Business Model Ecosystem Analysis
Case Study of Alphabet’s IoT Strategy

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Abstract

Alphabet Inc., the holding company of companies like Google or Nest, stands for a rather secretive public relations strategy, with limited informational value of public announced statements and interviews of executives, especially when it comes to the strategy of its investments in the field of the Internet of Things. One of these investments is the company Nest, a developer of intelligent devices for private households and of the associated platform. This business case will be utilized as the centerpiece of the performed study, with the aim to describe and analyze the strategic approach of Alphabet’s Internet of Things strategy. Different architectural and business model frameworks will be discussed and applied for the in-depth study of the chosen case. The secondary focus will be on the other initiatives of Alphabet in the internet of things and how these may affect the development of Nest in its function of the holding structure. Ethics and sustainability will be discussed in terms of the security and privacy of users and the data they share through the use of intelligent and interconnected devices and applications. It will be pointed out, which issues and concerns arise with the spread of novel concepts in the Internet of Things.

The findings of this thesis are of a tentative nature and need to be treated with caution, due to the lack of reliable information and the use of secondary data as reports of company insiders. This paper has been written as the degree project in the course Entrepreneurship and Innovation Management. With this thesis the author intends to obtain a Master of Science degree at the university KTH Royal Institute of Technology, Stockholm.

Key-words:

Business Model Ecosystem, Internet of Things, Digital Platform, Intelligent Devices, Business Model Design
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1 Introduction

“[…] the internet will disappear […] There will be so many IP addresses … so many devices, sensors, things that you are wearing, things that you are interacting with that you won't even sense it. It will be part of your presence all the time. Imagine you walk into a room, and the room is dynamic. And with your permission and all of that, you are interacting with the things going on in the room.”

Eric Schmidt, Chairman of Alphabet Inc.

(Smith 2015)

The world as we know it, the way humans interact with each other and with their environment is just before to change in an almost abrupt manner. That is what Eric Schmidt sees for the future and the reason why he is trying to shape the future in his function as chairman of Alphabet Inc., the parent company of Google.

The term Internet of Things (IoT) gained in the recent years a lot of attention in the media and also in science as an expression for intelligent devices, which are connected to a network, where various participants can profit from this interconnection (Ju et al. 2016). The mere quantitative sales potential of these devices seems to be seen as extremely high. As Gartner (2014) predicts there will be 25 billion connected devices in use by 2020, other sources state 24 billion (Gubbi et al. 2013) and go up to 50 billion at that time (Westerlund et al. 2014). The variance in the predictions already implies the different assumptions researchers make. This is mostly reasoned by the circumstance that the definition process of IoT is still not finished (Ju et al. 2016) and that there is not yet a final setup for the architecture of this field, if there ever will be. That means that it is nowadays not clear yet what IoT contains and where its limitations are. This freedom has the potential to attract start-ups as well as established IT companies, to design innovative business models (BMs) to monetize the creative potential of the IoT sector.

With this thesis the author intends to investigate with a case study the IoT strategy of the company Alphabet, formerly known as Google. Therefore an analysis and evaluation of the strategy of Alphabet’s IoT subsidiary Nest will be performed with the consideration of Alphabet’s prior strategies, when it came to the creation of a market dominating position.

In the following, a first shallow overview will be given about this papers structure. A more detailed introduction will be made at the beginning of each first level part. In this first section the research problem, purpose and question will be stated. In the second section theoretical background information will be reviewed. These have the aim to give an introduction into the field of IoT, to put it into the academic context and to lay the foundation for the performed scientific case study.

With the literature review part, the author will state and analyze information about the relevant architectural models, underlying frameworks and concerning theories under the use of the most recent literature of this topic. As the field of IoT and especially the development of IoT BMs just got major attention, of researchers and the public, in the
recent years, the applied literature will be as up to date as possible to guarantee the use of state-of-the-art scientific knowledge. As the last sentence of Eric Schmidt’s quote already indicates by mentioning the word ‘permission’, it seems to be essential that ethical questions need to be raised and discussed. In conjunction with that, the importance of sustainable BMs will be highlighted as well.

To ensure that this knowledge will be used in a proper scientific manner, the methodological procedure will be explained in the third section. Research limitations will be set, the method explained and the paradigm clarified.

The beforehand collected information will be utilized in the fourth section to discuss the strategy of the chosen case, to make comparisons and to figure out similarities and differences, in regard to give concrete answers to the stated research questions. The author will state in conclusion his view, which will be based on the prior sections.

1.1 Problem

The mentioned information in this section will be specified in section 4 under use of the most recent sources. Alphabet, formerly known as Google, develops and offers under the name of its subsidiary Nest, intelligent devices and the technological platform, which are needed to form an IoT ecosystem. Besides of that, the company already has a very successful platform in its portfolio, in form of the well-known mobile device operating system Android. The relation of both platforms to one another within the strategy of Alphabet is rather vague and leaves room for speculations. Publicly announced detailed information are a rather rare medium of choice in Alphabet’s public relations strategy (Arthur 2012). This concerns information about the business model strategy, as well as the organizational structure and finances (Unknown 2015). Because of that, the available sources of information can be of limited informative value and must be perceived with caution. Nevertheless, obligatory statements in company reports, announcements of mergers and acquisitions (M&A) and most importantly leaked information of insiders, published by reporters, can be seen as valuable indicators to analyze Alphabet’s IoT strategy, concerning Nest and affiliated parts of the company.

1.2 Purpose and Research Question

With this thesis the author aims to address some of the major challenges IoT ventures have to face, by the design of a business model in an IoT ecosystem, in a practical approach. Lee and Lee (2015) point out the most urgent challenges, that will appear in the near future and IoT companies need to solve, from a general perspective. Technical problems as data management, storage and mining are discussed as well as ethical challenges that will arise, as privacy and security affairs. These ethical questions will be part of this thesis as well and be reviewed in section 2.4 and 4.3. Concerning the design of business model ecosystems, the so called chaos challenge is probably of the highest significance. They state that very short innovation cycles, a large number of different and competing standards and the vast complexity of the whole IoT environment result on the one side in a high difficulty of business model and product design. The interconnection of actors and nodes in a single ecosystem can
result in a much larger impact of mistakes than in less dynamic environments. The vulnerability of a complex system is much higher, in terms of failure or purpose, than in linear functioning ones. On the other side, chaos offers the opportunity to shape it and to create a novel business, which can be supported by the proper use of the mentioned BM ecosystem frameworks and architectural models.

Westerlund et al. (2014) formulate a more detailed description of the chaos challenge through the division into: diversity of objects, immaturity of innovation and unstructured ecosystems, which will be explained in the following. Object diversity implies the need for commonly accepted standards in terms of communication protocols and interfaces as well as the connectivity challenge to link things to the ecosystems, which have no IoT abilities yet. By means of innovation immaturity, the actual circumstance is named, that most products and services, as well as the ecosystems, on the market have not reached a stage for wide spread use so far. Actual market participants need to scale up and expand their product portfolio from simple IoT devices and services with limited functionality to a more innovative portfolio with advanced features. This will create value through the use of a larger portion of the potential of the IoT environment. The goal must be the penetration of the early majority adopter group (Rogers 2003), which has not been reached so far. Nevertheless, this firstly can go in line with the later described concept of a minimum viable product. As the number of actors or nodes in an ecosystem increases, its complexity does so as well. In an early stage this can lead to an unstructured nature and beneficial conditions for business model innovation in an ecosystem.

![Diagram](image)

*Figure 1: Progress through IoT (Reusch 2016)*
The adaption of the IoT concept comes with major challenges, but also opens new spaces, which allow the spread of innovation and creativity. As shown in Figure 1, the traditional linear concept of automation can be seen as a rather narrow approach in comparison to a dynamic IoT environment with all its interacting participants. Reusch (2016) compares the actual state of the IoT environment and its challenges with the situation of the internet at the beginning of the 1990s. Numerous Platforms and technologies with limited compatibility set the boundaries of previous and nowadays development. In case of the internet a first solution has been implemented with the development of http and the use of browser technology. In case of IoT a final solution is pending, nevertheless there are lots of ventures, who make great effort to bring order into chaos, with uncertain outcome.

Out of the outlined situation and chosen case example, the following questions are formulated:

1. What is Alphabet’s strategical approach in case of Nest, concerning the evolvement of an IoT business model ecosystem?

2. How do other IoT initiatives of Alphabet affect the development of the Nest platform?

The focus of this study is on the first question, whereas the second question has the aim to highlight the interaction of different IoT ecosystems, developed by one company.
2 Literature Review

IoT as a term is often mentioned in connection with terms like Web 3.0 and Industry 4.0, because all three influence and are to some extent part of each other. In this section the author will discuss various definitions of IoT. Therefore different opinions and findings of researchers will be mentioned in terms of IoT architecture, participants of the ecosystem, fields of application as well as IoT related terms will be explained. Furthermore, business model frameworks will be discussed and if or how they can be applied to the IoT environment. To round off the background theory the importance of minimum viable products for young companies will discussed.

2.1 Internet of Things

Dijkman et al. (2015) define IoT from the application perspective, as devices or ‘things’ get equipped with sensors and actuators, which enables them to interact with each other and a network in a technological advanced way. This functional upgrade will allow the possibility to create new innovative concepts, like products and services, as well as it can be applied to existing applications. Glova et al. (2014) add that each device is individually addressable, which is a necessity that they can interact with the network and other devices via standard protocols. The steady exchange of information can be used and analyzed on the technological basis of a platform in the cloud. As different technological approaches will be realized, a large number of different IoT ecosystems with different characteristics is available and will evolve further on. The so gained insights will create value through the dynamic interconnection and analysis of information at an unprecedented level. The sectors this transition will affect, in the use of information, are often characterized by the prefix ‘Smart’, as devices in a household, which are embedded in an IoT ecosystem are called Smart Home applications. Other areas of utilization are for example, Smart Grid, Smart Transportation and Smart Mobility. Gubbi et al. (2013) segment these areas into the four domains personal and home, enterprise, utilities and mobile. Even though they state that the allocation of an application to one certain domain is influenced by its primary use and can also belong secondary to other domains as well.

As Wu et al. (2010) describe an IoT architecture, which consist of the three layers: perception, network and application, they especially put emphasis on the functional structure. Whereas, the application layer contains digital applications and services and the perception layer contains the physical side of the IoT infrastructure. Nevertheless, the author prefers to use the below mentioned model as it is more detailed and describes the IoT architecture from the value creation perspective, which will be more useful for the discussion of IoT BMs later on.
With the aid of the figure above, Fleisch et al. (2015) describe a general model of IoT value creation by classifying the process itself into five levels. The main point of the developed model is that the user, or customer of the devices, in an IoT environment can perceive value on the one side from the physical thing, the device itself and on the other side through a service, which just could be offered through the interconnection of the device with the network.

In level 1 the device creates value through its primary functions, e.g. a lamp is supposed to shine and deliver light. As soon as sensors and actuators get combined with the device, the things are able to deliver locally value for its users. Therefore, sensors measure data and actuators deliver services, e.g. a lamp is automatically turning on as soon as somebody enters the room. The value creation of level 1 and 2 is as long on a local level as the devices have no access to the network as it is necessary for the implementation in the IoT environment. For that reason, the connectivity of the device to the network needs to be given. The intelligent things are now able to exchange data with the network through standard communication protocols, which is technically based on the applied platform (Scully 2016). In the next level of the IoT value creation, the exploitation and analysis of the collected data is in focus. Recommendations get created, conclusions are drawn and feedback is given to the devices. In the fifth level additional value gets created through the use of the generated data in cloud based services, either for personal use, or for sophisticated data mining purposes in innovative BMs. But generally business models, which cover the whole range of the IoT value chain are rare (Ju et al. 2016)
To clarify the term of an IoT platform, which is in its definition also still as vague as IoT itself and often used to name the key technical components and functions of an IoT ecosystems, Scully (2016) categorized the functions and purpose of IoT platforms as follows: “In its simplest form, an IoT platform is just about enabling connectivity between “things” or devices. The architecture may also consist of a software platform, an application development platform or an analytics platform. In a more sophisticated form, a true end-to-end IoT platform consists of eight important architectural building blocks.”

![Figure 3: The 8 components of an IoT application enabled platform (Scully 2016)](image)

It is important to point out that the various applied platforms and their characteristics and abilities can differ heavily from each other, depending on the chosen business model ecosystem of the developers. However, the field of IoT platforms is its own interesting and complex research field and will not be explained more detailed.

### 2.2 IoT Business Model Frameworks

As already mentioned before, it is very unlikely that companies will be active in every level of the described value creation model. Therefore, the BMs which will evolve will show significant differences in complexity. Either because of a lack of resources or because of strategic business model development reasons, as specialization in certain gaps. It is of high importance for a company to know, what the characteristics, strengths and weaknesses of its chosen business model are and it will be very helpful for the further development to know about its components (Dijkman et al. 2015). Therefore a business model framework can be deployed to identify the most important information and to illustrate them in a vivid manner.
A popular framework is the so called Business Model Canvas (BMC) by Osterwalder and Pigneur (2010), which consists of nine different blocks that segment the characteristics of the business model into key partners, key activities, key resources, value propositions, customer relationships, channels, customer segments, cost structure and revenue streams. Each of the mentioned BMC blocks has different elements, caused by the individual business model characteristics. As the tool itself is more or less a generalized scientific approach for analysis and better understanding of how a company does its business through its business model, some researchers tried to modify the framework for the IoT perspective. Ju et al. (2016) tailor made these elements, after a literature review, according to the IoT specific architecture in a generalized way. Following that, the modified framework has been used through a case study to apply practical business model examples as Nest and Car2Go. Dijkman et al. (2015) performed a more comprehensive approach to adopt the BMC framework by collecting and analyzing primary data out of 300 survey responses and 11 interviews. The study aimed for the identification of the building blocks and elements with the highest relevance in IoT businesses. This resulted in the finding that especially the value proposition block has been rated with the highest significance. The interviews were used to find out which elements should be used for a BMC with IoT focus, which have been rated in their significance afterwards as well.

Glova et al. (2014) state that in terms of the field of IoT the view of the single business model is not as essential as the view of the whole IoT environment, which consists of several interacting businesses and models. Westerlund et al. (2014) add that frameworks for these environments, or ecosystems, which are based on the applied and shared technological platform, have not been investigated so far. As they point out, researchers focused with frameworks like the BMC rather on analyzing the single business model and platform concept rather than putting emphasis on a broader view of interrelations and the network of different actors. An early approach, to take a change of the view into account, has been made by Weill and Vitale (2001) by mentioning three parts of a business model ecosystem: participants, relationships and flows.

Considering that, Westerlund et al. (2014) suggest a model, which has the goal to face the insufficiencies established frameworks, as the Osterwalder and Pigneur (2010) BMC, have in analyzing IoT ecosystem business models. They point out that most existing frameworks focus rather on the bare architecture of business models, by segmenting them and analyzing these segments one by one. This approach hinders the vivid clarification of important connections between the different actors in a complex and dynamic IoT ecosystem business model network. Therefore the authors created a value centered concept with the four pillars: value drivers, value nodes, value exchanges and value extracts. These four sum up to the value design of the ecosystems business model architecture (see Figure 4). The concept focuses on the creation and capture of value in the mentioned boundaries from an IoT perspective.
Figure 4: Key pillars of a business model design tool for IoT ecosystems (adapted from Westerlund et al. (2014))

In the described framework, an IoT business model ecosystem consists of a large number of different value nodes, which are characterized by their diversity and interconnection with each other. The nodes themselves vary in their manifestation, but all have in common the creation of value. Examples mentioned by the authors are: sensors, intelligent machines, processes, individuals or whole networks and organizations. These nodes have individual and common motives as the generation of value, innovation, data and money. These shared interests are the value drivers, which lead through the interconnection of nodes with similar drivers to the evolvement of an ecosystem. The interconnection of the nodes enables them to exchange value through so called flows. They can be of tangible and intangible nature like physical resources, knowledge, information and money. Exchanges make visible how value gets created, captured and distributed in the ecosystem. As not every value is suitable for commercialization, the value extract pillar has the aim to highlight suitable value through the identification of the concerned nodes and exchanges. This pillar helps to increase the efficiency of the framework by putting attention on the things that matter for profit oriented IoT businesses in an ecosystem. Depending on the accuracy and complexity of the mapped ecosystem, the value design can provide explicit information about the influences which affect a single actor directly and about the indirect influences of certain parts or the whole ecosystem.

Westerlund et al. (2014) explain in their study more or less the bare basic principle of their framework as an unfinished draft and make no fix statements about visualization and evaluation of the findings. Nevertheless, they state that the illustration as a web is probably most suitable. One of the main points the authors make is that in an IoT environment the thinking or perspective of the decision makers needs to change from the business model of their venture towards the ecosystem, to exploit the whole economic potential of the environment.
2.3 Minimum Viable Product

As the field of IoT is still in a stage of immaturity, a lot of products on the market are in the early stage of their development. This environment allows companies to test their product on the market in a simplified form of its maybe intended final version. This is a so called minimum viable product (MVP), as Ries (2012) points out the benefits of such a low-cost and fast developed product version. Scaling up a business with a MVP will be more comfortable in comparison to a fully developed product, which increases the complexity in managing the business and decreases the dynamic to react on difficulties that appear. Pivots in the business model or the strategy are less complicated if it is possible to change the product in a fast and efficient manner. With a final version of a product, changes can get very costly in terms of time and money. He puts special emphasis on the advantage that a MVP and some of its features help to analyze, if it satisfies a certain customer need. Innovators and early adopters can give valuable feedback on the product and are seen as an indicator for the future diffusion of the innovation (Rogers 2003). The feedback will then be used to improve and modify the product according to the customer needs, which will lead to a more efficient development process than offering a product, where features are maybe overloaded or do not match with the customer need. Fleisch et al. (2015) add the beneficial effect of a MVP on ease and speed of maintenance work as well as on the update process of the installed firmware. For a start-up, the optimal MVP is difficult to create. The trade-off, which needs to be found, is described in the figure below.

![Figure 5: Trade-off to create a MVP (adopted from Barth (2016))](image-url)
2.4 Ethics and Sustainability

The described steady communication between the nodes of an IoT ecosystem generates large amounts of data, which will be transmitted, processed and stored. The necessary infrastructure, as the applied platform, cloud services or storage centers, will be provided by device manufacturers and companies with a commercial interest in the data (Gubbi et al. 2013). User centric data is an essential part of the value creation process of IoT business models, and it appears that the profit potential is as high as the potential that ethical and commercial concerns collide at some point (Ju et al. 2016). Most ethical concerns can be summarized by the two keywords security and privacy and will be reviewed in the following.

As IoT networks are based on modern information technology, the thread of security risks, in form of hacker attacks and malicious software etc., applies there likewise. Depending on the technological basis, which has been applied in an IoT ecosystem, several precautionary measures can be taken to defend a network. Gubbi et al. (2013) state, regarding the digital components of the IoT architecture, the most recent encryption and authentication technology is of high importance, to reach the goal of maximum network security. For the physical site the need for up to date hardware, especially when it comes to sensor technology, is highlighted. Even though the authors differentiate security measures with the focus on outsider attacks and insider attacks.

In the business model ecosystems of the future, the interpretation and realization of privacy laws and guidelines will play a significant role, especially when it comes to the final use of private data and the intensity of data exploitation (Gubbi et al. 2013). Fleisch et al. (2015) state that a sustainable value creation through IoT business models will be influenced by the way the trade-off between user self-determination and profit maximization is solved. Transparency is a key factor to create trust in an IoT ecosystem between the concerned participants, where data should get exploited in an advanced way. Following that, they suggest that data should be seen as a good, which is fully owned by the emitter. The emitter has then the power to decide, if he or she trades the data with money, goods, services or applications or some kind of other reward.

Furthermore, an expanding IoT infrastructure and the expected increasing number of communicating devices will lead to significant growth in energy consumption (Gubbi et al. 2013). Nevertheless, the savings in energy consumption through the use of IoT devices and services can be significant likewise, as Weber and Weber (2010) point out. They base their argumentation on energy efficiency gains through functions as remote control of devices or whole systems as houses, as well as intelligent optimization through planning and prediction in traffic and travel.
3 Methodology

The methodological approach used in this thesis will be based on the theoretical work of Collis and Hussey (2013). In the following, it will be stated under which scientific approach this thesis will be conducted, as well as the thematic and scientific priorities will be clarified.

3.1 Research Method

The chosen case study of Alphabet’s Nest will be conducted in an analytical way. After the situation of the IoT ecosystems, their architecture and business model setup, has been described, the facts will be examined and evaluated. Comparisons will be made by a limited adaption of a cross-case study, in the light of the prior strategical approach of the Android ecosystem, which has been applied by Alphabet. The data will be collected, using the qualitative approach, by reviewing the most recent scientific and magazine articles about the chosen case. By use of the, in section 2, described theory, the case will be analyzed and evaluated according to the mentioned IoT architectural models and business model framework.

The data will be of secondary nature in the case study. This is mainly caused by the already mentioned circumstance that the information situation, of the chosen case Alphabet, can be described as rather difficult. Nevertheless, the author of this thesis sees this as a rather interesting challenge, as it is more essential to assess the information available in a more detailed way. Additionally, this will open up the opportunity to analyze the case out of different perspectives, because there is no need to narrow the argumentation to the company perspective. Regarding the second research question the same approach will conducted.

Because of the author’s personal interest, the author intends to examine briefly the strategical actions of start-ups, which they undertake to face the financial superiority of companies like Alphabet. Because of that, primary data will be used. Therefore, a limited number of interviews will be conducted by the author in a semi-structured way. The detailed interview procedure will be described when it comes to the findings of these.

3.2 Research Paradigm

This thesis will be conducted with an interpretivist research paradigm, especially due to the reason that the used references are of highly subjective nature. Furthermore, the execution of qualitative research supports this assignment. Nevertheless, the limitation exists, that interpretivism and positivism in their pure form are unlikely to exist in reality (Collis & Hussey 2013). Because of that, the study can be seen as one with a strong interpretivist tendency by the use of a rich variety of perspectives with reasoned argumentations.
3.3 Limitation and Delimitation

As already mentioned in section 1.1 and 3.1, difficulties in the validity and reliability of the sources can appear. The limited timeframe and scope of this thesis does not allow the execution of comprehensive interviews or questionnaires. The gathering of first-hand-information, about the company strategy of the chosen case study, is difficult, due to Alphabet's PR policy. Primary data will only be used as a supplementary source of choice, where the author expects to gain additional valuable information for the studies purpose. The conclusions drawn can therefore be at least of a tentative nature. Furthermore, it is not intended to provide a full scenario analysis for the chosen case, as well as no recommendations will be stated.

If required, the market perspective will be delimited to the German market. As the research focus is more on the general applied business models and the related ecosystems, it is not expected that the geographical delimitation will play a significant role to the research. The thematic scope will be delimited on companies with own ecosystems, technologically based on more or less independent functioning platforms. Technical details are not subject to this thesis. Technical state as well as macro- and microeconomic developments will be considered to the point May 2017.
4 Case Study

In this paper’s case study the IoT strategy of Alphabet Inc. will be analyzed. The primary focus is on the Smart Home subsidiary Nest, the secondary one on the mobile platform Android and other IoT initiatives of Alphabet, which will be used as comparative examples in section 5. As an introduction, Nest will be set in the organizational and strategic context within Alphabet. Therefore, its structure, the logic behind the purchase and its history will be reviewed briefly. Following that, Nest’s technology and its IoT architecture will be analyzed according to the described theoretical model of Fleisch et al. (2015), as well as the realization of privacy and data security will be reviewed. Finally, its business model and the associated ecosystem will be analyzed according to the theoretical business model framework of Westerlund et al. (2014). Both, the architectural as well as the business model framework, have a value oriented approach and are therefore chosen, by the author of this thesis, as a suitable professional base for a deeper analysis of the business case.

Beforehand, a definition will be given regarding the terms user, developer and customer. As Nest generates revenues with sales of devices and services to its customers and these customers do not belong to the same group, clarification is needed. A user is the party, which is buying and using the devices and the applicable digital services. As the products of Nest target private households, a use in companies will not be considered for the study. In the prior explanations the user has also been described as customer of the devices or data emitter. The developer can be either the company Nest as developer of the Nest platform, devices and software applications or a third party developer, who integrates its products and services into the ecosystem. The customer is a party, which benefits through the exploitation of the user data in form of advertising and other marketing related services from the value creation process, with the help of the various Alphabet platforms and tools.

4.1 Nest within Alphabet

In the year 2015 Larry Page, one of the founders of Google, announced to reorganize the operations of Google under the name of a new holding, called Alphabet Inc. (Page & Pichai 2015). It has been pointed out, that this organizational change has the aim to strengthen the single brands and their independence within the holding. Furthermore, it has been stated to enhance structural and financial transparency and the investment focus of its actual subsidiaries. That are at least the motives, as mentioned in the official statement.
Figure 6: Organizational structure of Alphabet Inc. (Kelly 2015)

Figure 6 shows how Alphabet’s core business and revenue source will continue its business under the name Google. Cutting-edge technology fields like health care, IoT and more risky investments will gain a limited independence in the holdings structure. Nevertheless, other sources than the official statements and interviews of the company and its representatives assume other motives, which drive these changes. Even if it can be assumed that tax reasons may played a role as well and should not be underestimated, such assumptions cannot be evaluated, due to a lack of recent and valid information in this field, regarding the new business structure.

As Alphabet generates most of its revenues and profits out of advertisement related businesses, the new and more segmented structure will allow to identify less successful ventures within the company more efficient (Unknown 2015). This improvements in transparency were less driven by the company’s own willingness to do so, but were more a result of the pressure it faced from the investor side (Zenger 2015). This collided with the already described PR strategy of maximum secrecy and little transparency when it came to the performance of the individual ventures and the strategy behind the apparent unrelated investments (Reeves 2015). Even though the new structure just guarantees a minimum level of transparency, Zenger (2015) predicts that investors will definitely request a more detailed accountability in the future, especially in times where the financials and returns do not satisfy them. He furthermore states, that with increasing transparency it will become more and more obvious, how heavily the Google core business supports the extensive venture capital investment activities of Alphabet financially and how dependent the overall holding is on the performance of the advertisement business. However, Alphabet’s several investments in health care and IoT can be seen in the light of its efforts to strengthen the revenue
streams and to widen its financial basis. Because of that, the acquisition of Nest supports the strategy to penetrate the market of IoT devices and ecosystems with its already discussed commercial potential.

Nest has been founded in the year 2010 by Tony Fadell and Matt Rogers (Geis 2015). The story of the startup, as a part of the predecessor organization of Alphabet, started in early 2014 through a takeover agreement with a value of 3.2 billion USD (Investor Relations Alphabet 2014). Fadell continued to lead the operations of the Nest organization with its own brand. At that time the company offered intelligent devices as a learning thermostat, as well as smoke and carbon dioxide detector alarms, based on its own technological platform, which enabled communication and control of the devices (Ju et al. 2016). As illustrated in Figure 6, Nest will retain its position further on, within the new holding structure, with a more or less independent brand and organizational structure.

Geis (2015) wrote a comprehensive book about the M&A activities of Alphabet and its predecessor Google. He pointed out that the company pursues a so called semi-organic growth strategy, which is described by him as the combination of inorganic growth through M&A activities and organic growth through the development of the existing business. In line with that, he mentions several failed attempts to penetrate the Smart Home market, with the most prominent one in 2011 by announcing a platform for interconnected home devices, based on Android. The investment in Nest made it to Alphabet’s most promising one in the Smart Home sector, with the best prospects to develop a functioning ecosystem on its basis. This was mainly caused by the fact that the young company had a proven product on the market and a functioning platform with significant growth in user numbers (Geis 2015).

As additional motive for the purchase has been named a specific interest in the intangible assets of Nest, like a strong brand, a talented and highly motivated team and valuable patents (Barr 2014). A solid patent portfolio shouldn’t be underestimated, especially with the past legal conflicts, concerning intellectual property, in mind. Furthermore, an already developed and growing user base and the interest of Alphabet in the commercial exploitation of user data, may also played a role as well (Trefis 2014).

4.2 Nest’s Technology and Architecture

In the year of the takeover through Alphabet, Nest offered just two devices. On the one hand the learning thermostat, which is now as of 2017 in its third generation, and on the other one the so called Nest Protect device, which is a smoke and CO alarm and now in its second generation (Bergen 2016). Following the Nest deal, Alphabet added in 2014 through the purchase of the startup Dropcam a camera, now known as Nest Cam, to its portfolio (Geis 2015).

The company already experienced several issues of its MVP alike early product versions. Software issues could be settled with automatic updates, whereas hardware issues required the release of new product generations and partly product recalls (Yarow 2014). The new product generations came with the required fixes, as well as they gave the company the opportunity to introduce the latest and advanced state of the art technology. Furthermore, in case of the Nest Cam it turned out to be right, that
there existed a customer need for an outdoor version, which soon got introduced in 2016 (Yeung 2016). The observation Nest made was that the prior camera, which was just able to perform indoor, has been used by a large group of users to scare burglars off, simply because of its existence and ability to recognize and film, activated through movement. The company recognized the customer need, took the MVP version of the indoor camera as a technological basis and was able to release a weatherproof and redesigned outdoor version soon. Nevertheless, observing the actual product portfolio and the releases of the last years, a generally rather low output of new and innovative devices of the Nest brand can be complained (Gartenberg 2017). A fact that will be considered later on in this thesis.

Besides of the mentioned devices of the Nest brand, several other developers produce compatible devices, which can be integrated in the Nest ecosystem and form the device level of the Nest IoT architecture. Examples are products like energy management systems, light bulbs and household appliances by renowned manufacturers like Philips, Osram, Samsung and Logitech (Nest 2017g). Not all of these products are equipped with sensors and actuators themselves, for example the Philips light bulbs (Nest 2017d). The sensor and actuator component and function is in this case delivered by other interconnected products in the ecosystem. This can be done by the use of any Nest branded product, which is, as a mandatory part of the Nest Smart Home system, the interface function between physical and digital world (Nest 2017f). The Nest product is following that able to connect, through a so called locally deployed Works With Nest (WWN) connection, third party devices with the Nest platform through the internet and symbolizes the connectivity level of the physical side of the architecture (Nest 2017b).

Thus it appears that the some devices, especially by third party developers, barely cover the device level and just become part of the Nest ecosystem through their ability to connect through a WWN connection with a Nest product and the platform. The Nest products themselves, cover the whole bandwidth of the physical side of the IoT architecture and can be seen therefore as the centerpiece of the IoT ecosystem from the user perspective.

From the technical perspective, the WWN connection is built on the application protocol Nest Weave, the networking protocol Thread and on the IEEE standards 802.11 and 802.15.4 (Nest 2016; Brown 2015), which simply enables the Smart Home network to communicate internally even without active connection to the internet and the cloud.

The digital world of the IoT architecture of Fleisch et al. (2015), is formed in the case of Nest, by the Nest platform and its primary visual representations, which could be for example the Nest app. Whereas the analytics level is defined by the platforms range of functions and algorithms. The provision of digital services to the end user can therefore occur in many ways, as a technical user interface, as an app or unasked services, which are caused by a certain analyzed behavior. The Nest ecosystem has an open concept, where developers can add devices and apps by use of the Nest architecture. The app can either be an independent one or an extension of the existing Nest app (Nest 2017c). Developers of third party devices and applications are able to integrate something into, not to change, the underlying architecture.
4.3 Realization of Security and Privacy Standards

The profiteers of value creation through IoT can be either the different nodes of the ecosystem, or an external party, which participates in some indirect way. In IoT ecosystems personal data can be seen as the core commodity. As data is a very volatile asset, transparency about the use and flow of data is of high importance for the sustainability of an IoT business model ecosystem. Sustainability in IoT is about customer trust and data control and can just be achieved, if the ecosystem is able to ensure that data is not used in a disadvantageous way for the emitter and that the data is protected in a sufficient way (Moulds 2014).

The success of the business models of Alphabet and especially its subsidiary Google rely mainly on the extensive data exploitation and optimization of its value creation process. In the first quarter of 2017, 21.5 billion USD out of 24.8 billion USD of Alphabet’s overall revenues, have been generated through Googles advertisement business (Investor Relations Alphabet 2017). Because of Googles large database of detailed information, customers are able to aim for effective marketing through selective user targeting. With this in mind, the commercial possibilities in the field of IoT seem more than promising, taking into consideration that the deeper penetration of the personal life of users will lead to a never seen amount and quality of usable data.

A conflict of interest becomes visible by consideration that Alphabet has an interest in profit maximization, through additional value creation for its customers, and its user’s interest in a certain amount of privacy. It is worth to mention that already the Google privacy policy of 2012 gave the company permission to analyze and link user centric data over the different platforms and services used (Baraniuk 2014). Although, Nest plays economically a tangential role, compared with Google, the subsidiaries privacy and security policy could become more important in the future.

Even though, Nest states that personal user data is not automatically shared over a WWN connection, the company admits that a WWN connection will not work until the user gave permission to share certain types of information with the applicable developer (Nest 2017a). That means in consequence, that the local use of an IoT product may be possible, but the additional value offer to the user, as remote control through an app etc., may not be usable. In other words, the main reason why users bought the devices, may just be usable if they agree to the sharing of data to the terms of the third party developer and Nest. Comparably to the situation, as it is already nowadays with the use of apps on mobile phone platforms.

In the privacy statement of Nest (Nest 2017e), the company firstly pledges, not obligates, itself to be transparent, to ask for data sharing permission and to ensure the safety of user data through authentication. It states, that the data could become subject to U.S. laws and which kind of data will be gathered and transmitted. That affects actually, to sum it up, all the data the device’s sensors can collect and the data the user shares during the setup and operation of the device. The statement also points out, that data between the developers of installed third party devices and other devices can be exchanged as well, if the user agrees beforehand. The company allows itself to contact the user in some form and to communicate and exploit data in an anonymous form together with third parties for marketing and sales purposes, by considering the given permissions of the WWN connections. It is finally stated that the information
stored on the device can be deleted through a reset and the information transferred to the platform can be administered through the personal Nest account. Although the data is likely to be stored longer through backups and for legal concerns.

In conclusion, it can be said that Nest privacy statement already points out an exploitation of data similar to the one of Google platforms. It can be assumed that it is Alphabet's goal to keep the privacy statements as similar as possible to avoid barriers and difficulties for the commercialization. As an example, this is highlighted by a Nest patent that enables the Smart Home system to update the social media status of the applicable user through the gathered sensor information (Barr 2014). Trefis (2014) adds the thread, that the detailed information could enable Nest and affiliated companies to influence the user behavior and lifestyle.

4.4 Nest’s Business Model

In this thesis' section it will be explored in which way the business model ecosystem framework of Westerlund et al. (2014) can be applied to the business case of the Nest ecosystem. Following the theory, the value nodes, drivers, exchanges and extracts will be identified. On the basis of these findings, a clear picture can be drawn how concerning business models in the Nest ecosystem create and capture value.

The wide diversity of value nodes has already been described. To identify the nodes of the Nest ecosystem it is firstly important to clarify in which scale the whole system is viewed. From a technical perspective and with detailed view, the single sensor can already represent a value node. This one can be grouped together with the actuator and the device to the value node of an IoT device. Furthermore, this device can be grouped together with other Nest and third party devices and maybe the individual user to the Smart Home node of a single household. The described situation makes clear, that within the Nest ecosystem, or an IoT ecosystem in general, several other ecosystems can exist and that an ecosystem can also be a value node until it reaches its smallest or largest manifestation. Due to the architectural and technical setup of the Nest ecosystem, the Smart Home node has the ability to work with a limited functionality independent from the rest of the whole Nest ecosystem. This includes the node of the Nest platform and its physical nodes, as data centers and the whole network infrastructure are, for example. The fact that the single user can be a node, already implicates that other self-determined actors as developers and customers can be nodes as well.

The mentioned nodes share joint motivations, the so called value drivers, which is necessary to form the Nest ecosystem. If one node, especially the self-determined ones, would not share these drivers, there would be no need for the node to participate in the ecosystem. The main value driver of nodes within the Nest ecosystem could be formulated as the motivation to create and capture value through the exploitation of data for the benefit of all the participating nodes. There may exist further drivers, which subordinate themselves under the main value driver and need to be, at least to a varying extent, shared by all the nodes.
A value driver, as high security and privacy standards for users could be, needs to be demanded and expressed by a node. If the other nodes of the ecosystem recognize the need as an essential requirement and value driver, a trade-off will be found for the realization as a shared driver. The following scenario can help to make things clearer: The user has the feeling that his data gets exploited in an unorthodox and intense way by developers and customers. The user feels that he does not get an appropriate reward in terms of physical or digital value in return. The user feels because of that, that his privacy rights and data security are not ensured and will express the need for a joint value driver of the ecosystem. The expression can manifest itself through user decisions, as to participate in another IoT ecosystem, which shares the same drivers as the user node, or to deny participation in IoT ecosystems at all, if the trust is lost. The other nodes need to react if they want to sustain the ecosystem for the long term.

In any case Nest and the concerning third party developer, if applicable, act as a mediator in all exchanges. Direct exchanges, especially in a non-anonymized form, between the user and the customer are not possible in the Nest ecosystem (Nest 2017a). The value exchanges that appear within the Nest ecosystem can be categorized, as Westerlund et al. (2014) suggests, into devices, money, knowledge and information. To which extent each of this exchanges can also be named as a value extract is difficult to determine. The most typical knowledge exchanges are probably the ones between the different developer nodes, which are a requirement for the technical operability of the ecosystem. Devices are exchanged by the user against money, whereas the operation of the devices, including the digital IoT services is an exchange of information. On the one side user data, on the other side the reciprocate feedback of the analytics or digital service level. It is imaginable for the future that these services will become fee-based in some sort, which would make this exchange an extract. Information for marketing purposes can either be exchanged by customers and developers, for market research purposes for example, or can be commercialized directly on the developers’ platforms, in form of advertisements, both cases would involve exchanges of money and information. Every exchange with money represents also a value extract. Whereby, it can be argued that also exchanges which are a requirement for the extracts and do not involve money directly, can be characterized as meaningful for the commercialization within the Nest ecosystem. It can be stated that the boundary between exchanges and extracts is rather fluent and difficult to identify, as a combination of any exchange will probably have an impact on the commercialization in some indirect way. This circumstance shows up the limits of the framework of Westerlund et al. (2014), as it did not found attention in the study they published.
5 Findings and Discussion

In the case study it has been pointed out, how the Nest business model ecosystem aims for a value creation for the diverse participating nodes, especially the self-determined ones. The study of the architectural model, especially puts emphasis on the value creation perspective of the user node, as this is the node, which has to make a conscious purchase or usage decision for the devices, the ecosystem technology and its services. The value creation processes, based on the data exploitation, for the other self-determined nodes originate from this decision of the user node and is of the highest importance. Users capture value in form of the physical things, their usual functions and digital services, which enable the additional functions of the devices, or allow the use of advanced services based on the use of the devices. It has been pointed out, that in this system of nodes, value exchanges happen where a reciprocal desire exists regarding the subjects of the exchanges.

The case study paid attention to matters of ethics and sustainability in IoT environments. The discussion how the security and privacy trade-off between user, developer and customer interests will be designed, depends on how intense the participating self-determined nodes articulate their desires. The single user has with the purchase and usage decision the power to put the other nodes under pressure and to influence such developments in an advantageous way. Whereas, the single user himself has a disadvantage of scale. A beneficial effect could be the organizational unification of users to express the desires more vehemently and to underline the importance of their role within the Nest ecosystem in front of the other self-determined nodes.

It has been described that the Nest ecosystem adopts an open approach, where companies, which decide to participate in the ecosystem as developers, through offering products or services, are allowed to do so. Nevertheless, it is more suitable to describe the Nest ecosystem as an open one with strict and defined limits. These limits are set by the architecture and the underlying principles and policies of the Nest ecosystem. Following that, value creation for third party developers and their individual business models can happen just to an extent, which is allowed and dependent on Alphabet’s company politics. Third party developers try to decrease this dependency by enabling the integration of their devices in as many ecosystem technologies as possible (Tweed 2016). If this strategy still works when consolidation processes among the competing ecosystems start and just an overseeable number of ecosystems is left, is another question.
Nest as a platform developer and Alphabet subsidiary can increase its value capture by promoting user and third party developer number growth. The number of customers will follow the trend the more attractive the quantitative and qualitative characteristics of Alphabet’s database gets. The more complex the database gets, the more sophisticated tools need to be developed and implemented to guarantee customers a noticeable improvement in data exploitation and commercial realization possibilities for marketing and sales. It is time for Alphabet to offer its customers quantitative improved data for a higher efficiency in the targeted advertising business. The times where Google AdWords was the dominant provider in online marketing have changed at the moment where Facebook made out of a monopoly a duopoly (Ingram 2017). Customers have since then the opportunity to choose the provider, where they can capture the most value, according to the individual requirements of the advertisement.

5.1 Strategical Challenges

The business strategy of Nest faces multiple challenges, which threaten the success of the ecosystem and need to be addressed by the management. In the following section, the most major ones will be pointed out and discussed.

It has already been mentioned in section 4.2, that the release of new Nest products has lost its pace in the recent years. Weinberger (2016) points out, that the leaving of the Nest founder and CEO Fadell in 2016, must be viewed with this underperformance in mind. Whereas, he also wonders what Alphabet’s intention is by the entering the hardware market with own devices. Bergen (2016) assumed that Fadell, who was a former Apple employee, tried to create an Apple alike hardware portfolio and failed. It has been mentioned, that Alphabet generates most of its revenues and profits out of advertising services. Alphabet made already several attempts to enter the hardware market, be it with Pixel Laptops or Nexus and Motorola mobile phones, all of them were rather less than more successful on the long-term, but served successfully the aim to demonstrate the platforms possibilities and capabilities (Weinberger 2016).

Considering the above stated arguments, it can be said, that one challenge for Nest in the future will be to decide how it is going to position itself on the market and within its own ecosystem. It’s the author’s opinion that the already introduced Nest products have served well for the purpose to support the development and diffusion of the ecosystem and its devices and services among users. But with growing scale of the ecosystem, the fact that Nest is offering its own devices, which could stand maybe in competition to devices of other third party developers within the Nest ecosystem, could become more and more an obstacle for the growth of third party developer products. This could result in a negative impact on the attractiveness of the Nest ecosystem for developers and could maybe lead to the decision to focus more on competing ones. Nest products already fulfil main functions within the physical architecture of the Nest ecosystem and are a necessity for its functionality. Therefore, the author is convinced that the developer will strengthen their functions in regard to ensure safe and reliable operability, rather than focusing on the household device functions. This would also clarify the role of its revenue sources for Nest, as the situation at the moment is, that Nest has to pay attention, to create suitable products for users on the one side and customers on the other side.
First indicators and rumors for such a pivot in Nest’s business model ecosystem strategy already occurred. With the Google Home device, Alphabet launched in late 2016 a product outside of the Nest brand, which has the ability to act like a hub of the ecosystem, just as the other Nest devices can function as well (Tweed 2016). The device is compatible to the existing Nest ecosystem, as it uses the same technology and communication protocols, and can integrate seamlessly to fulfill its functions. Google Home is a device which is able to react on the voice of the user and give feedback through the speakers it is equipped with. Furthermore, it enables the user to control the installed Smart Home devices verbally and is seen as Alphabet’s answer on Amazon’s Echo device. This product release marks a shift in Alphabet’s strategy to position the Nest brand as the centerpiece of its Smart Home efforts, as it is now challenged in its innovativeness through inner-company competition.

Regarding Software development, Weinberger (2016) mentioned that Nest programmers started working under the supervision of Android development department. This can be seen, as he assumes, as the strategical step towards an Android based Smart Home platform, which could one day replace or transform the Nest platform as it is nowadays. He adds that already other devices, like the TV streaming device Google Chromecast, are based on Android. Nevertheless, in review of these indicators, it can be stated that, if not a full integration of the platforms is Alphabet’s goal, at least a strategical approach will be made to unify standards and achieve full compatibility of the different platforms with each other. The author shares the view that a technical convergence of the different platforms and the applicable ecosystems, which are currently deployed by Alphabet, can have a profitable effect for the overall success of the company’s Smart Home efforts. As Android has a large user base, a switchover to a Smart Home ecosystem, which has a familiar user interface and setup, would be a logical consequence.

5.2 Other Strategical Approaches

It was one of the prior purposes of this thesis to figure out, how small and young companies, what startups are, face the financial and economical superiority of established companies, as Alphabet, in the IoT sector. Therefore, two interviews have been conducted. Following that, it has been proved that there seems to be a certain secretiveness when it comes to details of the individual IoT ecosystem strategy. The author in consequence decided to focus on the case study of Alphabet rather than building his study on a lack of information. Anyway, the author would like to mention the findings of these interviews, even though these findings will have no influence on the answering of the research questions.
The interviews have been conducted in a semi-structured way. The guideline was to find out, how data gets exploited and distributed and on which level on the value creation process this is done. A second question had the purpose to get information, regarding the importance of certain customer groups and their potential for future sales. The third question was aiming for findings in the field of sales categories, as products and services are. The fourth question was requesting information about the use of private data. In case of question two and three, no usable data could be conducted. Following that, the limited information, exploited out of question one and four will be discussed in a brief way. Whereas the companies will be mentioned anonymously, by the names A and B, as requested by their representatives.

The first interview has been conducted with a startup (Company A), which develops energy management systems for industrial and private use. The company has about 200 employees, is based in Germany and sells products like energy management panels, smart metering devices and delivers the appropriate independent technological platform to its customers. The customer base exists of industrial companies and energy suppliers, which equip private households with the devices. The findings of this interview were, that they stated that their ecosystem was not competing with the Alphabet ecosystems at all. The company representative reasoned that on the fact, that their main customers, the energy suppliers, attached great importance to the ability to manage the data of their user by themselves. Furthermore, it has been stated that on the German IoT market, transparency about the use of information plays a comparably important role. Therefore, the company A enabled its customers to manage and use their product, with the supplied software, on the basis of a monthly fee. That means, that data is in the ownership of the applicable customer and that the revenues and profits get generated out of a fee based pricing system.

Company B is a Germany based developer for IoT network technology, which enables companies, as Nest is, to operate and ensure safety within the network. The company representative stated, that it is the company's aim to ensure a compatibility with as many technological platforms as possible. Nest is rather seen as a cooperation partner, than a competitor, even though one of Company A's products fulfills the same purpose as the ones of Nest's, the learning thermostat. The representative stated that the targeted customer group is more in the industrial and network infrastructure sector than the smart home sector. Nevertheless, the company representative acknowledges that companies as Alphabet and Amazon will play the most significant role in the digital domination of the everyday life of private persons.

Even though the described findings, as mentioned in this section, play a rather marginal role in this thesis, it can be stated that developers as Nest, or Alphabet at all, will push forward to dominate the market in the IoT sector. Bare hardware developers are unlikely to dominate the sales and revenue figures, if a serious aftersales strategy is missing in terms of data exploitation and commercialization. Independent IoT platform developers have probably just a promising future, if they fill the gaps that established developers leave unoccupied, as certain fields of industrial applications and products, which do not target a mass market.
6 Conclusion

In this section the findings of the study will be summarized in regard to answer the stated research questions. The findings that have been stated already in section 5 will not be recaptured again in a detailed way. The author of the thesis would like to mention again, that the described findings are of a tentative nature and need to be treated with caution, due to the lack of reliable information, as official company statements, and the use of secondary data, which cannot be verified sometimes.

The first question had the aim to clarify, what Alphabet’s strategical approach is, concerning the chosen business case of Nest and the evolvement of an IoT business model ecosystem. It can be stated that Nest IoT strategy is based on a semi-open platform, which allows third party developers to participate, but according to the rules and limitations as set by Nest and Alphabet. The author shares the view of some of the mentioned authors that it does not belong to Alphabet’s core business to produce hardware and that these efforts must be seen in the light of the promotion of the underlying platform. Following that, the exploitation and commercialization of the gathered user data. The evolvement of the business model ecosystem has already reached a proper stage, but has still much potential in light of the future prospects of the field of IoT products and applications. The more developers see the Nest ecosystem as one, which is attractive enough for the integration of their individual business models, the more users will be attracted to use it extensively. As long as the trust of the user, concerning data security and privacy, can be sustained. The more extensive users generate data, the more customers are attracted to make use of the processed data and to pay for it. The evolvement of the Nest business model ecosystem is likely to continue, as long as the different self-determined actors, or nodes, share the same motivations, or drivers, to participate in the ecosystem.

If the Nest ecosystem will sustain its position as the centerpiece of Alphabet’s IoT investments, was the subject of the second question. Therefore some of the most recent developments, concerning other IoT investments and organizational changes of Alphabet have been reviewed. These developments indicate, that the Nest ecosystem, its platform and products will become more and more part of a joint network, which will include the different platforms and available products and will be characterized by the technical compatibility of the different IoT investments. This development can also lead to a fully integrated product, platform and digital service portfolio, which exists of the most profitable and advantageous parts of Alphabet’s IoT strategy. The most prominent developments are the growing importance of the Android platform, as well as the introduction of the Google Home device, which scale up quickly as well. The author has the opinion, that Nest in its actual more or less independent state will not exist in the future any more.

In the research field of industrial management the business case has been discussed regarding its organization and structure, as well as certain relevant micro- and macroeconomic developments have been pointed out. Theories as Roger’s model of the diffusion of innovation, customer or user targeting, minimum viable product and the various architectural and business model frameworks have been more or less explained and applied in the chosen business case of Alphabet and its subsidiary Nest.
With this study the author pointed out the strategical IoT approach of Alphabet, by analyzing different secondary data sources, according to the described theory, in order to provide a comprehensive picture of the subsidiary Nest and other IoT initiatives. The difficulty of the study was to find information of sources, where the author could count on, at least to a certain extent, that the information are reliable. Therefore, just established tech and business blogs and websites, have been considered as usable web sources. Furthermore, the author tried to use mainly sources not older than 5 years and to double check information with other sources as much as possible. Nevertheless, the explanation of the theory is based on established scientific sources, as science magazines, journals and other publications.

6.1 Further Research

The author sees the most promising opportunities for further research especially in the field of IoT platform development. The functionalities of the technological platforms can differ heavily from each other, depending on the intended purpose and underlying business model ecosystem. From a business research perspective, the investigation of the commercialization of the collected user data and the development of specialized business models will have a high significance. Following that, it would be interesting to clarify in which way single business models need to adapt to the specific requirements of the individual ecosystems, as well as to more than one ecosystem, if a business model is working with a multi-ecosystem approach. From the technical perspective more research is needed how a more extensive exploitation of user data can be achieved, while simultaneously sustaining user privacy standards and increasing the level of user data protection. The effect of upcoming technological developments on IoT platform development, as artificial intelligence and blockchain are, is also an interesting field of research and has the potential to contribute to increase efficiency and data output quality of the platform technology.
7 References


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