuminates the phenomenon Internet of Things (IoT) from a consumer marketing perspective. The goal of this paper is to discuss the marketing implications of the Internet of Things and highlight the possibilities as well as the accompanying challenges and risks of it. A literature review revealed, that the Internet of Things is projected to generate a potential value of up to $11.1 Trillion in 2025. However, there are still privacy and security issues that need to be overcome in order to fully exploit the Internet of Things. Eventually, the theoretical insights gained from a literature review have been utilized to classify the Internet of Things into different application domains. The new, integrated classification encompasses the following domains ranked based on popularity: Personal, Smart Environment, Home, Vehicle and Retail. For each domain, one real-life application has been selected and qualitatively analyzed with regard to the marketing value of the application. The selected cases for the respective domains are: LiveSkin, Placemeter, Amazon Dash, Tesla Model S, Smart Retail Solution. The analysis led to the conclusion, that the marketing value of the applications is not reflected in the respective rank based on popularity. Research evinced that the Retail domain does offer the highest potential marketing value, although having the lowest popularity. In contrast to that, the Personal Application provides the lowest marketing value, while having the highest popularity. The remaining categories achieved the same ranking on popularity as well as marketing value.

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Keywords

Internet of Things, Consumer Marketing, Smart Objects, Applications, Marketing Value, Internet of Things Classification

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1. INTRODUCTION

"If you think the internet has changed your life, think again. The IoT is about to change it all over again!"

- Brendan O´Brien, Chief Architect & Co-founder of Aria systems (O'Brien, 2014)

The average consumer is not very likely to know much about the phenomenon Internet of Things (IoT), maybe they have heard of it, maybe they even know about its usefulness and possible applications such as smart homes and smart cars. However, the true potential of the Internet of Things remains concealed to the majority of the people. Experts predict that the Internet of Things will spread rapidly over the next few years and will offer a whole range of new services improving the life of the consumers as well as the productivity of companies (GSMA, 2014). Many businesses have already identified the vast opportunities offered by the IoT. According to Bonnet, Buvat, & Subrahmanyam (2014), 96 % of questioned companies stated that they are going to adopt the IoT in some way within the next three years, and 68% stated that they are already investing in the IoT.

But how and why does the IoT adoption accelerate at such great pace and how did it all start? When Kevin Ashton first used the term Internet of Things in 1998 during a presentation for the Procter and Gamble company, the proportions the IoT would assume were not foreseeable. Initially, the technology Ashton helped develop, the electronic product code, was meant to replace the UPC bar code, in order to identify products more easily. However, the technology was still in its infancy, and not yet ready to be exploited to its full potential. The subsequent advance of IoT was fueled by the progress in the development of smaller devices with larger processing power. As a result of the technological advancement, formerly simple products are now smart, connected products equipped with sensors, data storage and microprocessors. (Porter & Heppelmann, 2014). According to PTC (2014), the IoT is a result of the "convergence of markets and parallel innovation of enabling technologies". Products do not only have physical components anymore. Instead, they are equipped with sensors and software, creating a whole network of products with connections to the internet and among each other.

With the emergence of the Internet of things (IoT), the world as we know it today might change drastically. In the next years, the number of inter-connected smart objects will rise tremendously and could potentially reach 21 billion until 2020 (Gartner, 2015). This trend will not only affect the end user, but also pose new opportunities and challenges for businesses. Especially the means of marketing will change, since companies can use their gathered data to offer more refined value propositions to the customer and even create completely new ways of marketing. Therefore, this research will illuminate whether IoT applications do in fact provide value for marketing or not.

1.2 RESEARCH PROBLEM

Due to the lack of extant literature in this field, this paper aims to analyze the potential of Internet of Things applications as a marketing tool for companies. The basis for the analysis will be an integrated classification of IoT applications gained through an extensive literature review. During the course of the research, the paper will try to address this problem by answering the following questions:

- What consumer relevant categories of IoT are existent at this point in time?
- How can applications be exploited for a company's marketing activities?

1.3 SIGNIFICANCE OF THIS PAPER

Doing this research will shed light on the ill explored field of IoT applications utilized for marketing activities. It will show, what the IoT is used for at this point in time, and how the IoT can be deployed for marketing purposes in the future. Researchers as well as practitioners will benefit from these practical insights and their associated advantages and disadvantages, since they may integrate them into future projects and help to identify possible future marketing trends. Moreover, this paper raises awareness for lack of marketing related research in the IoT field and could encourage other researchers to conduct further research in this area.

1.4 METHODOLOGY

1.4.1 Design

This research paper will use two research methods for collecting and evaluating data. First, a critical literature review of the extant literature on the Internet of Things will be conducted. In the conclusion of the literature review, I will attempt to integrate the views of several authors on categorization of the IoT into one model. Then, for each category identified in the integrated model, one matching real life application will be selected. Afterwards, the marketing value of these applications will be tested. Therefore, an extensive analysis of the application and its advantages and disadvantages will be conducted. In the end, a comprehensive conclusion for each application will be provided that determines whether a specific application is suitable for marketing usage or not.

The timeframe of this research will be from the 20th of April 2016 until the 22nd of June 2016.

1.4.2 Procedure

For the literature review, Google Scholar will be the main tool for finding relevant literature from scientific journals and magazines such as the "ad hoc networks", the "Management Information Systems Quarterly" and the "Harvard Business Review". Furthermore, reports by consulting companies are going to be used as sources for relevant information. Additional information, especially concerning the applications for the case study, will be collected from websites and blogs.

For the literature review, scientific papers, as well as consulting reports will be analyzed and contrasted, and the most important similarities and differences will be pointed out. Due to the fast technological advancements in the area of the Internet of Things, I will aim to include mainly rather new sources, dating back as far as 2010 in the paper, in order to achieve high relevance and topicality of the paper.

2. LITERATURE REVIEW

The extant literature has often investigated the IoT from a technical perspective, elaborating the technical specifications and limitations of IoT, as well as those of the enabling

technologies. Furthermore, authors wrote about possible industry applications of IoT, e.g. in the transportation industry or health industry. Prominent literature examples for this are: Miorandi, Sicari, de Pellegrini, & Chlamtac (2012), Gubbi, Buyya, Marusic, & Palaniswami (2013), Cook, Augusto, & Jakkula (2009), Atzori, Iera, & Morabito (2010).

However, there has been very limited research on IoT in connection with marketing (e.g. Accenture, (2015), Silverpop (2015), Wang & Zhang (2012)). Especially, how marketing is going to change with the emergence of the IoT and which marketing domains e.g. consumer marketing, services marketing, industrial marketing and online marketing, are going to be affected. In existing literature, it has been noted that the economic effect of B2B IoT applications will be greater compared to the effect of consumer applications (Manyika, et al., 2015). B2B applications are usually restricted to worksite applications, which do not affect the consumer directly. Thus, the marketing possibilities for B2B IoT applications are limited. Out of the nine IoT settings identified by Manyika, et al. (2015), five could largely affect the consumer. These include: Human applications, Home applications, Vehicle applications and retail environment applications and cities. Due to the tremendous potential economic impact, the focus of this research will lie on consumer marketing.

2.1 GENERAL OVERVIEW

The origins of the Internet of Things trace back as far as 1998 when Kevin Ashton first used the term to describe radio-frequency identification sensors (RFID) attached to everyday objects. Since then, scientists have put effort in making the vision of the IoT a reality. However, today the true potential of IoT has not been reached. Gubbi, Buyya, Marusic, & Palaniswami (2013) assume that the adoption of the IoT will take around five to ten years. By this time, the amount of inter-connected smart objects is expected to be around 21 Bn in 2020 (Gartner, 2015) and up to 100 Bn in 2025 (Huawei, 2016). The US National Intelligence Council even listed the IoT as one of six disruptive civil technologies with potential impact on US national power (Council, 2008). The IoT will trigger fundamental changes in the way manufacturers create value. PTC, (2014) expect that new business models will emerge that center around creating value through software and cloud services.

But what exactly is the IoT and how is it defined? PTC (2014) breaks down the IoT into three core elements: A collection of smart, connected products, which are connected through a communication infrastructure to a computing infrastructure that allows the creation of value via e.g. real-time reports on condition and operation of the "things". Miorandi, Sicari, de Pellegrini, & Chlamtac (2012) state that the IoT is an "umbrella term" referring to the extension of the internet to the physical world "by means of widespread deployment of spatially distributed devices with embedded identification sensing and/or actuation capabilities" (p. 1497). In contrast to this rather general definition of IoT, Haller, Karnouskos & Schroth (2008) propose the following definition for IoT: "A World where physical objects are seamlessly integrated into the information network and where the physical objects become active participants in business processes. Services are available to interact with these smart objects over the internet, query their state and any information associated with them, taking into account security and privacy issues" (Haller, Karnouskos, & Schroth, 2008, p. 15) These three definitions all differ from each other in various ways. Miorandi, Sicari, de Pellegrini, & Chlamtac (2012) provide a definition that is easy to understand and covers essence of the IoT, namely the smart things. However, unlike PTC, (2014), Miorandi, Sicari, de Pellegrini, & Chlamtac (2012) fail to cover the whole spectrum of the IoT since they omit communication infrastructure and computing infrastructure from their conceptualization. When comparing PTC E-book´s definition with the one of Haller, Karnouskos & Schroth (2008) it becomes evident that they, yet again accounted for other factors of the IoT, i.e. the business applications as well as possible risks and pitfalls.

In addition to their definition of IoT, Haller, Karnouskos & Schroth (2008) also mention the necessity of the "things" to be smart. Extant literature has identified several criteria "smart objects" need to fulfil. On the one hand, Porter & Heppelmann (2014) state that smart devices need to be equipped with sensors, data storage and microprocessors. On the other hand, Miorandi, Sicari, de Pellegrini, & Chlamtac (2012) propose the main prerequisites for smart objects are to be identifiable, to be able to communicate and to be able to interact. Furthermore, they need to have a physical embodiment, a minimal set of communication functionalities, an unique identifier, be associated to at least one name and one address, basic computing abilities, and most importantly, possess capability to sense phenomena such as light, temperature etc. The latter definition describes smart objects more in detail, which is necessary when talking about the IoT from a technical perspective. However, this paper illuminates the IoT from a business/marketing point of view, therefore the inclusion of technical specifications is rendered redundant and the paper will adopt the broader definition by Haller, Karnouskos & Schroth (2008)

With regard to the capabilities of smart things, PTC (2014) proposes six categories along which smart things are distinguished from non-smart things. Firstly, smart can be customized through mobile platforms and apps. Secondly, smart objects are capable of monitoring their own condition/status. Thirdly, smart objects can assess the environment through sensors, e.g. rain sensors for windshield wipers. Fourthly, smart objects can be remote controlled. Fifthly, smart objects can be serviced and updated from any place in an instant. Lastly, smart objects are autonomous meaning they are able to self-operate and can learn/update/correct.

2.2 ECONOMIC IMPACT

Pessimistically estimated, the potential captured value of the five aforementioned sectors Human, Home, Vehicle, Retail and City amounts up to $1.92 Trillion in 2025. Positively estimated, the value would amount to $5.5 Trillion by 2025, whereas most potential value could be gained from Human applications and retail applications.

The economic impact of the Internet of Things on business activities across the world will be immense. Manyika et al. (2015) estimate that IoT devices will create a value between $3.9 trillion and $11.1 trillion per year in 2025. This would equal around 11 % of the total world economy. Furthermore, Cisco

Solutions (2015) expects internet traffic of non-PC devices to rise up to 67% in 2019 as compared to 40% in 2014. Rose, Eldridge, & Chapin (2015) identified an important implication derived from these trends. According to the authors, the term "on the internet" mainly means active engagement with the internet in form of downloading content or creating content using PCs or portable devices. However, if the growth projections of the IoT come true, more and more passive interactions with the internet will occur. These interactions can take place with car devices or home appliances without human intervention or awareness. This view is confirmed by Miorandi, Sicari, de Pellegrini, & Chlamtac (2012) who predict a shift from connected end-user devices to connecting physical objects capable of communicating with humans and other "things".

2.3 ENABLING TECHNOLOGIES

When talking about IoT, experts refer to enabling technologies, which need to be fully developed in order to successfully deploy an IoT network around the globe. Prominent literature identifies the RFID technology to be the main enabling technology of the IoT (Atzori, Iera, & Morabito, 2010; Gubbi, Buyya, Marusic, & Palaniswami, 2013).

In contrast to that, PTC (2014) classifies enabling technology into three categories. Firstly, computing infrastructure, i.e. data storage capabilities and processor performance. Secondly, communication infrastructure, i.e. the evolution of connectivity, in particular the ubiquity of connectivity and thirdly, how the smart connected things combine processors and sensors with software. In addition to that PTC (2014) considers the important role that declining prices for processors and other components play in enabling the IoT. Manyika, et al. (2015) define low cost hardware as the most crucial enabler for widespread IoT adoption. Concerning the most important technologies, Manyika, et al. (2015) agree with other authors on the RFID technology. Similarly to a price drop in MEMS sensors (for smartphones) in recent years, a price drop for RFID would make IoT tracking useful for low-value, high-volume items. To sum it up, there is a clear consensus among experts about the necessary technology for a worldwide IoT adoption and what developments need to be made (cost reduction) in order to realize this vision of IoT.

2.4 PROBLEMS AND CHALLENGES

2.4.1 Technological Problems and Challenges

Albeit the tremendous positive impact the IoT could have in the future, there are also some problems and pitfalls that have to be taken into consideration. Firstly, scalability is named to be a big issue (Miorandi, Sicari, de Pellegrini, & Chlamtac, 2012). With the exponential increase in machine connection (from 6.8 Bn in 2016 to 21 Bn in 2020 (Gartner, 2015)), efficiently managing these devices is key to successful IoT implementation. According to Haller, Karnouskos & Schroth (2008) the solution for the scalability problem is to filter transmitted messages and therefore reduce the overall amount of transmitted data. In addition, research has to be conducted regarding self-configuration, self-healing, self-optimization and self-protection of the "things".

Another rather big problem is that some technologies are not yet sufficiently developed to be used in everyday products. This includes RFID readers, which are often still battery dependent and do not support heterogeneous devices (Miorandi, Sicari, de Pellegrini, & Chlamtac, 2012).

Lastly, interoperability is regarded as one of the key challenges for IoT. It would bring two big advantages according to Haller, Karnouskos & Schroth (2008). Firstly, it grants the possibility to apply different solutions to different applications, which can be chosen based on the specific requirements. Secondly, new technologies can easily be integrated into existing infrastructure. This is especially important in wireless sensor technology, since several new innovations and developments are expected in the near future. Manyika, et al. (2015) confirm the interoperability problem. They consider it the single most important issue for IoT in the future. According to the author, 40% of the total potential value of IoT can only be captured by integrating multiple IoT software systems with each other. Additionally, security and privacy concerns are prevalent among potential users of IoT. This is mainly due to the fact that everyday objects could potentially become information security risks. This raises the question, whether the utility offered by the IoT outweighs the privacy risk that accompany it (Welbourne, et al., 2009).

2.4.2 Privacy and Security Problems

Manyika et al. (2015) identify privacy/confidentiality concerns, security issues, intellectual property issues and public policy issues to be the main barriers to IoT adoption. The authors propose to counter confidentiality concerns of the public with transparency of data usage. However, they also acknowledge that several new security risks might arise with the adoption of IoT, which have to be anticipated and managed, since they could potentially cause physical harm, i.e. through remote controlling self-driving cars.

Furthermore, it is yet to be clarified, who exactly has the rights to the data gathered through an IoT system. In the example of a medical device implanted into a human, it is yet unclear who the owner of the data is, the patient, the producer of the device or the implementer?

Lastly, Manyika et al. (2015) give cause for serious concern when noting that several IoT applications have to be approved by governments. The most obvious example being the self-driving car. It becomes apparent, that there is still a lot of work to be done before IoT solutions can be applied on a larger scale. Especially governmental regulations could severely hinder the adoption of IoT in the future, since the concern of the public, especially with their own privacy and the security of the systems, could slow down the process of adoption or even completely prevent it. This is particularly detectable in the case of "radical" new approach such as self-driving cars.

2.5 THE IOT IN MARKETING

Concerning marketing utility of the IoT not a lot is written in scientific articles. However, there are several IoT experts creating blogs and articles on the matter.

Matt Goddard argues that IoT will go through a two-step development process. During the first step, marketers' main goal will be collecting data about their customers' product use in an attempt to create services that satisfy formerly unmet needs. He suggests to complement products and services to make them "more useful and marketable". According to Goddard, in the

second phase of this development process, marketers will make their previously generated systems available to advertisers. As a result, there will be ad networks specifically tailored to IoT (Goddard, 2016).

Goddard illustrates this two-step process with the example of a smart fridge, since it is the most desired kitchen appliance (Blogs: Next/Market Insights, 2014). To improve the experience gained by a smart fridge, the owner would be offered the possibility to notify the owner when items are running low. The monitored items can be selected based on personal preference of the owner. After gathering and analyzing the data, companies will gain information on consumer preferences, in varying demographic layers and geographic regions. In phase two, companies offer the consumer new ways to purchase goods. The company could enter a partnership with a food deliverer, and every time the consumer presses the reorder button, groceries are delivered by said company. When connected to other smart devices in the house, the fridge could even transmit information on reordered goods to the TV and thus influence ads shown on TV.

2.6 APPLICATION DOMAINS

Manyika et al. (2015) identified several settings in which the IoT applications can be utilized. However, as mentioned before, for this paper only the settings directly affecting the end consumer will be regarded, therefore narrowing the scope down to: Human applications, Retail Environment applications, Vehicle applications, Home applications and city applications.

According to Manyika et al. (2015), the major human applications are related to healthcare, such as monitoring illness. If a smart object senses that a person´s health condition is deteriorating a notification is sent to their smartphone with a referral to the nearest specialist.

As for home applications, a popular one is the smart refrigerator described above.

Retail environments provide several IoT based possibilities. Not only can IoT help to manage inventory more effectively and automate checkouts in order to speed up the process, but it can also prove to be useful when marketing products to customers. An example for this could be in-store personalized promotions, tailored exactly to the customer's shopping list.

For vehicles, applications could include continuous maintenance and pre-sales analytics (Manyika, et al., 2015). Thus, the car´s functionality is monitored at all times and in case some parts are not up to par anymore, the owner will be notified of this and referred to a mechanic in his area.

In smart cities, IoT applications can benefit in various areas such as saving water/energy, and reducing the amount of traffic congestions. A very basic example for an applications would be a smart parking meter. This device would continuously update the occupancy status of the parking lots and effectively guide the driver to a free parking lot. Moreover, it registers, how long one particular spot has been occupied and therefore eases the job of giving fines.

Other authors propose a different classification of IoT applications. Gubbi, Buyya, Marusic, & Palaniswami (2013) suggest to categorize IoT applications into four main domains: Personal and Home, Enterprise, Utility and Mobile.

Regarding personal applications, the author mainly talk about "ubiquitous healthcare" (Gubbi, Buyya, Marusic, & Palaniswami, 2013, p. 6). Sensors would measure several physiological parameters, afterwards, the collected data is uploaded to a centralized cloud and made accessible for physicians.

As for home applications, the control of gadgets such as washing machines and air conditioning will offer the energy saving benefits. In and enterprise context, the authors call attention to environmental monitoring applications. This includes e.g. measuring the amount of people in a building and then adjust conditions such as light and temperature accordingly.

For the utilities sector the authors claim that applications usually aim at service optimization instead of consumer consumption. It is stated, that these applications are usually composed of large networks to keep track of essential utilities and resource management. Furthermore, the authors mention water network management and water quality assurance to be one of the key applications in the utility sector. For this, sensors are installed at pivotal points in the water network constantly measuring the water quality.

Lastly, the mobile sector principally focuses on reducing traffic congestions and therefore also noise pollution, as well as improving urban air quality. Real time traffic information will improve scheduling and planning of freight transports and reduce delays. As a result, the economic and social cost forced upon the city population will be minimized.

Atzori, Iera, & Morabito (2010) provide yet again another classification. They provide the five main domains: Transportation and Logistics, Healthcare, smart environments, personal and social and futuristic. Apart from the futuristic domain, the applications more or less resemble the one of previously introduced classifications. Similarities include: logistics, environmental monitoring, smart homes/offices, personal monitoring for the sake of healthcare and security applications against thefts and losses.

In the next sections of this paper, the classifications provided by Manyika et al. (2015), Atzori, Iera, & Morabito (2010) and Gubbi, Buyya, Marusic, & Palaniswami (2013) will be integrated into a new classification for a case study. However, since this paper does merely focus on consumer marketing, only domains directly affecting the consumer will be integrated into the new typology. Therefore, domains such as factory and worksite will be neglected for this study. As a result, the newly created typology consists of the following domains:

	Possible Applications
Personal	*Healthcare applications* such as: patient monitoring, health predictions *Other applications:* Search engine for things to protect against losses and theft, social networking through constant updates on social media
Home	*Building management:* home security, smart fridge, smart thermostat, smart air conditioning
Retail	automated checkout, layout optimisation, customised sales promotions
Smart Environment	*City management:* traffic control, assurance of water quality, control of air pollution/noise pollution, improve automation in industrial plants
Vehicles	assisted driving, car condition monitoring, insurance premium based on driving behaviour

Table 1. Integrated Application Classification for IoT

2.6.1 Personal

As proposed by the other authors, the personal application domain is a very critical one and offers a lot of possibilities in the future, in particular for the healthcare industry. However, as pointed out by Atzori, Iera, & Morabito (2010) in their article, personal applications can also revolve around social interactions. These could include constant updates on social media about the user's locations. Furthermore, it could include a search engine for things, helping to find lost or stolen objects.

2.6.2 Home

The home applications of the IoT are likely to be to most popular ones. They include things like the smart fridge that offers the owner the possibility to automatically reorder items, if the stock falls below a threshold, a smart thermostat, that adapts to the owner's preferences and knows exactly, when to start heating and when to stop or a smart fan, that turns on by itself when the temperature in a room exceeds a threshold.

2.6.3 Retail

The retail domain is adopted to a great extent from Manyika et al. (2015). As mainly includes features like the automated checkout, which registers the purchased items on the way out of the store and automatically charges the customer. Moreover, tracking the customer behavior in-store could also contribute to gaining insights on layout optimization within the store. Lastly, customized purchase promotion based on the customer's location in the store and his recent purchase history could possibly positively influence the buying behavior.

2.6.4 Smart Environment

In cities the applications possibilities for IoT devices are plentiful. Examples are the previously mentioned smart parking meter that allows people to find a spot more easily and also allows the city to fine non-abiding citizens more easily. Furthermore, traffic congestions can be reduced through real time traffic monitoring and water quality can be upheld through continuous measuring. Lastly, smart building management based on the amount of people in the people and the location of them could prove to be an efficient way of decreasing energy consumption.

2.6.5 Vehicles

The vehicle applications are also largely adopted from the Manyika et al. (2015) classification. Consequently, possibly applications could be the condition based maintenance as described above or things like customized insurance premiums based on the owner's driving style.

2.6.6 Conclusion

In conclusion, the IoT is one of the biggest trends right now, and will continue expanding at great pace in the upcoming years. The main component of the Internet of Things are smart, connected products. These are equipped with sensors and distributed across the globe making up a large network of things able to communicate with each other. However, there are also some yet unresolved issues that have prevented the Internet of Things from unfolding its true potential. Most importantly, the sensors being the essential part of every IoT device are still too expensive to be used for high volume goods. Furthermore, interoperability remains an issue. According to Manyika et al. (2015) 40% of the total potential value of the IoT (between $3.9 Trillion and $11.1 Trillion in 2025) can only be captured if interoperability between systems is assured. In addition, there are problems with privacy/confidentiality, security, intellectual property and public policy. These needs to be dealt with by being transparent about the usage of data and establishing clear rules and regulation as well as security mechanism.

It is clear that the Internet of Things offers a multitude of possibilities for marketers to exploit. Matt Goddard proposes a two-step model for marketing utilization of the IoT. During the first step marketers have to collect information about the customers such as location, demographics and habits, and in the second step this data is used for advertisements. Several authors came up with different classification for the IoT applications. Three of these classifications have been integrated into a new one providing the basis for the analysis in the next section of this paper. In this chapter, the actual use of the IoT applications for consumer marketing will be evaluated.

3. APPLICATIONS FOR CASE STUDY

Before selecting a specific application for the categories: Personal, Home, Retail, Smart Environment and Vehicles it is interesting to identify which category is the most popular in the society. As a result, marketers could focus on the most popular category and try to extract as much marketing value as possible out of it.

The ranking serving as a foundation for the evaluation is derived on the basis of an analysis of four dimensions. Firstly, the number of news items, referring to the amount of times newspaper and blogs mention an application domain. Secondly, the amount of times an application is tweeted with a hashtag on Twitter. Thirdly, the amount of LinkedIn posts. Lastly, how often an application domain is searched for on Google. The total score is an average of all four dimensions (Analytics, 2015).

In the second quartile of the year 2015 the top five application domains were: 1. Wearables, 2. Smart City, 3. Smart Home, 4. Industrial Internet, 5. Smart Grid. Wearables can be categorized

as human applications, Smart City does fall into the Smart Environment Category, Smart Home falls into the Home category. Smart Grid, the efficient management of energy or electricity systems, could potentially be categorized as a Smart Environment application, however it does not entirely fit into the newly developed classification since it does not directly affect the end user. Similar to this, the industrial Internet of Things (IIoT) does not find a place in the classification, since it focuses more on the manufacturing industry instead of the end consumer.

The last two of the five application domains of the integrated classification, namely Vehicles and Retail Applications were also included in the statistic, however, they scored lower than the aforementioned applications and reached rank six and nine, respectively. (Pantzer, 2015).

In conclusion, the application domains within the integrated classification can be ranked according to popularity. This results in the following:

Rank according to popularity	Application Domain
1	Personal (Wearables)
2	Smart Environment (Smart City)
3	Smart Home
4	Vehicles
5	Retail

Table 2: Ranking of Application Domains based on Popularity

Now, one application for each domain has to be selected and the marketing value of each application has to be analyzed subsequently.

3.1 AMAZON DASH

For home applications, I chose Amazon Dash. This application is perhaps one of the more known applications of the IoT, due to its rather large media coverage by some of the most popular news websites available online (Ebizmba, 2016). These include Huffington Post (Beres, 2015), CNN (Kelly, 2016), New York Times (Wingfield, 2016) and the renowned Forbes Magazine (Adamczyk, 2015).

Amazon Dash allows the end consumer to order goods. There are several functions to the Amazon Dash. Amazon Dash scanning devices can keep track of your inventory, Amazon Dash Replenishment Services are specifically designed for home appliances manufacturers, which can integrate a device in their products to automatically reorder supplies directly from amazon. Lastly, there are the Amazon Dash Button, programmable in order to resupply a specific product with just one push of the button. When placing an order, a notification is sent to the user´s phone, allowing him to cancel the order within a small time frame. (Lee, 2015)

The Amazon Dash Button illustrates a key factor of the IoT, namely the convergence of industries. By partnering up with producers of consumer goods, Amazon brings two formerly unrelated industries together. Furthermore, Amazon Dash displays another one of the key characteristics of the IoT, namely the machine to machine connections.

3.2 LIVESKIN

Regarding Personal Applications, the two major areas are healthcare and wearables. Considering this, the selection was focused on satisfying both, the health aspect and the wearability aspect. “Sansible Wearables” offer a product called LiveSkin that covers both of these aspects. The company produces wearable technology for Rugby and (American) Football players, which measure the impact of tackles and hits and can then estimate the damage that has been done to a player´s body. Consequently, coaches can better judge whether a player can continue playing or has to be taken of the pitch due to health risks. In addition, the technology can also be used for training purposes (Technology: Sporttechie, 2016).

3.3 PLACEMETER

Thirdly, regarding Smart Environments, I have chosen an application called the “Placemeter”. It measures objects like cars, pedestrians and entrances in a specific areas and then provides people with information about places, i.e. how crowded a place is, how long they can expect to stay in a queue, whether it will be less crowded or more crowded in the next time. The data this information is derived from is gathered by video cameras as well as user reports from the mobile application. This application will most likely be relevant for tourist attractions and in general highly frequented places. It will allow the user to better plan ahead their daily schedule. Furthermore, it will allow the operator of a store/museum to know when they can expect a rush of customers, enabling them to safeguard themselves against such an event by e.g. deploying more employees in their shop at a certain time. The Placemeter could also aid owners in determining, the conversion rate of pedestrians, i.e. which displays make the people enter the shop and what is the percentage of pedestrians who enter the shop. (Internet of Things Award: Postscapes, 2013)

3.4 SMART RETAIL SOLUTION

Fourthly, concerning retail application, the Yourcegic Smart Retail Solution was chosen. It is one of the most famous smart retail applications and is already in use in over 70 countries and over 20,000 stores. The Yourcegic Smart Retail Solution offers a wide array of solutions to retailers. Firstly, it can increase the customer experience by reducing transaction time, while at the same time improving staff efficiency by providing real time inventory information. Additionally, it aids in building customer relationships by gathering purchasing data of the customer and creating customer segments based on this data. Moreover, it can help tailor marketing campaigns designed for a specific customer with the help of the collected data. The hardware necessary for this is limited to an ePOS tablet and an ePOS station, which serve as a source of information for customer data, inventory sales promotion and are also used to quickly conduct transactions. (Cegid, n.d.)

3.5 Tesla Model S

Lastly, for vehicle applications the Tesla Model S is going to be used. The Model S contains several sensors measuring the

environment, such as location and speed at all times. Furthermore, it possesses sensors measuring the "internal operations" of the car, meaning the condition of vital parts such as the brakes. The data collected by the sensors is used in order to constantly improve the functionality of the car. In addition, the information can be accesses remotely, which allows Tesla to repair their cars "over the air". This eliminates the necessity to see a mechanic in order to have the car fixed. (Brisbourne, n.d.; Luo, 2014).

4. MAKRETING VALUE

In this section, the marketing value will be analyzed for each application. There are several factors that have an impact on the degree to which an application can be used for marketing. In this analysis, I will try to include some of the basic factors, in order to come up with a rough indication of how the application could be of use for marketing in the future.

The factors that will be used for the assessment include the following:

Firstly, market size is an important indicator for the feasibility of the product for marketing. The more people are interested in the product, the more people will be reached through marketing activities.

Moreover, the growth rate of the market will be taken into account, so as to assess not only the current potential of the application for marketing but also the future possibilities.

Then, key success factors will be analyzed, which need to be given to make the marketing activities a success. These can include factors such as the perceived usefulness/safety of the product or sufficient technological progress to use the applications on a large scale.

Lastly, some specific ways of marketing will be proposed for each application.

4.1 AMAZON DASH

4.1.1 Market Size and Potential

As of October 2015, between 300,000 and 500,000 buttons had been ordered already. It is expected that Amazon could reach as many as 15,000 000 to 20,000 000 Dash Button installations in the next three years. The growth potential of the market is strongly linked with the number of Amazon Prime members, since the membership is needed to get access to the Amazon Dash buttons. The number of prime members is estimated to be 75 Million within three years. (Munster, 2015). The products sold through Amazon Dash are usually rather expensive and make up a large percentage of the profit of grocery stores. They are often also items which are not purchased on a regular basis.

On 31st of March 2016, one year after the initial release of Amazon Dash Button, the company has extended the range of available Dash Button brands to over 100. By incorporating more brands into the Amazon Dash program, the company can gain a larger customer base and consolidate its position in the market (Crone, 2015).

4.1.2 Success Factors

Right now, the Amazon Dash button is still an unprofitable business for Amazon, this is the result of the limited brand choice offered to the customer. With the Dash button, consumers have only one product available for a certain type of item, compared to 30 or 40 when going to a supermarket. Furthermore, product loyalty also poses a problem for Amazon. Consumers often have products which they have been buying for a longer time and want to continue buying in the future. If Amazon does not offer exactly this product, the consumer is unlikely to purchase it and will instead use the conventional way of purchasing. Lastly, the delivery is not yet completely thought through, since delivering only a single product such as washing detergent makes them lose money. (Mulpuru, 2015).

Thus, the success of Amazon Dash will largely depend on Amazon's ability to further extend their partnerships with brands, in order to appeal to more consumers. Therefor, it is of high importance to conduct market research to create segments based on the preferred products in specific countries or even regions within countries.

4.1.3 Utilization for Marketing

Amazon Dash proves to be a powerful marketing tool for all the companies associated with it. The brands which enter a partnership with amazon are perceived as progressive and modern and will be able to greatly improve their brand image. Furthermore, the awareness for the brand is increased, since the choices per type of product are limited and the consumers are therefore exposed a lot more to the brand. However, this effect could also turn out to be bad for the brand, if a consumer would like to purchase a specific brand, yet is always exposed to one he is not interested in.

Amazon's Dash Replenishment Service (DRS) possesses a large potential regarding marketing value. The ability to put appliances, such as washing machines, in charge of what kind of product is ordered does heavily influence the brand image and the brand awareness.

4.2 LIVESKIN

4.2.1 Market Size and Potential

Currently, the main markets are in countries where contact sports such as American Football and Rugby are most popular, namely the US the UK and other Commonwealth states. The growth rate for such an application is likely to be high, due to rising popularity of these kind of sports in other countries, as well as more safety concerns and regulations by associations such as the NFL in the US (NFL, 2010). Safety concerns are also the reason why American Football is banned under the age of 16 in countries such as Germany. By establishing widely adopted safety measures, such as LiveSkin, which clearly indicates to the coaches whether a player is injured or not, these safety concerns could be lowered and the sport's popularity could increase. In an attempt to increase the potential market, the application could be modified to make it suitable for other contact sports.

4.2.2 Success Factors

There are several factors influencing the potential success of LiveSkin. Firstly, the reliability of the application has to be assured. It needs to measure accurate and function even under rough conditions. Furthermore, it would be beneficial to have low production cost, in order to increase the potential market size, by making it accessible for amateur clubs or private use,

instead professional organizations only. This would greatly increase the potential customer base.

4.2.3 Utilization for Marketing

The marketing value of this product is considered rather high due to several reasons. Firstly, efforts to increase safety of the players will be always be acclaimed by the public, therefore increasing the brand image of the Sansible, the producer of LiveSkin as well as the sports associations such as NFL and the sport in general. Sansible can boast itself as one of the pioneers in sports safety selling cutting-edge technology to increase the safety of people. Improving safety measures in the sport will also increase the popularity of the sport and as a result will increase the profit made by companies associated with the sport.

Secondly, and more relatable to the IoT, the gathered data from impacts could be centralized in one cloud and made accessible to medical researchers. This data could help in gaining insights into what injuries occur most frequently and how they occur. Ultimately, this information helps companies to further improve their protection gear, which would in return positively affect Sansible as a company.

4.3 PLACEMETER

4.3.1 Market Size and Potential

The market size of the Placemeter is extremely large. In Europe alone there are around 89 medium to large sized cities (excluding the metropolises), which can be considered smart and are still developing further (Giffinger, Kramar, Haindlmaier, & Strohmayer, 2015). The growth potential is considered high, since these cities are only a part of a large amount of cities striving to become smart. All of them could use the Placemeter as part of this development and use it for tourist attractions, or in general highly frequented public places. Another factor influencing the growth potential is the ease of use, and the fact that cities can use already installed infrastructures such as security cameras to complement the sensors.

4.3.2 Success Factors

Key success factors of the application include the willingness of the public to have cameras deployed, which will monitor certain areas of the city at all times. Furthermore, a large percentage of the users have to engage actively with the app and write frequent updates on the situation in a particular location. Lastly, the algorithm used to evaluate the camera footage has to be developed sufficiently in order to guarantee high accuracy of the information provided to the user. In addition, it is important to note that the value offered by the application is going to increase with the amount of users, since it does not solely rely on video footage but also on user participation.

4.3.3 Utilization for Marketing

The Placemeter offers high value to both, the city government and owners of tourist attractions or shops. Owners of stores and operators of tourist attractions to easily forecast rush hours and assign more staff to the shop to counter the increased number of customers. Furthermore, by gaining a better understanding of how customers behave in the shop/attraction, the owners will be able to improve the design and layout and thus enhance customer experience.

Placemeter could also provide crucial data for retailers and calculate the conversion rate of pedestrians, meaning the percentage of pedestrians that actually enter the shop. This can result in valuable insights on how and where to improve factors like the entrances to a shop or the displays. The gathered information is not only beneficial for owners of stores but also for city architects. They can analyze at what time during the day roads are congested, and consequently build roads to create safeguards against congestion.

4.4 SMART RETAIL SOLUTION

4.4.1 Market Size and Potential

The market potential for this application is huge, since it is relevant to essentially every larger retailer there is. Once a large supermarket chain has established a smart retail solution in all their shops, other retail chains will be forced to follow this trend and establish a smart retail solution themselves.

The growth rate for this application is expected to be very high once some of the larger retailers adopt this solution throughout all their shops. Until then, it will probably be not as high, since customers first have to adapt to the new way of retailing and retailers have to be convinced of the added value of a smart retail solution. However, with the emergence of other IoT applications, the retailing sector will start embracing several IoT solutions.

4.4.2 Success Factors

One major problem is customer inertia, referring to the reluctance of customers to change their shopping habits. Once this inertia has been overcome and the society accepts the new way of shopping smart retail solutions are going to take over, due to clearly higher offered value compared to traditional retailing methods.

4.4.3 Utilization for Marketing

Marketing value could be extracted through customized sales promotions. Potentially, a collaboration between producers of smart kitchen appliances and smart retailers is possible. If, for example a shopping list is created by a smart fridge, the necessary items could be automatically ordered from a specific retailer brand like it is done with Amazon Dash. Moreover, the retailer could create an app and send customized sales promotions based on their purchase history or their current shopping list to people walking by.

Faster shopping through an automated check-out will enhance the customer experience tremendously and therefore also improve the image of the company spreading of good word of mouth. A further improvement of customer experience can be achieved through layout optimization based on the analysis of how customers interact with the store.

4.5 TESLA MODEL S

4.5.1 Market Size and Potential

The market for the Model S is large, due to the increasing popularity of the brand, and electric cars in general (Gosden, 2016). Sales numbers are skyrocketing for Tesla (Increase of 137% in 2015) and are expected to grow further (Coren, 2016)

The market is inevitably going to grow in the next years due to the limited availability of resources in the next years.

Furthermore, several large companies such as Google and Tesla are pushing the self-driving car technology and smart car technology. This is likely to accelerate the adoption rate of smart cars.

4.5.2 Success Factors

Although the technology sounds very promising at first sight, there are several success factors which might inhibit the adoption of it. Firstly, the majority of the population is still very skeptical about smart cars, due to privacy issues occurring through the extensive gathering of user data. This has been evident in the past for inventions such as Google Glass, which encountered strong opposition by the public.

The same holds true for the smart car, and especially for the self-driving car since people do not have enough trust in the technology yet. In addition, it has recently been shown that smart cars are easily hackable (Greenberg, 2015), where important functions of that car have been turned off, without the driver being able to intervene. This proves that there are indeed still some security issues, which could potentially harm people.

4.5.3 Utilization for Marketing

Even though the use of the smart car is great for the public, the marketing opportunities for are rather limited. The smart car can be used to analyze driver behavior and identify patterns or habits which are more likely to lead to accidents. This information can be used to improve cars in general. Furthermore, when young drivers are driving on their own, reports can be created by the car and parents can control the report in order to check whether the driver was speeding or disobeying traffic signs. Improved safety, combined with new features such as the on the air repairs are also likely to have a positive effect on brand image and brand awareness. Through continuous monitoring of the car's condition the car can alert the driver in case of imminent danger due to a broken part and refer him to a mechanic close by. This can be seen as a form of marketing for the mechanics.

4.6 COMPARISON OF APPLICATIONS

When comparing the marketing value of the selected applications it is apparent that in this case, higher popularity does not automatically mean higher marketing value. When ranking the applications based on marketing value, LiveSkin, the wearable application would probably take the last place, simply due to least appeal to the broad public.

In comparison to that, Tesla, the Smart Retail Solution, Amazon Dash and Placemeter can serve a much larger market. However, some differences can be identified for the other four applications. Unlike Tesla and Amazon Dash, the Placemeter and Smart Retail Solution are not applications the typical consumer would purchase, but rather shop owners, retail chains or city governments. Thus, consumers have less influence on when the application is implemented, leading to an elimination of barriers to adoption, since they do not decide themselves when or how the applications are going to be deployed. Consequently, the Placemeter and the Smart Retail Solution could be brought to the market faster and the marketing value of the applications could be captured more easily. Moreover, the Smart Retail Solution and the Placemeter are more tailored towards marketing use than Tesla. In comparison with Amazon Dash, which provides strong marketing opportunities for both, Amazon as well as the partner companies, this does not hold true. Nevertheless, the marketing value of Amazon Dash is estimated to be lower, due to higher barriers to adoption and a very limited product portfolio.

It is rather difficult to determine, whether the Smart Retail Solution or the Placemeter yields the better results regarding marketing value. They are both very similar in a sense that they can be both deployed on a large scale and are both likely to be used in large cities first. However, I expect the Smart Retail Solution to have better marketing value, due to the fact that it is solely developed for the purpose to make the shop and product more appealing to the customer, while the Placemeter is not primarily designed to do so.

In conclusion, results in the following ranking based on potential marketing value:

Ranking according to marketing value	Application Domain
1	Retail
2	Smart Environment
3	Home
4	Vehicles
5	Personal

Table 3: Ranking based on Marketing Value

5. CONCLUSION

From the literature review it can be concluded that experts all agree on the large potential of the IoT. The question, which experts find no consensus on is: How big will the impact of the IoT on economy and society be?

For the consumer relevant sectors the impact is estimated to be between $1.92 Trillion and $5.5 Trillion. The total value created by IoT devices could amount to $11.1 Trillion per year in 2025, equaling 11% of the total world economy. However, this value can only be captured if the enabling technology is sufficiently developed.

Experts agree on the main enablers for the IoT. RFID is considered the most important technology. In the upcoming years, a cost reduction in RFID hardware would accelerate IoT adoption, since even low-cost, high-volume items can be equipped with RFID sensors.

In order to classify the applications of IoT, several authors created typologies for IoT application areas. I integrated these and created a classification for consumer relevant applications encompassing the following domains ranked according to popularity among the society: 1. Personal, 2. Smart Environment, 3. Smart Home, 4. Vehicles, 5. Retail

For the case study, I chose one application for each domain and conducted a qualitative analysis for marketing value. The main factors of that were accounted for are market size, potential growth, success factors and specific examples for potential utilization. The selected applications are: Amazon Dash (Home), LiveSkin (Personal), Placemeter (Smart Environment), Smart Retail Solution (Retail) and Tesla Model S (Vehicle).

From the gained insights in the analysis I can draw the conclusion that the Smart Retail Solution provides the most marketing value, due to a large market size and high potential for growth in the upcoming years. I expect the Placemeter could potentially have a higher marketing value than Amazon Dash, due to the still very limited product portfolio of Amazon Dash. The last two applications, Tesla Model S and LiveSkin, both offer rather limited marketing value and possibilities for the company itself however, they do offer value for the greater public good.

Specific examples for using the applications are: Customized Sales Promotion (Retail), brand promotion through Dash Buttons (Home), improving brand image through safety/health advancements (Vehicle and Personal) and calculating customer conversion rates (Smart Environment).

When comparing findings from the literature review and the case studies some similarities and differences are evident.

It has been evinced, that the applications, especially in the Retail- and Home Domain, do in fact, largely operate with RFID as a main technology. Furthermore, as shown in the example of Amazon Dash, the IoT does contribute to the convergence of industries. Lastly, one of the core challenges that was mentioned in the literature, the interoperability of systems, was confirmed to be important in the example of the Placemeter.

Regarding the differences between the literature review and case study, the main difference is the discrepancy between the popularity ranking and the marketing value ranking. While the retail domain scored lowest in popularity it is likely to have the highest marketing value. In contrast, the Personal domain scored the highest in popularity, yet the analyzed application offers the least marketing value. The remaining applications were ranked the same in both rankings.

The unresolved question is, whether this was a coincidence stemming from the selection of application, or if the Personal and Retail application domains actually are over/under hyped in relation to their marketing value. Answering this question in future research could be an insightful for marketers regarding their future marketing practices.

6. LIMITATIONS

Readers have to interpret the findings in this paper within the context of limitations.

The external validity of this research can be considered rather low, due to the fact, that it is not representative for all companies/applications and can therefore not be generalized. Furthermore, it is not entirely feasible to compare the applications, since they did not undergo an extensive multi criteria based selection process. Internal validity is irrelevant for this research, since no inferences about cause-effect or causal relationships were made. For this paper I chose to conduct qualitative research, due to lack of available quantitative data and time constraints.

Furthermore, there are factors threatening the reliability of the paper. Firstly, reliability is threatened, since not only peer reviewed scientific articles are going to be included, but also information from blogs and websites. Hence, there is a possibility that some information gained from these sources is not entirely reliable. In an attempt to counter the potential low reliability, I aimed to make use of data triangulation as much as possible to validate any information gained from potentially non-reliable sources. In addition, due to the fast-changing nature of the IoT, some information could potentially be outdated already or will be outdated within a short period of time.

7. FUTURE RESEARCH

In order to gain a deeper understanding of the matter, it is necessary to conduct a case study with more cases for each application and preferably also a more suitable research design.

For further research I recommend conducting a quantitative study in interest of achieving higher accuracy of estimating the marketing value of applications. Furthermore, I propose to determine criteria for the selection of applications prior to conducting the study. These could be determined through a consumer survey questioning which features of an application the consumers find particularly appealing. Consequently, the applications will be comparable and the validity of the study will be improved. Finally, I suggest to empirically investigate the relationship between popularity of an application (domain) and the marketing value. This could lead to conclusion as to how to utilize an application's popularity to leverage the marketing value.

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