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THE ROLE OF MOBILE HEALTH APPLICATIONS FOR HEALTH INSURANCE COMPANIES IN GERMANY

MASTER THESIS

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Executive summary

Recent years have noted the increasing prevalence of smartphones and an expansion of their user base across all age ranges. A growing amount of health-related mobile applications is flooding the application market and the digitization of the health sector processes rapidly with digital offerings becoming more and more popular. At the same time health insurance companies are facing tremendous difficulties such as increased costs through chronic diseases and an overall aging population. This thesis investigates how mobile health applications can create business development in terms of business model innovation/ customer value creation for German health insurance companies. Firstly, a literature review is conducted to gather relevant important information and to build a theoretical background on the concepts of mobile health applications, big data, the business model concept and app-enabled business value creation. The literature review has also shed light on three possible outcomes of health application provision for health insurance companies, in particular cost reductions, customer retention and new customer acquisition. However, privacy concerns, data security, noisy data and ethical concerns are considered limiting factors.

In order to filter out the role of health applications for German health insurance companies, knowledgable employees of health insurance companies are asked to participate in a self-administered online survey around health application offering of their company. As the research topic is quite recent the main goal of the research is to find an underlying construct within the data to prove correlation between the constructs. The results of the online survey are thus analyzed using an exploratory factor analysis and are then evaluated descriptively. Four factors were build using common factor analysis which cover the aspects of customer retention, targeted customer offering, big data possibilities as well as app use. Based on the findings a model is created that shows the underlying business value of mobile health applications.

The overall finding of this thesis is that there are correlations between health applications and three main factors. Firstly, health apps can possibly influence customer retention and customer relationships. Second, health apps hold an underlying potential of aiding in the prevention of widespread diseases, early detection of diseases, treatment of diseases and offering targeted customer offers. And thirdly, there are big data possibilities such as detecting trends about the collectivity of insurants and the provision of targeted offers based on customer knowledge.

Key Words: Health Applications, Health Insurance Companies, Business value, Customer retention, Customer Acquisition, Customer relationship, Big Data, Germany

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1. Introduction

1.1   Research Background

In todays society the topic of chronic diseases such as obesity, diabetes, arthritis, cardiovascular diseases as well as various cancer types has become an ever-growing issue especially in combination with the drastic aging of the population (Guidoux et al., 2014; Lasierra, Alescano, Guillén and García, 2013). Without any changes, this situation presents a worrying future prospect with severe economic consequences (Lasierra et al., 2013). This development inevitably demands for a change in terms of the population following a healthier lifestyle, which is especially important as the risks of developing one or multiple chronic diseases can be drastically minimized by following a lifestyle that consists of a healthy diet as well as regular exercise (Klein, Mogles and van Wissen, 2014).

At the same time there has been a change in people moving away from laptops and personal computers and increasingly shifting towards mobile devices such as smart phones and tablets (Chen, Chiang & Storey, 2012). As of 2016, around three out of four people of the German population own a smartphone, covering all age ranges. This change is partly supported through the immense development that mobile phones have undergone. Mobile phones used to be solely for facilitating communication whereas the smart phones of today are "the most ubiquitous consumer electronic device in the world" as they are highly dynamic and can be used for a multitude of purposes (Gouidoux et al. 2014, p. 272). These technological evolutions and developments in the innovative application of mobile phones but also the emergence of tablet computers have resulted in an immense increase in the development of mobile applications. Mobile applications are sophisticated programs that are specifically designed for the use on mobile devices such as smart phones or tablets. A major trend within the world of mobile applications is based around the topic of health and fitness. The smartphone is often regarded as a very personal object that is carried everywhere and contains highly personal information, which might explain consumer adaption and willingness to enter personal health and fitness data into mobile applications (Klasnja & Pratt, 2012). Applications aiming at exercise documentation, weight tracking, diet and nutrition monitoring appear to be the most popular within the category of mobile health applications. (Fox & Duggan, 2012). Next to the most popular applications mentioned before, other health applications include for instance applications that track, blood pressure, a women's menstrual cycle, pregnancy progression, blood sugar levels or diabetes, medication as well as a user's sleep cycle and mood

(Fox & Dugg, 2012). More and more users are tracking their personal health, fitness and nutrition on mobile applications every day. Quantified self is the headword that describes "any individual engaged in the self-tracking or any kind of biological, physical, behavioral, or environmental information" which can be done out of curiosity or based on a need to have control (Swan, 2013). Swan (2013) further states that about 60 percent of US adults are keeping track of their weight, diet and nutrition and exercise behavior and around 33 percent are controlling their blood sugar levels, blood pressure and sleep patterns.

Growing usage is predicted which results in masses of ever-present and low-cost data which can potentially yield highly relevant insights for health insurance companies such as understanding customers and the market in general (Chen et al. 2012). Next to the general application usage, another factor that is causing the explosion of raw data comes from connected devices (Fanta and Miller, 2012). Under the umbrella term 'Internet of Things' (IoT) everyday consumer objects or devices are connected to the network to facilitate data collection and information exchange (Xia, Yang, Wang & Vinel, 2012). Wearable fitness sensors for instance in the form of a bracelet such as the Fuelband by the brand Nike or the Up2 by the brand Jawbone can automatically collect data on a multitude of different factors such as activity levels and heart rate (Li & Guo, 2016). Mobile analytics entails the process of „collecting, processing, analyzing and visualizing such large-scale and fluid mobile and sensor data" (Chen et al, 2012, p.1168). Users that actively document their health and fitness with connected devices in combination with mobile applications are providing an extensive documentation about their personal health. A main question is how and to what extent firms can use these mobile phone development, documentations and the technological progress. Moreover, new technologies can improve the health care structure as well as enhance efficiency and transparency of the health sector. According to Knöppler, Neisecke and Nölke (2016), a main aspect is the cooperative and interactive application of information and communication for the purpose of improving health care and general population health.

Therefore, a tremendous potential lies in the use of mobile health applications. However, since mobile health applications are still a very recent topic it has not been established what exactly is feasible and what is not especially with respect of personal data protection (Liu, Zhu, Holroyd & Seng, 2011).

1.2   Research Objective

Recent years have been subject to growing digitalization, all types of information is accessible every time of the day, from everywhere and just at the fingertips. Growing network sophistication including high speed internet access data transfer along with more powerful mobile devices are shaping new ways of access, delivery and management of data (World Health Organization, 2011). The digitization of the health care system progresses at a very high speed and digital offerings in the health sector are becoming increasingly popular. Ever more users are and will be tracking their personal health with and without the use of connected devices on their smartphones in mobile health applications. This creation of masses of highly detailed and rich data provides an enormous source of potentially useful business insights if they are to be analyzed.

Simultaneously, medical insurance companies in Germany are increasingly facing tough competition among each other and further difficulties such as growing costs stemming especially from ambulatory treatment, inpatient care and psychiatric hospitals (pwc, 2013). Other very large expenses for statutory medical insurance companies next to inpatient treatment are doctor's fees and pharmaceuticals. Attributable for the growing costs in inpatient care, and pharmaceuticals are the changing demographics in Germany in terms of an aging population and a decreasing amount of young people in the population (Ulrich, 2003). These demographic trends are accounted for by the negative population growth rate (-0.18%), a low birth rate and a low fertility rate (1.43 children born per woman) (IndexMundi, 2014). In todays economy, chronic diseases are a growing concern which is why a lot of preventative action is needed in the areas of obesity and smoking (Handel, 2011). It becomes apparent that the "current model for healthcare service delivery faces enormous challenges posed by an aging population and the prevalence of chronic diseases" (Triantafyllidis et al., 2015, p. 1). A very critical aspect for the future of health insurance companies, especially statutory health insurance companies is thus is to be able to stay competitive in the market and accordingly achieving a reduction in costs. A potential source of cost reduction can come from active and healthy insurance members as a healthy lifestyle is said to decrease the chances of chronic diseases, a cost intensive circumstance (Warburton, Nicol & Bredin, 2006). Since private health insurance companies are calculating their insurance premium based on age and health of the individual, data from health applications can provide useful insights int terms of all of their customers. In order to remain competitive it can additionally be very important for health insurance companies to concentrate on customer acquisition, customer retention and customer service.

Quite some research has been conducted in the area of Social Media Analytics and in how far Big Data from Social Media can be used to create useful insights about customers. The results show that technological developments such as Social Media can aid in strengthening customer retention through increased transparency, using social networks for acquiring new customers and cost reductions (pwc, 2011). The new environment of mobile devices, mobile health applications and connected devices and wearables opens up a whole new field of research. A study of Vital Wave Consulting (2009) in the developing world has indicated the positive effect of the use of mobile technology in particular smart phone-based applications on the "effectiveness of health care delivery" (Liu et al. 2011). The role of health applications is still a very young research area and therefore, the relationship between health applications and business development are not fully understood which is why the role of mobile health applications within business development can be presented as a gap in scientific literature.

Derived from the introductory chapter and the research gap the following research question arises:

How can the use of mobile health applications enable business development in terms of business model innovation/customer value creation in German Health Insurance Companies?

Throughout the thesis, the following sub-questions will be addressed:

- What are Mobile Health Applications and what data is generated by them?
- How can Data from Mobile Applications be useful for Health Insurance Companies?
- How do how do mobile health-related applications relate to business model innovation?
- What possibilities for Health Insurance Companies exist from Mobile Health Applications?
- What are possible limitations of the use of Data from Mobile Applications?

1.3 Research Approach

In order to answer the research question „*How can the use of mobile health applications enable business development in terms of business model innovation/customer value creation in German Health Insurance Companies?*" both a literature review and an empirical study is conducted.

The first part of the thesis consists of a literature review for the purpose of providing a theoretical background that is necessary to identify the role of mobile Health Applications for Health Insurance Companies in Germany. A literature review is used to understand and learn what is already known in the area of concern and what has been studied before (Babbie, 2010). Moreover, a literature review can be used to show gaps in the literature indicating the importance of further analysis. The topic of this thesis is a very recent and new topic, resulting in only a small amount of scientific

literature that is concerned with the role of mobile health applications especially for German health insurance companies. The criterion for selecting literature for the literature review is thus a focus on academic papers which were mostly found using online search engines for academic literature such as Scopus, the University of Twente Online Library and Google Scholar. An additional way of finding literature was by applying 'reference harvesting' or also called 'snowballing'.

In the second part of the thesis, an empirical study is carried out to analyze the role of mobile health applications for German medical insurance companies. Chapter four discusses in detail the methodical aspects of the empirical research of this thesis.

1.4   Thesis Structure

The first chapter is an introduction to the topic of the master thesis by providing background information concerning relevant background information, the research objective followed by the research question as well as an explanation of the research approach. Within chapter 2, the medical insurance sector in Germany will be introduced. Chapter 3 discusses important theoretical information which is necessary for answering the research question. The fourth chapter explains the methodology for the second part of the thesis, the empirical research. The chapter is used to introduce the research type and design, sampling, data collection and data analysis as well as the reliability and validity of results. The fifth chapter will present the results of the survey which are then thoroughly discussed in chapter six. The sixth chapter will also give recommendations to health insurance apps as to how health-related applications can generate possible business developments. The last chapter of this research merges all insights together and also discusses limitations of the study, gives suggestions for further research and discusses theoretical and practical implications.

2. Industry Background

2.1   The Health Insurance Market in Germany

The German Health Insurance environment is split up into mainly statutory health insurance companies and private health insurance companies. The history of the German statutory health insurance situation reaches back to the German Empire. In 1883, Germany is the first country to establish a national social insurance system including obligatory health insurance for industrial workers (European Observatory on Health Care Systems, 2000). During the years, the German

health insurance system has been revised and adapted incrementally resulting in a growing insurance coverage (Bärninghausen & Sauerborn, 2002). In the early years only 5 to 10 percent of the population were insured within the statuary health insurance whereas in March 2015 about 87 percent of the German population (around 70 million) are insured within statutory health insurance, while the remaining 13 percent (around 9 million) are insured by private health insurance companies. (Bärninghause, & Sauerborn, 2002; Bundesministerium für Gesundheit, 2016).

The competition among statutory health insurance companies is quite fierce since German citizens are able to freely chose their preferred health insurance company. Since health insurance is an obligation in Germany one can classify the health insurance market as relatively mature which is an additional source of competition among insurance companies. Additionally insurance companies are faced with increasing costs stemming from impatient treatment, pharmaceuticals and medical treatments.

As a result of an increased competitive market situations the number of statutory health insurance companies has decreased tremendously over the last decades, from 1.815 in 1970 to only 124 in 2015 (statista, 2015). As of July 2015, the five largest statuary health insurance companies based on the number of members are as follows, Techniker Krankenkasse, Barmer GEK, DAK-Gesundheit, AOK Bayern and AOK Badenwürttemberg (statista, 2016).

A main difference between the private and public health insurance is the calculation of insurance contribution. For the statutory health insurance, the insurance premium is currently at around 14,6 percent of gross wage shared between the employers and employee, whereas the premium for being insured at a private health insurance is based on risk, age and health (Hullegie & Klein, 2010). This assessment on risk in terms of age and health inevitably means that someone with pre-existing illnesses will have to pay a larger premium or can be completely excluding depending on the severity of the illness.

If the salary reaches a certain minimum threshold, individuals are eligible to opt for private health insurance (Hullegie &Klein, 2010). Exceptions to this rule are self-employed people and civil servants who can always decide to be insured with a private insurance company. For civil servants the option of being privately health insured is often times even cheaper as being insured within statuary health insurance as part of their insurance premium is taken over by the country.

Within statutory health care almost all of the services are legally fixed in terms of that they have to be provided in the same manner across all statutory health insurers. Some of these fixed benefits include for instance disease prevention, early disease detection through regular doctors

appointments or prophylactic treatments, treatment of diseases through impatient treatment, home health care and ambulance service (European Observatory on Health Care Systems, 2000). The fact that almost all benefits and the salary-based contributions are legally fixed leaves the statutory health insurance institutions little room to differentiate themselves from others in order to attract and retain customers. Statutory health insurance companies are however allowed to offer additional health services.

A common way to pursue a differentiation strategy is to offer additional health services for which, on the other hand, often times additional fees up to 1,7 percent can be charged. In order to prevent customers from switching to another health insurance due to high additional charges, the institutions have to present the customers with a good customer value proposition which essentially means that the customer is willing to pay a certain additional rate for the services that are coming along. Traditional ways to differentiate oneself from other insurance companies are now briefly introduced.

2.1.1. Bonus Programs

The first form of additional services that can be offered to customers as added value are bonus programs. Bonus programs can be used by customers to receive a monetary or non-monetary bonus for living a healthy lifestyle. These bonus programs are different for each insurance company but can for instance include bonuses for regularly doing sports and physical activities, for non-smoking or a health-conscious behavior in general.

2.1.2 Alternative Medicine

Ever more people are interested in alternative medicine or natural medical treatments next to the standardized medical services. There are quite a lot of possible alternative medical treatments and offering services that include for example Ayurveda, homeopathic treatments, autohemotherapy, osteopathy and phototherapy can create a competitive advantage and fulfill the desire of a growing consumer group.

2.1.3 Dental Medicine

Additional Health Services in the area of dental health are mostly targeted towards partly or wholly cost-takeover by the health insurance company of professional tooth cleanings or being able to get dentures at a reduced cost.

2.1.4 Selective Tariffs and Other

A lot of health insurance companies are also offering selective tariffs. An example is that customers can receive a reimbursement of the expenses of one month if one does not visit the doctor for a complete year except for preventive check ups and early detection screenings.

Other extra services include for instance that insurance companies wholly or partly pay for vaccinations that are required for traveling to specific countries.

3. Theoretical Background

3.1 Mobile Health Applications

Mobile-health (mHealth) applications can be classified as a subset of electronic-health (eHealth) applications. Electronic-health applications are described as applications which offer the tools and communication channels which are used in professional healthcare settings, enabling the practice of electronic health (Liu et al, 2011). EHealth has been said to be a key part of enabling a patient oriented, efficient and and economical future for the health insurance system (Knöppler et al., 2016). mHealth can be characterized as an overall term for the "areas of networking, mobile computing, medical sensors and other communications technologies within healthcare" (Liu et at. 2011, p. 2022). In line with the research question, this paper will however only focus on mobile health applications that are targeted for private use on smart phones and/or tablet computers and are targeted for both healthy people as well as patients.

Mobile applications that are designed around user health and fitness are booming. In fact, a review of the literature by Riley et al. (2011) have worked out four main fields of health behavior areas, namely (1) smoking cessation, (2) weight loss, diet and physical activity, (3) treatment adherence and (4) chronic disease management where mobile technology has been used. Fiordelli et al. (2013) have also conducted a literature review to explore the impact and outcomes of mobile devices on health. They filtered out that the main area within the literature they observed is chronic conditions such as diabetes which is followed by prevention and well-being and acute conditions. Moreover, seven non mutually exclusive mobile features could be identified within Fiordelli et al.'s (2013) research, namely text messaging, voice messaging, video messaging, multimedia messaging, ad hoc developed features for certain conditions, external sensors and native applications.

The fact that mobile devices, especially mobile phones are "personal, intelligent, connected, and always with people" provides a large advantage within their use in health care (Fiordelli, Divani and Schulz, 2013). Moreover, the literature suggests that there are certain features that constitute the field of mobile health monitoring applications. Triantafyllidis et al. (2015) for instance have presented three areas within personalized health status monitoring, videlicet mobile phone sensing, self-reporting and social sharing of health information. The first area, mobile phone sensing describes the ability to sense health data through the mobile phones internal and / or external sensors (Triantafyllidis et al. 2015). Modern smartphones are equipped with high technology features which enables the accessibility and generation of a variety of different data. Klasnja and Pratt (2012) describe that all large smartphone platforms such as iOS, Android and Windows Phone allow applications access to the phones hardware features such as the camera, microphone, accelerometers and the global positioning system (short GPS) through APIs. Via wireless technologies, such as Bluetooth, mobile applications can be additionally interconnected to external sensors that can measure further variables such as blood sugar level, blood oxygen level, heart rate, body temperature and many more (Gouidoux et al. 2014). Using these possibilities, and of course the Internet or Bluetooth, has allowed for the development of different types of mHealth applications suitable for different needs in different situations (Fiordelli et al. 2013, Triantafyllidis et al. 2015).

The second area, self-reporting is concerned with the manual gathering and registering of health data such as symptoms, problems, dietary or physical behavior and test results which are currently difficult to sense through sensors (Triantafyllidis et al. 2015). This presents another advantage of mobile health applications in that they enable and improve self-management which empowers the patients and allows them to actively engage in their medical path at low cost and right at the ir fingertips while at the same time increasing their quality of living by elevating mobility and independence (Lasierra et al., 2013). According to Klein et al. (2014) patient involvement as described above can improve patient adherence to the recommended therapy and can ultimately improve the patients overall health status. For this kind of approach to work successfully over the long run, it is however critical that mobile applications are also designed around changing a patient's perception of their disease as well as motivations and thinking to overcome the barriers that inhibit long-acting behavioral changes (Klein et al., 2014; Oinas-Kukkonen, 2013).

Thirdly, social sharing describes the sharing of personal health information with an online social network, doctors or other online communities. This online sharing of health data has proven to be effective in educating patients about their condition as well as promoting a change in health behavior by for instance discussing experiences, suggesting new ideas and providing emotional support (Triantafyllidis et al., 2015; Laranjo et al., 2015).

Building on the aforementioned information a variety of health applications have been designed. The following sections will provide a taxonomy of popular mobile health applications based around the design of the application. However, it has been noted by Triantafyllidis et al. (2015) that an application that integrates the three main areas is likely to be more accurate as applications that only integrate one of the three features.

3.1.1 Logbook of Health-related Data

The first category of mobile health apps can declassified under the idea of self-monitoring and can be seen as a logbook or journal in which the user records health and fitness related data such as physiological states and symptoms (Klasnja & Pratt, 2012). Tracking health information is said to have a positive influence on adopting „healthy" behaviors while at the same time decreasing the frequency of behavior patterns that are undesired (Kopp, 1988). Moreover, Klasnja and Pratt (2012) claim that studies have shown that self-monitoring can overall positively affect a user's health. Many applications are targeted around the tracking of physical activity or daily diet. However it is important to note that it has been proven that the provision of tailored feedback and nutritional information can increase effectiveness in terms of adherence and health benefits (Klein et al., 2014). MyFitnessPal and Lifesum are examples of health applications that help users in tracking their daily calorie intake. These apps are further providing additional information concerning micro nutritional information for each meal. RunTastic is an application that can be used to track the level of physical activity including running, hiking and biking. Often times applications can display the data in a way that unveils rends over time such as he Apple Application 'Health' which portrays results graphically to enable a quick comparison to the prior time period. Furthermore is the 'Health' App useful to track a large variety of other personal health-related data such as body fat percentage, body temperature, heart rate, weight, blood sugar levels and respiratory frequency. Other health applications that fit within this category are applications that can be used to document water intake and other lifestyle behavior and patterns that are regarded as healthy.

3.1.2 Health and Fitness Communities

Studies have found that a social network can have a positive impact on an individuals lifestyle and health-related choices (Consolvo, Everett, Smith and Landay, 2006). Consolvo et al. (2006) describe three types of social influences that affect the way that users are motivated, in particular social pressure, social support as well as being able to communicate about the data that is shared with peers. A lot of health applications are thus build around this positive influence of networks and communities and create an open environment where people that share the same health-related interest can communicate, motivate one another and exchange progress photos and tips. Freeletics, Weight Watchers and Pump Up are examples within this mobile health application group where users can share progress and motivate each other.

3.1.3 Informative Health Apps

A third category within the sector of mobile health applications are applications that are targeting at informing the user about health related topics or medical conditions. As the purpose is informative in nature, this kind of application will not generate customer-centric data which can be further analyzed and processed.

3.1.4 Reminders

Mobile Reminder Applications are utilizing the push intervention method to remind the user of certain events which can be for instance the intake of time-dependent medications and thus increasing the adherence to a medication schedule (Klasnja & Pratt, 2012). Other forms of reminder applications are apps that remind the user of adopting health beneficial behaviors such as water intake and reapplication of sunscreen depending on skin type and user location. Many other health applications also incorporate a reminding feature into their software which reminds users to regularly log for example their glucose levels for diabetes patients or nutritional consumption for individuals that are interested in their calorie intake (Klasnja & Pratt, 2012). Reminding applications can have a positive effect on adherence and lifestyle adaption but can also increase motivation (Curioso et al. 2012; Dennison, Morrison, Conway & Yardley, 2013). On the other side, obtrusive and very frequent reminders can build up aversion and dislike among users (Dennison et al., 2013). Furthermore it has been shown that generic reminders without specific medical advice are less efficient compared to reminders that are patient specific and at best even based on user data that is collected through sensors (Klein et al., 2014).

3.2   Big Data and Big Data Analytics

The topic of Big Data has already been shortly introduced in the introductory chapter of this paper however to answer the research question it is useful to enlighten this topic further. The term Big Data is most commonly used to indicate a massive amount of raw data which cannot be handled without the use of specific processing and analyzing tools. Raw data for Big Data Analytics can come from a variety of different sources such as Social Media usage, the Internet of Things such as wearable fitness trackers or the use of mobile applications on smart phones or tablet computers. For the scope of this research a focus is however laid on Big Data resulting from the use of mobile health applications also in combination with wearables or connected devices.

3.2.1 Classification of Big Data

According to Russom (2011), Big Data can be explained by three main characteristics which are Volume, Variety and Velocity. Volume represents the quantity of data. The increasing usage of different mediums such as health related applications as well as the digitalization of existing health care data is accountable for a growing volume of Big Data in the health care sector (Feldman, Martin & Skotnes, 2012). Data variety describes the nature of the data can be sub-classified into structured data, unstructured data or semi-structured data and data velocity can be explained as the speed of data with the sub-categories of batch, near time, real time and in streams. (Russom, 2011). Another advocate of the idea that Big data does not solely evolve around the size are Boyd and Crawford (2012) who define Big Data as an interplay of technology (maximizing computation power and algorithmic accuracy), analysis (drawing on large data sets to identify patterns) and mythology (the widespread belief that large data sets offer a higher form of intelligence) (p.663).

3.2.2 Collection of Big Data

One form of data can come from the build-in camera which almost all smartphones of today are equipped with. The camera feature can be accessed by mobile applications and can thus aid in collecting data that is connected to the user's health and physique (Klasnja & Pratt, 2012). Furthermore, through the access of applications to the mobile devices hardware features, geographic data can be used within applications which can provide insights about the user's covered distance and movement (Klasnja & Pratt, 2012). Another facet that constitutes to Big Data from Health Applications are connected devices or Wearables. The positive aspect of these devices is that they can automatically insert the generated data into the mobile application which can have a positive

effect on the adherence to the desired schedule or plan and reduce the possibility of errors from manual entering of the data (Klasnja & Pratt, 2012).

In relation to the aforementioned source of Data an additional source of data from mobile health apps are data which is entered by establishing information exchange through personal area networking such as Bluetooth. mHealth Applications can integrate data from devices that are equipped with personal area network capabilities such as "scales, blood pressure monitors, glucose meters, portable electrocardiograms […] and gym equipment" (Klasnja & Pratt, 2012, p. 186).

Data from mobile applications and wearables provides a quite different data set than data that is generated through Web 1.0 and Web 2.0 capabilities (Chen et al, 2012). Mobile and sensor-based data requires the needed analytical skills to analyze "highly mobile, location-aware, person-centered and context-relevant data".

3.2.3 Analysis of Big Data

Since Big Data is to a large extent defined by the volume and the complexity of the data sets, data is analyzed using data processing tools to make sense of the data and generate useful insights about customers. Data Analytics describes the technologies that are based on data mining and statistical analysis (Chen et al., 2012). Data from mobile applications and wearables require specific techniques that are able to process the complex data sets. Next to these technological capabilities an area of growing importance are also organizational skills which can build the foundation to successfully analyze big data (Fania & Miller, 2012). Researchers further argue towards the need for Data Scientists, professionals that have been trained to explore Big Data to find underlying business insights (Davenport & Patil, 2012). Compared to traditional analysts, Data Scientists can cope with the complex, unstructured and non-numeric data sets by applying for example machine-learning tools.

3.3 The Business Model Concept

Technology and new science by itself are not direct success factors for the creation of economic business outcomes or for the creation of customer value (Chesbrough, 2010). New technologies such as mobile applications and the analysis of the data generated from mobile applications have to be incorporated throughout all parts of a business (Johnson, Whittington & Scholes, 2011) This is where the concept of the business model comes into play. Since the introduction of the business model in 1975 the concept has especially in recent years created a lot of buzz (Bouwman, et al.,

2012). Scientific literature reveals that there are a variety of different definitions of the term, therefore some of these definitions will now be presented. Teece, (2010) states that a business model "articulates the logic and provides data and other evidence that demonstrates how a business creates and delivers value to customers" (p.173).

Within another definition the business model is described as a "system of interdependent activities that transcends the focal firms and spans its boundaries" (Zott & Amit, 2010; p. 216).

Even though the definitions differ in wording the essential message is that the business model describes how a specific organization "creates, delivers and captures value" (Osterwalder &Pigneur, 2010).

A critical aspect is the understanding of the positioning of the business model with regard to business strategy. The literature is drifting apart over this aspect in the way that some researchers are seeing no differentiation between business models and business strategy (Margretta, 2002; Al Morris, Schindehutte & Allen, 2005; and Burkhart, Krumeich, Werth & Loos, 2011). On the other hand, researchers are arguing that business models are the connecting link between business strategy and business processes indicating an interrelation between the three concepts (Al-Debei & Alison, 2010 and Osterwalder, Pigneur and Tucci, 2005). Within this view, the business strategy can be regarded as being at the highest level, concerning strategic aspects such as the organizational vision, goals and objectives whereas the business model reflects these strategic plans and business processes are concerned with the implementation of the strategic planning.

3.3.1 The Business Model Framework

The study within this thesis build upon the well known business model framework of Osterwalder et al (2005). Other models exist, however the framework of Osterwalder et al. (2005) is constructed on the basis of the most mentioned and most studied components of other models which indicates that all relevant aspects are combined within business model framework of Osterwalder et al. (2005). Using a synthesizing approach Osterwalder et al. (2005) concluded nine building blocks of the business model relating to 4 different pillars. Table 1 presents the nine building blocks in combination with the belonging pillars of Osterwalder et al.'s (2005) business model.

Pillar	Building Block	Short Description
Product	Value Proposition	Gives an overall view of a company's bundle of products and services.
Customer interface	Target Customer	Describes the segments of customers a company wants to offer value to.
	Distribution channel	Describes the various means of the company to get in touch with its customers.
	Relationship	Explains the kind of links a company establishes between itself and its different customer segments.
Infrastructure management	Value Configuration	Describes the arrangement of activities and resources.
	Core Competency	Outlines the competencies necessary to execute the company's business model.
	Partner Network	Portrays the network of cooperative agreements with other companies necessary to efficiently offer and customize value.
Financial Aspects	Cost Structure	Sums up the monetary consequences of the means employed in the business model.
	Revenue Model	Describes the way a company makes money through a variety of revenue flows.

Table 1: Osterwalder et al.'s (2005) nine business model building blocks.

3.3.2 Business Model Innovation

Academic literature implies that in order to create the most potential of a new technology it is relevant to find a way to incorporate the new technology into the business model as soon as possible as the technology cannot be used to its full capacity without a clear and fitting business model (Chesbrough, 2010). This results in the need to improve or to innovate the current business model to harness the new technology. New advances in the area of mobile devices, mobile applications, the Internet of Things, data collection and data analysis are a potential source of business model innovation. Business model innovation can be defined as re-innovating the current business model in such a way that improves the way of value creation, value delivery and capturing of value (Osterwalder, 2010). Another definitions comes from Souto (2015) who highlights that business

model innovation can be explained as "a new configuration of what is done in the company and how it is done, in order to provide a new value proposition to customers".

A downside of business model innovation is discussed by Chesbrough (2010) who claims that business model innovation can however be an extremely hard task and often includes a serials of trial and error runs. Osterwalder et al. (2005) further indicate that the business model is subject to a variety of different forces. These forces are classified into five subgroups, namely the social environment, the legal environment, competitive forces, customer demand and technological change. The force of technological change is especially important for the outline of this research as the potential of using data from mobile devices which is a technological development will be evaluated. Moreover, business model innovation on the basis of technology developments is discussed as the predominant type of business model innovation (Osterwalder, 2004; Teece, 2010).

3.4 App-enabled Business Value Creation

Previous sections have discussed the competitiveness of the German health insurance market. Within such an environment it is important to remain competitive by creating and providing value to customers. Mobile applications are able to achieve this need in that they offer new possibilities of value creation such as ensuring a firm's competitive advantage. (Ehrenhard, Wijnhoven, van den Broek & Zinck Stagno, 2017).

An important aspect to note is that mobile applications alone do not create business value but rather they create the interface through which consumers access a mobile service which can possibly present business value (Ehrenhard et al., 2017). However, in order to best exploit the potential of mobile apps it is crucial that the application is well developed and realized otherwise it can get lost in the large amount of other applications that are offered on the market (Ehrenhard et al., 2017).

Based on the Dynamic Capabilities Perspective and the Net Enabled Business Innovation Cycle Ehrenhard et al. (2017) have created a framework, the App-enabled business innovation cycle, short ABIC. The Dynamic Capabilities Perspective was first defined by Teece, Pisano and Shuen (1997) and describes the ability to constantly reconfigure internal and external resources and competences to create competitive advantage. The Net Enabled Business Innovation Cycle (NEBIC) by Wheeler (2002) is "an applied dynamic capabilities theory for measuring, predicting, and understanding a firm's ability to create customer value through the business use of digital networks" (p. 125). According to Wheeler (2002) emerging technologies hold the potential to lead to economic opportunities that make for growth in terms of business innovation for the purpose of creating

customer value. An overview of the app-enabled business innovation cycle of Ehrenhard et al. (2017) can be found in Figure 1. Ehrenhard et al.'s (2017) framework focusses on value creation processes in the context of app-enabled start-ups. The value creation cycle is characterized through four capabilities, (1) choosing emerging/enabling technologies, (2) matching with economic opportunities, (3) executing business innovation for growth and (4) assessing customer value, which are interlinked through learning processes in order to strengthen each of the capabilities.

Each of the capabilities is linked to specific routines. The choosing capability includes routines that help in choosing emerging/enabling technologies. These routines cover choosing platforms for a certain functionality, choosing dominant platforms and choosing a platform that is compatible across all other platforms. The matching capability covers routines that include the continuous search for new and improved solutions, looking for novelties between enabling platforms and finding efficiencies by combining platforms. Automation of the value proposition, creation of flexibility and organizational agility as well as funding and monetization are routines of executing capabilities. Lastly, the assessing capabilities includes assessing (potential) customer value through customer interaction, customer review and customer analytics. It is also advisable to include customers early on in the process to increase product success and consequently business value.
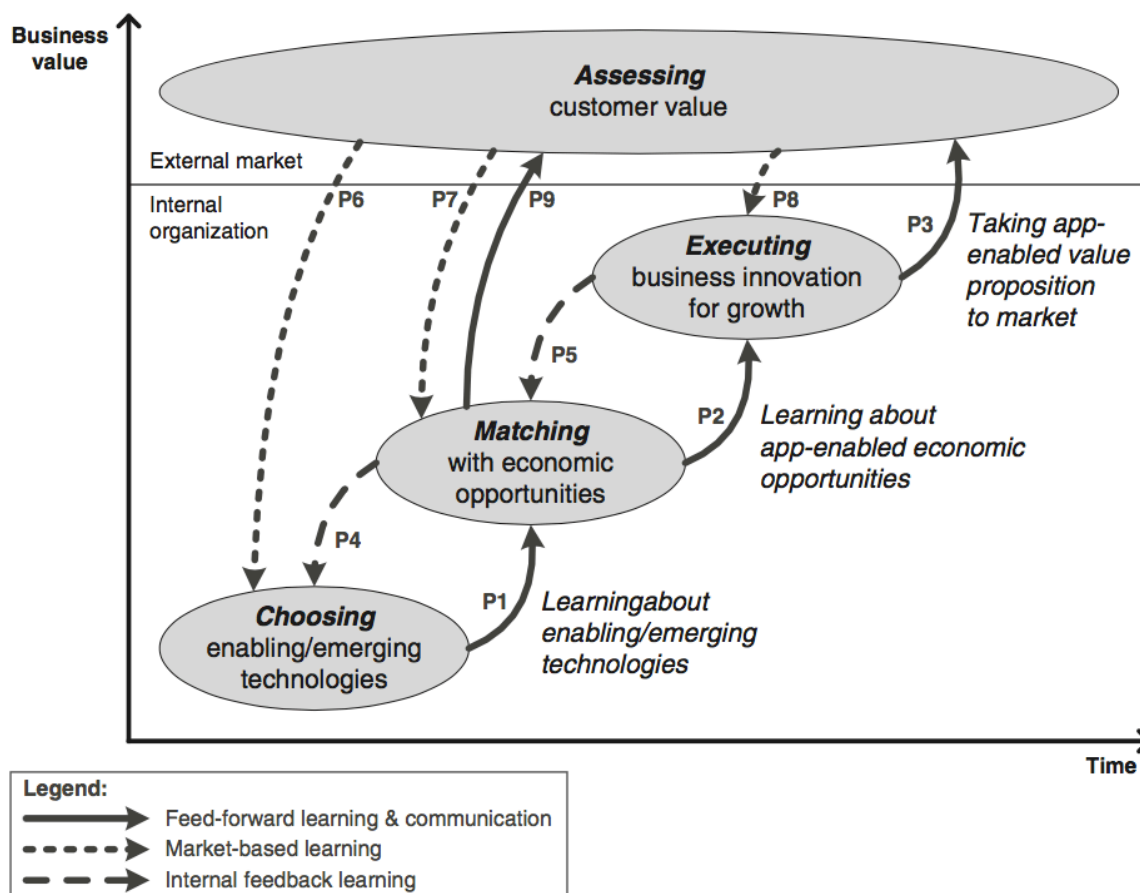
Figure 1: Ehrenhard et al.'s (2017) App-enabled Business Innovation Cycle.

The authors present four types of app-enabled business value, namely (1) strategic value, (2) informational value, (3) automational value and, lastly, (4) infrastructural value.

Strategic value is connected to transformational processes such as growth of sales, improved customer satisfaction or improved competitive capability. Informational value is associated with decision and control processes and involves the ability of IT to "collect, store, process, and distribute information (Ehrenhard et al. (2017, p. 29). Automational value is linked to operational process improvements by substituting labor with IT such as the communication with customers and decreasing delivery costs. And finally, infrastructural value is related to the IT-enabled supporting processes such as hardware, software, IT staff and maintenance of customer databases. Based on the case study data, the authors have linked the four capabilities with the four types of business value and worked out eleven app-enabled business value indicators. Table 2 displays the outcomes.

Capability	Choosing enabling platform ecosystems leads to	Matching enabling platforms to economic opportunities leads to	Executing business innovation for growth leads to	Assessing customer value leads to
Type of business value	Infrastructural value	Strategic value	(1) Automational value (2) Strategic value	Informational value
Business value indicators	• Reduced IT cost • Mitigation of privacy risks • Reduced distribution cost	• Improved product and/or service innovation • Strenghtened competitive capability	• (1) Reduced delivery cost • (1) Reduced transaction cost • (2) Supporting business growth • (2) Improved customer service and satisfaction	• Improved decision making • Improved market responsiveness

Table 2: From Ehrenhard et al. (2017) Business value indicators and dimensions from data linked to capabilities

3.5   Possibilities of Mobile Health Application

Consumers increased mobile health application usage potentially offers a variety of positive aspects to health insurance companies. The first positive aspect of data generated from Health Application usage is concerned with cost-effectiveness especially when the data is generated from in-house mobile applications. Klasnja and Pratt (2012) discuss that the main use of mobile applications by users is to track and monitor personal health-related data to create self-awareness of behavior patterns. The following subsections discuss how data from mobile health applications can provide advantages in terms of customer acquisition, customer retention and cost reduction.

3.5.1 Cost reduction

In section 2.1 a few of the main areas of statutory health insurance companies were introduced. In order to classify the role and potential of mobile health applications for health insurance companies the possibilities are explained within three of the main benefits offered by statutory health insurance. Again a large cost factor for health insurance companies are inpatient treatment, doctors fees and ambulant treatment. The first benefit is concerned with the prevention of diseases. Mobile health applications can be used as a motivational initiative to comply with the suggested amount of preventative check-ups such as prophylactic measures (Handel, 2011). Complying to the suggested preventive checkups can reduce the unnoticed development of severe diseases which is directly linked to the second main aspect, in particular early disease detection. Devices that track a users bio-signals can notice sudden changes and can serve as an early warning system for potentially critical health complications (Li & Guo, 2016).

Lastly, for the treatment of diseases. Data analysis can filter out which treatments are more efficient than others for a certain illness, which side effects are increasingly common for certain medications and other important information which can thus yield to a large cost reduction as it can be acted correctly much faster based upon the quicker insights.

Common widespread diseases in todays economy are for instance obesity and diabetes (Bradway, Arsand & Grøttland (2015). Handel (2011) describes that self-management practices and programs can trigger customers to keep working towards their fitness goals and learning new skills which will lead to long-term health and thus will eventually reduce costs of health insurance companies as these patients are potentially less likely to suffer from diseases that are provoked by obesity.

3.5.2 Customer retention and customer acquisition

Mobile health applications could potentially be useful within the retention and acquisition of customers in terms of analyzing a customers lifestyle to evaluate whether the customer pursues a healthy lifestyle including exercise, diet and nutrition and other factors. For statuary health insurance organizations the majority of offerings is fixed by law which leaves only little room for differentiation. However as explained in section 2.1, health insurance providers are able to offer additional services. Offering users that are active and regularly provide proof of their active lifestyle and behavior through mobile application usage additional perks could potentially result in the acquisition of new customers as well as retaining current customers. Another important aspect in the area of customer retention and customer acquisition is customer intimacy. Treacy and Wiersema (1993) discuss three value strategies, in particular operational excellence, customer intimacy and product leadership and argue that companies that have taken over superior positions within their industries have a more narrow business focus and concentrate on excelling at one of these value disciplines while at the same time reaching at least industry standards within the other two value disciplines. Operational excellence is about the supply of reliable and convenient products or services while leading the market in terms of pricing. Customer Intimacy is about precisely defining the targeted customer segment and offering a suited product or service, thus understanding its customers' needs and preferences. Lastly, the third value discipline, product leadership, is concerned with market leadership in terms of consistently supplying state-of-the-art products and services to customers.

A very important aspect within customer intimacy is in-depth customer knowledge as well as the ability to quickly respond to customer needs which has a great positive effect on customer loyalty (Treacy & Wiersema, 1993). Another characteristic of a customer intimacy strategy is the long-term view in terms of the customers lifetime value to the company and long-term relationships with the customer which can yield potential benefits for the company. Weinmann (2013) for instance claims that „deeper, longer-lasting customer relationships can mean greater revenue, higher customer lifetime value, lower relative customer acquisitions costs through lower churn and greater share of wallet". However, in order to build customer intimacy a certain level of trust and commitment is needed as a study shows that the level of commitment and interaction is influenced by the level of trust they have towards the service provider (Ponder, Holloway & Hansen, 2016). Yet customer trust does not automatically lead to loyal customers, rather this conversion requires intimacy building processes such as interactive communication as well as social bonds (Ponder et al., 2016)

In light of the digital revolution the economy is currently undergoing, Weinmann (2013) further argues that the era of Big Data augments customer intimacy towards collective intimacy, where as he states each relationship between a company and its customer is deepened by insights which are derived from all relationships. For insurance companies the collection and analysis of a multitude of data can potentially uncover underlying patterns and trends which can provide guidance in multiple cases such as individual as well as collective risk screening.

3.6   Limitations of Mobile Application Data

Next to the various possibilities coming from the use of customer data generated from mobile health apps for the health care sector quite a lot of negative concerns and challenges are discussed by researchers. By far the largest challenge is concerned with the topic of data security and privacy of sensitive customer data. Assuring the non-identifiability of health data is a very important factor which when being disregarded can act as a limiting factor in terms of technology acceptance (Nikayin, Heikkilä, de Reuver & Solaimani, 2014). In a focus group study, Dennison et al. (2013) have found that users have concerns about what happens to their data without their specific permission as well as discomfort about the possible privacy intrusion of context sensing features. It is furthermore argued that customers are having mixed opinions in that they understand that detailed individual information about them can be useful in a variety of ways and allows firms to offer matching solutions yet consumers are concerned about firms exploiting their personal data in unwanted ways (Akcura & Srinivasan, 2005). User acceptance is thus said to be an enabling factor when it comes to the potential analysis of customer health data as user acceptance is only achieved when data protection is functioning at a high standard. This is especially of interest in consideration with cyber-hacking or cyber crime which is an increasing area of concern especially as technology and hackers are evolving to become more sophisticated (Fania & Miller, 2012).

Ethical considerations are also a very challenging factor. The principle of granting supposedly fit and healthy customers a lower insurance premium or other benefits raises tremendous ethical concerns. The idea of this concept can be argued as being built upon the assumption that people with a certain level of weekly activity and with certain physical measurements are not the result of increasing health insurance costs. On the other hand this automatically signifies that people that are analyzed as being rather unhealthy are forcing up health insurance costs. Directly related to this is the fact that this would count as discrimination against a large group of potential customers which would have rather counter-effective results especially in light of the extreme competitive heath

insurance market. A negative aspect that is in particular of relevance for self-reporting type of health applications is that users need to stay active in inserting their data and using the application to provide data for analysis. Those patients that perceive smartphone usage per se as difficult might be prone to be less consistent with their submission of health information Triantafyllidis et al., 2015). Epstein, Siegel and Silberman (2008) furthermore discuss three main elements that are required for the principle of self-monitoring. These factors are motivation, attentiveness, curiosity and habits of mind. Another negative aspect is accuracy. Automatic pedometers for instance can falsely measure the steps that have been taken which in turn does not portray an accurate health behavior to the user and thus leads to false data analysis outputs. Furthermore, can miscalibrated devices or wearables lead to false data which can potentially have negative influence on the analysis of the data (Klasnja & Pratt, 2012). Low involvement of professionals in app development and low quality assuring measurements or certifications are further fueling the discussion of the quality of medical applications (Hussain et al. 2015). Lastly, the literature discusses the issue of trustworthiness of health information. Especially those pieces of information that are shared among online communities and on social media are seen as critical as this information is rarely verified by professionals and can thus lead to misinterpretations and dangerous outcomes (Triantafyllidis et al., 2015).

4. Research Methodology

4.1   Purpose of the Study

The topic of the thesis, the role of data from mobile health applications for Health Insurance Companies in Germany is a relatively recent topic which is why the purpose of the study is of explorative and descriptive nature. Exploratory studies are a typical research method when the topic under consideration is still quite new which is definitely the case with the research question at hand. Exploratory studies are often done for three main purposes, "(1) to satisfy the researcher's curiosity and desire for better understanding, (2) to test the feasibility of undertaking a more extensive study, and (3) to develop the methods to be employed in any subsequent study" (Babbie, 2010; p.92). In a descriptive survey the researcher's aim is to observe and later on describe what has been observed (Babbie, 2010). The units of analysis within this study are German Health Insurance companies and the way these health insurance companies can make use of mobile health applications for business model innovation and creating customer value. Since companies cannot be surveyed as a whole, the

units of analysis are observed indirectly by surveying employers working for the companies that are knowledgeable about the topic. These employees are then categorized as the units of observation and will act as the study population which is the collection of elements from which the study sample is chosen.

4.2   Research Design

Survey research is used to collect information from a sample of individuals with the use of questionnaires. A positive aspect of survey research is that a variety of different conclusions can be drawn (Babbie, 2010) which, in light of the circumstance that the research topic is relatively new and a variety of insights can be illuminated, is quite beneficial. Groves (1989) discusses that in order for a survey to be successful the risk of two types of error must be minimized, namely the errors of observation and the errors of non observation. Errors of observation could potentially come from the construction of the questionnaire such as the way the questions are formulated or how they are presented and the respondents personality traits. Errors of non observation are however concerned with the sample that is chosen for the research. Therefore problems can arise from a poor sampling frame, sampling error and non-response of respondents. These types of errors can result in a decreased generalizability of the results. Detailed information on the selected method of data collection is given in the following section.

4.3   Method of Data Collection

Data collection will be carried out by following the survey research method of a pre-constructed questionnaire. This implies that a standardized questionnaire is created. Babbie (2010) explains that questionnaires can be defined as "an instrument, specifically designed to elicit information that will be useful for analysis" (p.255). In constructing a questionnaire a variety of aspects need to be considered, which include the style of posing questions, as well as including only questions that are of relevance for the research objective, the general format of the questionnaire and the order of the questions (Babbie, 2010). Table 3 shows the argumentations for posing each of the questions within the questionnaire. The next crucial step is to pre-test the standardized questionnaire to eliminate the possibility of construction error as much as possible. Questionnaire pre-tests can ensure that the standardized questionnaire is well-constructed and valid. This will also assure that respondents are able to clearly understand what is meant by each of the questions and make sure that respondents are able to answer in such a manner that will be beneficial to the research intention.

As author of the thesis I might be anticipating certain outcomes and thus could unintentionally pose questions in a biased manner. To ensure that the questions of the questionnaire are unbiased the questionnaire is additionally tested among unbiased individuals.

The website www.enquete.com is used to create and administer the questionnaire. The website is easy to use and allows the gathered data to be exported to SPSS. The following link together with a short message explaining the authors background and the intention of this study was sent out to potential respondents: http://www.enquete.com/show?id=73F50959103BE70F2088B780705A73F5. As the standardized questionnaire was then sent out to respondents electronically and is thus a self-administered questionnaire. The questionnaire was sent out in German language as the research is targeting German health insurance firms. Using a survey which is in the German language might decrease any mistakes by lowering understanding errors based on language difficulties.

A short introduction to the research will provide respondents with the necessary informations they need to answer the questions correctly without however creating bias among respondents. Also, the respondents receive basic instructions for the completion of the questionnaire which can be additionally useful according to Babbie (2010). Respondents are informed that personal data entered in the questionnaire will be kept confidential which can positively enhance the response rate. On top of that, in order to further increase the response rate a reminding message was sent out to respondents that have not reacted to the initial message within three to four weeks.

Questionnaire Question	Argumentation
Part 1: General questions about the firm and the insurance industry market	
What is the name of the health insurance company that you work for?	General information about the company that the interviewee works for
What is your position within your organization?	General information about the interviewee
Does your company offer statutory or private health insurance?	General information about the company that the interviewee works for
How would you assess the competitiveness within the health insurance market?	General Information to assess and reassure the literature that the competition among health insurance companies is quite fierce
Part 2: Questions about mobile health applications	
Does your company offer one or more health-related apps?	General information about the company that the interviewee works for

What kind of mobile health application does your company offer? Please describe shortly!	General information about the company that the interviewee works for
Does your company plan to offer a mobile health application in the future? If not: why not?	Growing digitalization of the health care system. Mobile applications designed around user health are booming. Riley et al.(2011) present 4 health behavior areas where mobile technology has been studied. Will the health care firm use apps in the future and what are their decisions against mobile apps (thus also asking for limitations)
In which category would you classify the mobile health applications that your organization employs or plans to employ?	Triantafyllidis et al. 2015 describe three main areas of personalized health monitoring monitoring (mobile phone sensing, self-reporting & social sharing); 4 proposed categories of health apps based on Klasnja & Pratt (2012) and based on what types of health insurance health apps could be found within Apple's app store
Part 3: Questions about cost reduction	
How do you assess the potential of health-related mobile apps to assist in the early detection of diseases?	Current evidence suggests that the use of mobile technology can improve diagnosis and compliance with treatment guidelines, as well as patient information, and can increase administrative efficiency (Fiordelli et al., 2013) Devices that track a users bio-signals can notice sudden changes and can serve as an early warning system for potentially critical health complications (Li & Guo, 2016)
How do you assess the potential of health-related mobile apps to support treatment of diseases?	Current evidence suggests that the use of mobile technology can improve diagnosis and compliance with treatment guidelines, as well as patient information, and can increase administrative efficiency (Fiordelli et al., 2013); This type of telemedicine system guarantees patient supervision while reducing costs (enabling more autonomous patient care and avoiding hospital overflows) (Lasierra et al. 2013)
How do you assess the potential of health-related mobile apps to prevent diseases, especially widespread diseases such as obesity and diabetes?	The main use of mobile applications by users is to track and monitor personal health-related data to create self-awareness of behavior patterns (Klasnja & Pratt, 2012); Self-management practices and programs can trigger customers to keep working towards their fitness goals and learning new skills which will lead to long-term health and thus will eventually reduce costs of health insurance companies as these patients are potentially less likely to suffer from diseases that are provoked by obesity (Handel, 2011)
How do you assess the potential of health-related mobile apps to enable compliance to suggested preventative check-ups?	Mobile health applications can be used as a motivational initiative to comply with the suggested amount of preventative check-ups such as prophylacxis (Handel, 2011)
How do you assess the relationship between preventative check-ups and early detection of diseases?	Complying to the suggested preventive checkups can reduce the unnoticed development of severe diseases which is linked to early disease detection.

How do you assess the motivational potential of health-related mobile apps to follow a healthier lifestyle?	The main use of mobile applications by users is to track and monitor personal health-related data to create self-awareness of behavior patterns (Klasnja & Pratt, 2012); Self-management practices and programs can trigger customers to keep working towards their fitness goals and learning new skills which will lead to long-term health and thus will eventually reduce costs of health insurance companies as these patients are potentially less likely to suffer from diseases that are provoked by obesity (Handel, 2011)
How you you assess the potential of health-related apps in reducing administrative costs through possible digital business processes?	Current evidence suggests that the use of mobile technology […]can increase administrative efficiency (Fiordelli et al., 2013)
Part 4: Questions about customer retention	
How do you assess the impact of health-related mobile apps on customer retention?	Offering users that are active and regularly provide proof of their active lifestyle and behavior through mobile application usage additional perks could potentially result in the acquisition of new customers as well as retaining current customers.
How do you assess the influence of health-related mobile apps on the ability to influence customer relations?	Each relationship between a company and its customer is deepened by insights which are derived from all relationships. (Weinmann, 2013)
How do you assess the ability to detect underlying health related trends in big data sets?	The collection and analysis of a multitude of data can potentially uncover underlying patterns and trends which can provide guidance in multiple cases such as individual as well as collective risk screening.
If your company offers a health-related mobile app, how would you assess the impact of that app on customer retention?	Asking for previous perceptions of whether health-related apps have had an impact on customer retention
How do you assess the impact of customer benefit established though health-related mobile apps on customer retention?	
Part 5: Questions about customer acquisition	
How do you assess the impact of customer knowledge on providing targeted offers to customers?	A very important aspect within customer intimacy is in-depth customer knowledge as well as the ability to quickly respond to customer needs which has a great positive effect on customer loyalty (Treacy & Wiersema, 1993)
How do you assess the impact of health-related mobile apps to offer more targeted options to customers?	Health related apps offer a lot of in-depth customer knowledge which could be used to create targeted options.
How do you assess the influence of health-related mobile apps on building deeper and longer lasting customer relationships?	A very important aspect within customer intimacy is in-depth customer knowledge as well as the ability to quickly respond to customer needs which has a great positive effect on customer loyalty (Treacy & Wiersema, 1993)

How do you assess the interest of customers to use health-related mobile apps from health insurance companies?	Asking for an opinion on the general willingness of customers to use health apps from insurance companies
Part 6: Final Questions	
Do you have additional comments or remarks concerning this study?	General question to get additional information and feedback from interviewee

Table 3: Argumentation for questionnaire questions.

4.4 Sampling

As previously mentioned, the study population consists of everyone that has knowledge in the research area of health-related mobile applications and their potential effects on health insurance companies. In order to reach out to possible respondents of the questionnaire, a German business networking site was used. This approach was selected as it bypasses several negative aspects of other methods in that for instance the direct contact to highly knowledgeable employees of health insurance companies within the topic of interest could be established.This approach does have a downside in particular that one is limited to 20 messages that can be sent out to non-contacts per month. 4 premium accounts have been created to reach a larger amount of possible respondents. Knowledgeable respondents were selected based on their job description, prior employments and interest in the field of digitalization and mobile applications. The business networking site that was used to select the most fitting respondents was the German site www.xing.de. The decision for this German business networking site was based on the circumstance that this research focusses on the German health insurance industry. Approximately 200 employees of different health insurance companies are contacted directly via a personal message on the business networking site. This included employees from statutory as well as private health insurance companies. Additionally, one respondent offered to help out by sharing the message with his network of people which included around 450 further contacts that could potentially see the survey request. However not all of those 450 contacts work for health insurance companies. Looking at the job descriptions of this 450 contacts, around 116 people do actually work for health insurance providers which would have been part of the population of this study. Adding up all these numbers results in approximately 316 contacted people, 44 respondents have filled out the questionnaire which leaves a response rate of 13,92 percent. However six responses have to be excluded from the analysis due to several reasons that will be explained in more detail in section 5.1. The response rate thus decreases from 13,92 percent to 12,03 percent.

4.5   Data analysis

The next step is to analyze the data that has been provided through the electronic questionnaire. In order to allow for qualitative assessment in terms of how data from mobile health applications can enable business development the data generated from the surveys is then analyzed among certain aspects. The questionnaire starts with general questions concerning the respondent personally and the health insurance company that he/she works for. This also included questions concerning the current situation of whether the company offers one or more health applications and whether the firm plans to offer health apps in the future. To give an overview of the sample and an idea of the current situation the first section of chapter five (Section 5.1) will therefore concentrate on analyzing this general information. The main part of data analysis is however concerned with finding an overarching construct within the data in order to answer the research question. This will be investigated in section 5.2. For this analysis the statistical analysis program SPSS version 23 will be used. Based on the literature it can be assumed that there is a correlation between the provision of health applications and business value. In order to find correlating aspects within the survey data an exploratory factory analysis will be conducted. Exploratory factory analysis is an interdependence technique with the purpose of finding and defining an underlying structure among the variables in the collected data (Hair, Black, Babin & Anderson, 2010). Hair et al. (2010) further explain that common factor analysis also known as principal axis factoring is more appropriate when the researcher aims to theoretically explore an underlying factor structure.

For the purpose of performing a common factor analysis, the data that is to be analyzed should meet two principles, in particular an appropriate sample size and a sufficient correlation between the variables. Considering sample size, it is a general rule of thumb that the larger the sample size, the more reliable the results. According to Hair et al. (2010) the rough guideline is that there are around four to five times as many observations as there are variables. As the sample size in this case is very small the interpretation of findings has to be made with caution. The second aspect to consider before conducting a factor analysis is that of intercorrelation. A variety of measures are available to assist in ensuring intercorrelation between the variables. One of them being the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy.   The value of the KMO ranges from 0 to 1, however a KMO value of higher than 0,50 is advised for proceeding with the factor analysis. Another useful statistic is the Bartlett's Test of Sphericity. It tests for the existence of correlations among the variables. A significance of lower than 0.05 is recommended. SPSS is appointed to suppress factor loadings lower than .40 so that only significant fa Furthermore, only factors with an Eigenvalue

over 1 will be used for further analysis. The factors that are provided with the use of common factor analysis will then be investigated with the Cronbach's Alpha, which measures the internal consistency of the factors. Section 5.3 will look into analyzing whether there are variations between different groups of respondents. In order to compare means the analysis of variance (ANOVA) method is used. The following segmentation variables are used to explore whether there are differences in responses among groups of respondents.

- Does your company offer statutory or private health insurance?
- How would you assess the competitiveness within the health insurance market?
- Does your company offer one or more health-related mobile applications?
- Does your company plan to offer a mobile health-related application in the future?
- In which category would you classify the mobile health applications that your organization employs or plans to employ?

4.6   Reliability and Validity

Reliability is the idea that "a particular technique, applied repeatedly to the same object, yields the same results each time" (Babbie, 2010, p.150). The extent of this research only allows for a one-time observation which means that it will be impossible within the scope of this thesis to test whether repeated application would generate the same outcomes every time. One form of enabling reliability is by providing respondents the option of keeping data anonymous which can enhance the willingness to share sensitive information which will in turn increase reliability of the research. Pre-testing the questionnaire before sending it to the actual sample respondents can also yield a higher rate of reliability. Through these measures it was tried to make the research as reliable as possible.

The second measure of quality is validity. Validity is concerned with "the extent to which an empirical measure adequately reflects the real meaning of the concept under consideration" (Babbie, 2010, p.153).

5. Results

5.1 Analysis of the sample and the current status concerning Mobile Health Applications across the sample

The first part of the analysis will resolve around the participants and their companies to summarize and give an overview of the participating sample. 44 participants started the questionnaire however five out of those 44 failed to complete the survey which results in 39 completed surveys and a completion rate of 88.6 percent. The five unfinished responses are left out of the further analysis.
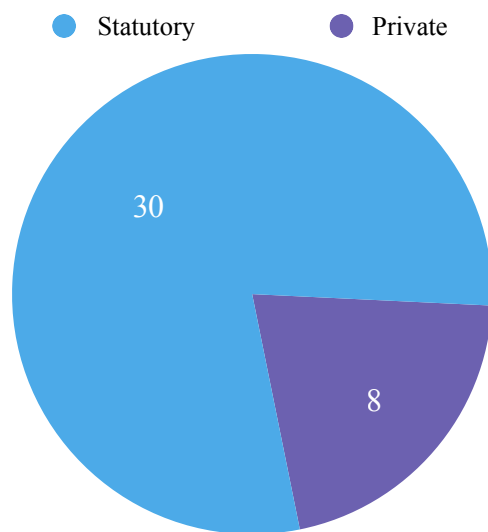
Figure 2: Distribution of survey participants from statutory and private health insurance.

One out of the 39 respondents is working for a Swiss-based insurance company called SWICA and is also disregarded from further analysis as this research is focussed on the German health insurance market. Ultimately a total of 38 respondents have successfully completed the survey. Out of these 38 respondents, 30 are employed by a health insurance company that offers statutory health insurance and eight are employed by a private health insurance company which results in a percentage of 78,95 percent of respondents working for a statutory health insurance company and 21,05 percent of respondents working for a private health insurance company. Appendix C shows a list of the participating health insurance companies along with information about whether the health insurance company offers statutory or private health insurance as well as the positions of respondents within their health insurance companies.

Section 2.1 discussed the high intensity of competition within the health insurance market in Germany. Table 4 shows the results of the questionnaire regarding this topic. The results prove that most of the participants perceive the competition among health insurance companies as being high although around 34% believe that the competition is average.

As far as mobile health application provision currently goes, slightly more than half of the respondents (in particular 20 respondents) have stated that the company for which they work for is currently not offering a health-related mobile application. Of those 20 respondents that claim that

Level of insustry competitiveness	Statutory health insurance	Private health insurance	Total
Low	0	0	0
Average	11	2	13
High	19	6	25

Table 4: Perceptions of competitiveness for types of health insurance providers

their company does not offer a health-related mobile application, 15 work for a statutory health insurance provider and five work for a private health insurance provider. The remaining 18 respondents (47,37%) indicated that their company is currently offering at least one health-related mobile applications. Of those 18 respondents, 15 work for a statutory health insurance provider and three work for a private health insurance provider.

When asked about whether their health insurance company is planning on offering a health-related mobile application 28 respondents answered with yes and six respondents answered with no. Looking further into the numbers it becomes apparent that respondents whose companies currently offer at least one health-related application have also indicated that their company plans to implement health based applications in the future. In total out of the 28 respondents that stated that their company offers at least one health-related application 24 are respondents from statutory and four from private health insurance companies. In order to make a further distinction table 5 shows the answers of the respondents that have said that their company does not offer at least one health based application so far on whether their company plans to offer a health-related application in the future. Respondents that answered with no were additionally asked to give an indication as to why their employer does not plan to offer health-related applications in the future. Five respondents have explained why their company does not plan to offer one or more health apps. The answers reach from negative opinions such as "we deployed an application but discontinued it", "still indecisive regarding a useful utilization" over "still uncertain" to more positive answers such as "probably!" and "application for invoices".

	Statutory health insurance	Private health insurance
Plans to offer a health app in the future	11	2
Does not plan to offer a health app in the future	3	3

Table 5: Distinction between statutory and private health insurance firms as to whether they plan to offer health apps in the future (if they have no current application)

From figure 3 it becomes obvious that among the sample of this study informative health apps are the most common health related applications that health insurance companies are currently providing. Excluding the category of ‚others' the next most common forms of mobile applications that health insurance providers are offering are apps where users can log health and fitness related data in form of a journal or diary and apps that remind users for instance to take medications or of upcoming preventative check-ups. Table 6 shows the answers of respondents to the request of naming "other" applications that would not fit within the given taxonomy of health apps. Looking at the answers it becomes apparent that a lot of apps by health insurance companies revolve around providing a more simple, fast and convenient service for customers such as submission of invoices and other documents as well as a way to enable communication with the insurance provider. In fact most of the four respondents from private health insurance companies that answered "other" have said that their company offers an app that revolves around digital processes such as invoice upload.
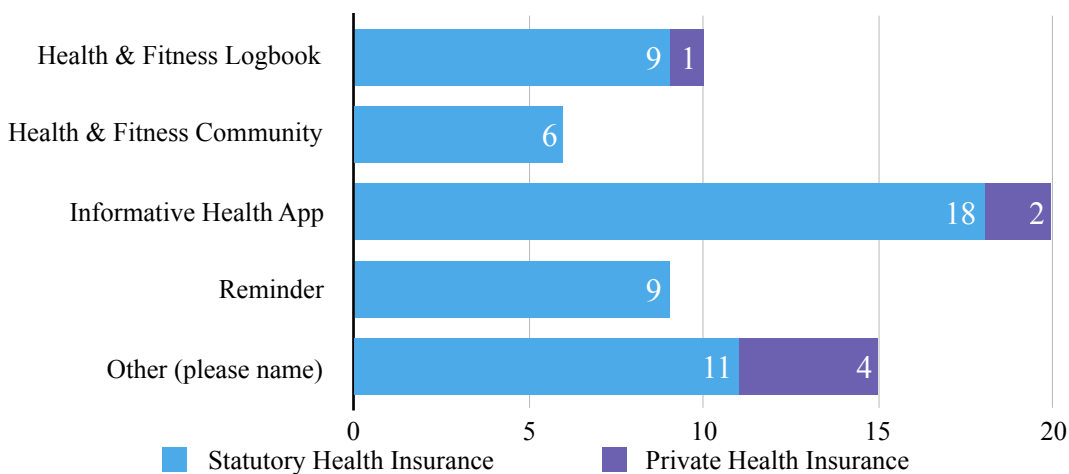

Figure 3: Distribution of mobile applications that are currently deployed by health insurance companies.

Noch in der Ideenphase	Still in idea phase
Rechnungs App; digitale Einreichung von Rechnungen	Invoice application; digital submission of invoices
Service App zur Einreichung von Arbeitsunfähigkeitsbescheinigungen, Dokumente und Rechnungen (Fotofunktion)	Service app for submission of certificates of disability, documents and invoices (photo feature)
Zur besseren Versorgung	For better care
Service App	Service app
App für Dienstleistungen im Zusammenhang mit der Krankenversicherung	App for services connected with health insurance
Kommunikation mit der BKK (datengesichert)	Communication with the BKK (data protection)
Kundenbeziehungs-App	Customer relationship app
Alternative z.B. Hausmittel	Alternatives for instance home remedies
Gesundheits- und Versorgungssteuerung	Health and care governance
Daten-Uploads (Arbeitsunfähigkeitsbescheinigung etc.)	Data Uploads (certificate of disability etc.)
Digitale Prozessunterstützung	Digital process support

Table 6: Additional written answers to question 8 in both German and English.

5.2 Analysis of potential positive outcomes of providing health-related mobile applications

The second part of the analysis revolves around the possible business value that health insurance firms can potentially attain through the deployment of health-related mobile apps. In the survey respondents were asked to answer questions about the possible influence of mobile health apps on aspects such as cost reduction, customer retention and customer acquisition. The following section will discuss the statistical results.

Figure 4 shows the percentage composition of all responses to the questions that are covering the topic of potential positive business outcomes. In order to find an overarching structure within the data a common factor analysis was conducted. The Kaiser-Meyer-Olkin score for this sample is 0.690 which is according to Hair et al. (2010) a mediocre yet acceptable value. The score for

Bartlett's Test of Sphericity ($\chi 2$=311.018; DF=120; p<0.001) is significant, meaning that the correlation is high enough to continue with the factor analysis.
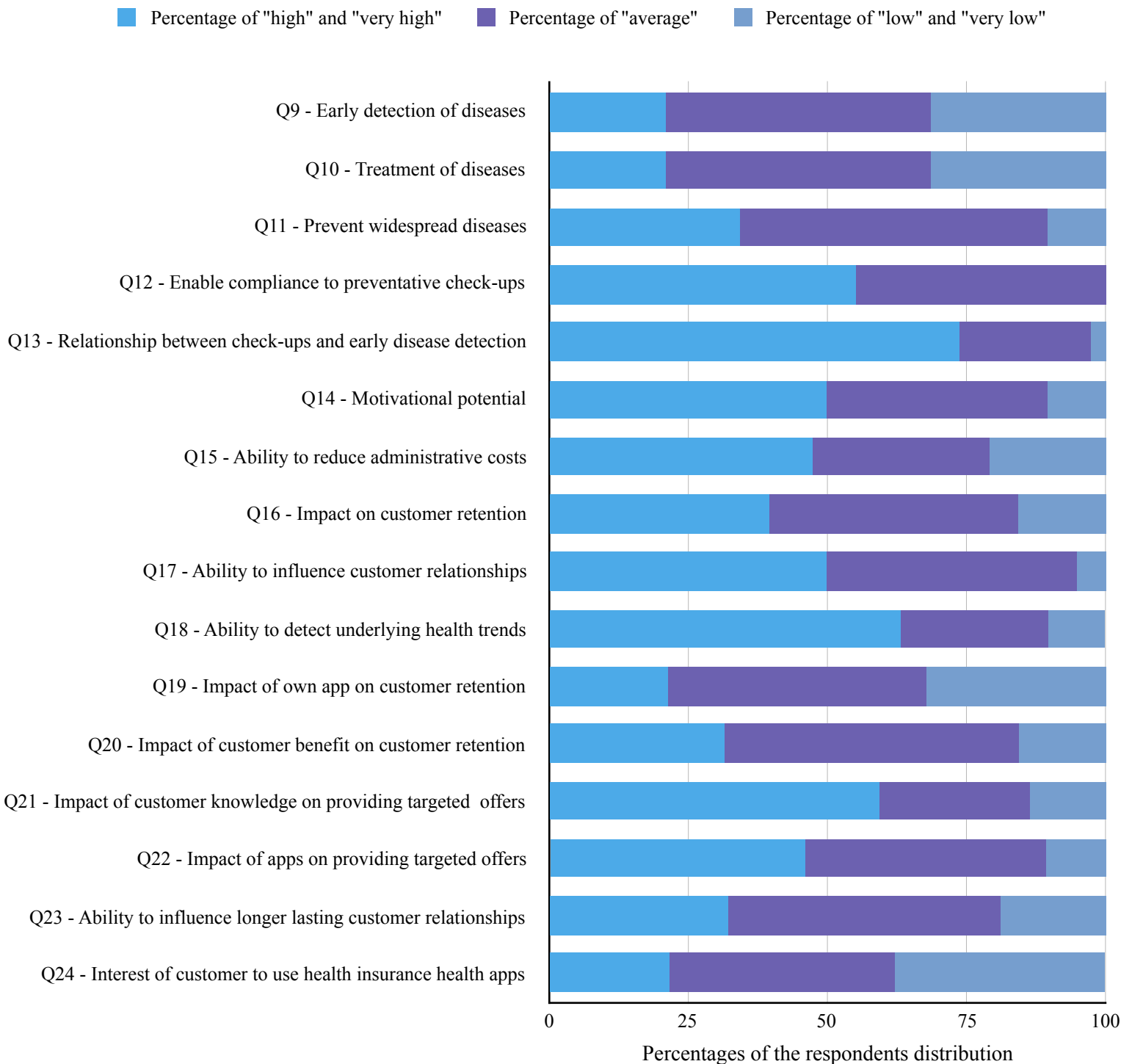

Figure 4: Distribution on a percentage basis of respondents answers to questions 9 through 24.

	Factor			
	1	2	3	4
Influence of your firms app on customer retention	.882			
Influence of health apps on customer retention	.847			
Influence of health apps on building deeper and longer lasting customer relationships	.847			
Influence of customer benefit enabled through health apps on customer retention	.785			
Influence of health apps on customer relationships	.548			
Potential of health apps in reducing administrative costs through digital business processes	.548			
Potential of health apps in enabling compliance to suggested preventative check-ups	.480			
Potential of health apps in treatment of diseases		.701		
Potential of health apps on the provision of targeted customer offers		.683		
Potential of health apps to prevent widespread diseases		.551		
Potential of health apps to detect diseases early		.477		
Ability to detect underlying health trends in big data sets			.867	
Influence of customer knowledge on provision of targeted customer offers			.703	
Influence of preventative check-ups on early disease detection				.791
Customer interest in using health insurance health apps				.621
Motivational potential of health apps to follow a healthier lifestyle	.529			.561

Table 7: Common Factor Analysis results using Varimax rotation

The initial common factor analysis results in 4 components that have an eigenvalue of over 1. However there are several cross-loadings throughout the factor matrix which is why the factors are additionally rotated using Varimax rotation, an orthogonal rotation method. The resulting rotated factor matrix is portrayed in Table 7. There are still five cross-loadings however a general rule of thumb suggests that for smaller factor loadings to be significant a higher number of samples would

be needed. Again, in this case the sample is very small which means that the loadings lower than .5 are disregarded.

In a next step the Cronbach's alpha for each factor is calculated using SPSS. The complete results are presented in Appendix E. In general, for the interpretation of Cronbach' alpha it is said that an α score of higher than .7 is acceptable, higher than 0.8 is good and higher than .9 is excellent. α values that fall below that are questionable but can be included within exploratory factor analysis (> .6), poor (> .5) and unacceptable (< 0.5) (Hair et al., 2010).

Factor 1: 'Customer Retention'

The original Factor 1 consists of seven variables and covers 27,08% of variance. The highest factor loading is .882 and the lowest factor loading is .480 which is relatively low but the variable will remain included for now. The overarching topic of factor 1 is concerned with customer relationships and customer retention. The Cronbach's alpha for the first factor is 0.911 which is a quite good score. It can even be improved to 0.923 if the variable with the lowest score, namely 'Potential of health apps in enabling compliance to suggested preventative check-ups' is removed from the factor. Additionally looking at the commonalities of each of the variables of factor 1, two variables have low extracted communalities, therefore 'Potential of health apps in reducing administrative costs' is also removed from this factor. The new factor 1 now consists of five variables.

Factor 2: 'Targeted Customer Offering'

The second factor consists of four variables, 'Potential of health apps in treatment of diseases', 'Potential of health apps on the provision of targeted customer offers', 'Potential of health apps to prevent widespread diseases' and 'Potential of health apps to detect diseases early'. The value of Cronbach's Alpha is 0.724 and it is not increased through deletion of any variable. This factor explains 17,21% of total variance.

Factor 3: 'Big Data Possibilities'

The Cronbach's alpha for the third factor is .693 which is just around the cut off point of an acceptable alpha value. Due to the exploratory nature of this research it will be accepted but interpreted with caution. This factor consists of two variables 'Ability to detect underlying health trends in big data sets' and 'Influence of customer knowledge on provision of targeted customer

offers'. Both items are not directly linked to health apps however indicate what could be possible with Big Data potentially from mobile health applications. This factor explains 11,56% of variance.

Factor 4: 'App Use'

This factor consists of three variables which are difficult to interpret. The aspect of customer interest in using health apps by health insurance companies does not seem to fit with the other two variables which are concerned with the motivational potential of health apps to follow a healthier lifestyle as well as the influence of preventative check-ups on early disease detection. Moreover, the Cronbach's alpha value ($\alpha = .588$) is classified as poor. which indicates that this factor can be neglected. The original variance covered by this Factor is 10,70%.

The previous section has analyzed the survey data by conducting an exploratory factor analysis using SPSS with the purpose of revealing an underlying construct within the data. It has been shown that certain questions of the survey do cluster together. All of the four factors that were produced within the factor analysis are kept for further consideration. However a few variables have been excluded from the factors due to reasoning based on Conbach's alpha, low extracted communalities as well as content assessment. The resulting Factors can be seen in Table 8.

Factor 1: Customer Retention	Factor 2: Targeted Customer Offering	Factor 3: Big Data Possibilities	Factor 4: App Use
Influence of your firms app on customer retention	Potential of health apps in treatment of diseases	Ability to detect underlying health trends in big data sets	Influence of preventative check-ups on early disease detection
Influence of health apps on customer retention	Potential of health apps on the provision of targeted customer offers	Influence of customer knowledge on the provision of targeted customer offers	Customer interest in using health insurance apps
Influence of health apps on building deeper and longer lasting relationships	Potential of health apps to prevent widespread diseases		Motivational potential of health apps to follow a healthier lifestyle

Factor 1: Customer Retention	Factor 2: Targeted Customer Offering	Factor 3: Big Data Possibilities	Factor 4: App Use
Influence of customer benefit enabled through health apps on customer retention	Potential of health apps to detect diseases early		
Influence of health apps on customer relationships			

Table 8: Final factor composition

5.3 Analysis of variations between different groups of respondents

Four factors have been filtered out of the exploratory factor analysis in section 5.2. This subchapter discusses the significant relationships among the respondents answers, presented for each factor. Again, the segmentation variables are as follows:

- Does your company offer statutory or private health insurance?
- How would you assess the competitiveness within the health insurance market?
- Does your company offer one or more health-related mobile applications?
- Does your company plan to offer a mobile health-related application in the future?
- In which category would you classify the mobile health applications that your organization employs or plans to employ?

Factor 1: 'Customer Retention'

The first factor has an overall mean of 3.18 which means that the relationship between health applications and customer retention is regarded as being slightly higher than the middle option of 'average'. The questions 'influence of health apps on customer retention'$(F(1,36)=7.770, p=.008)$, 'influence of the firms own application on customer retention'$(F(1,26)=7.056, p=.013)$, 'influence of health apps on building deeper and longer lasting relationships' $(F(1,36)=5.851, p=.021)$, 'influence of customer benefit enabled through health apps on customer retention'$(F(1,36)=7.092, p=.012)$ and 'influence of health apps on customer relationships'$(F(1,36)=6.094, p=.018)$ have been answered significantly more optimistic by respondents that work for private health insurance providers. Moreover, respondents whose company currently offers a health and fitness community

application have answered on higher on the questions ''influence of health apps on building deeper and longer lasting relationships' (F(1,36)=5.955, p=.020) and 'influence of the firms own app on customer retention' (F(1,26)=7.056, p=.013).

Factor 2: 'Targeted Customer Offering'

The second factor has an overall mean of 3.14. This shows that respondents see a moderate potential in health apps in terms of treatment of diseases, prevention of widespread diseases, early disease detection and potential of provision of targeted offers.

Two significant relationships were found within this factor. Firstly, respondents who said that their company currently does not offer a health-related app see a lower potential of health apps in the provision of targeted offers (F(1,36)=5.531, p=.024). Secondly, respondents whose companies offer informative health apps perceive a lower potential of health apps in early disease detection (F(1,36)=5.158, p=.005).

Factor 3: 'Big Data Possibilities'

The overall mean of this factor lies at 3.60 which indicates that the questions within this factor have been answered on average more optimistically than average. This is potentially explainable as the questions within this factor are quite generic and it is a more widespread believe that big data can positively influence the questioned aspects. Respondents are more optimistic towards the underlying Big Data Possibilities provided through health apps. There is however no significant relationship found between the various answers within this factor.

Factor 4: 'App Use'

The last factor scores an average mean of 3.15. This indicates that there is a moderate acceptance of a customer interest in health apps from health insurance companies and a moderate acceptance of the motivational potential that can lie within health-related applications.

Two statistically significant relationships could be found. In particular, respondents whose company currently offers an application based around providing a health and fitness community see a higher motivational potential in health apps than other respondents (F(1,36)=6.475, p=.015). And furthermore, respondents whose firm currently offers informational applications signify a lower customer interest in health apps than other groups of respondents (F(1,36)=5.004, p=.032).

6. Discussion and recommendations

6.1   General Discussion

This chapter will discuss the results of the survey, the results of the statistical analysis and in how far recommendations can be built from these results. A good way to start the discussion is to revisit the initial subquestions of this research and answer them shortly. The first question „What are mobile Health Applications and what data is generated by them?" cannot be answered with a single answer. Mobile applications can come in a vast amount of different forms and thus create a variety of different data for health insurance firms. Based on the results it can be seen that the possible applications that are discussed in section 3.1 almost fully cover the applications that health insurance companies in Germany are currently providing. The results of the survey show that the prevailing mobile health application among the sample are informative applications. As informative health apps are used to inform the customer about for example the health insurance company, tariffs or bonus programs they do not generate much qualitative customer data. The second most chosen answer option was ‚other' for which most respondents then clarified that they offer service apps in which customers can easily communicate with the health care provider, send invoices or other paperwork digitally. The data that is generated by those applications is similar to what type of information health insurers are currently receiving from customers but rather digitalizes it. Another category of health-related apps is labeled health and fitness logbook. This provides highly valuable data for insurance companies about the individual customer, their exercise routines or nutritional habits. Health and fitness logbooks can however also include diaries in which customers enter and control possible side effects of medications, illness symptoms or allergy circles. This shows that the data generated by these apps is rich of different types of information. Another common health application provided by health insurance companies are reminders. These apps remind customers of medication intake or upcoming preventative check-ups or other doctors appointments. This also provides very personal data such as what medications someone is using and whether the person regularly goes to doctors appointments. The last and least often selected category of proposed health applications is the category of health and fitness community. This includes applications in which customers can engage among each other to give certain impulses, motivate and discuss. This form of health application also provides very personal information but this information might not be as rich of valuable information alone as other type of applications but rather more in combination with for instance a health and fitness logbook.

The second subquestion asked for how data from mobile health applications can be useful for health insurance companies. The results of the survey show that the assumption that health insurance companies can detect underlying trends and coherences within large data sets hold true for the sample of this survey. This is because the majority of respondents, in particular 24 and thus 63,16 percent, believe that large data sets can be used to detect hidden trends within data sets. For the future this could generate tremendously large new insights if health insurers could spot relations between different aspects such as for example complications or outcomes due to the synergy of different medications sooner rather than later. Looking at the entirety of customer data not at the data of a single individual can enable the detection of hidden patterns and lead to new medical insights. One respondent also included the fact that health apps can be helpful in collecting large amounts of data for research and patient inquiries which in turn will evoke health-related information useful for the collectivity of customers.

Thirdly, the question „how do mobile health-related applications relate to business model innovation?". In light of the high competitiveness within the German health insurance market there seems to be the need to differentiate oneself from other health insurance providers. As described in paragraph 3.3.2 business model innovation can be a way to achieve this differentiation. Health-related mobile applications offer a way to innovate the business model in that they offer new forms of generating customer value and increasing customer relationships with specific service applications. In particular, this means that the customer segments have to be reevaluated in order to target the mobile offerings as best as possible. Even though nowadays smartphones are omnipresent and spread across all age ranges it can be assumed that a specific age range fits better than another due to the fact that for a lot of elderly people the continuous use of smart phone technology for various aspects might be a burden or strenuous. A customer segment that is assumed to be to a large amount willing to accept health insurance health apps is the range of 20-60. Based on the segmentation of customers it is important for health insurance companies to think of the type of relationship that each customer segment is expecting. Those that fall within the range of accepting and being potentially interested in using health-related apps from health insurance companies might be willing to have a closer relationship with their insurance provider in order to attain other positive outcomes such as more targeted offers based on their acceptance to analyze data for underlying trends. Another aspect is that a lot of people are already using such health-related applications. Providing a holistic application that incorporates various aspects from documenting health data, to

being reminded of health-related events or tasks to being able to submit documents digitally etc. holds a large amount of customer value.

The responses to question 20 have revealed that even though most respondents have chosen for an average impact of enabled customer value through mobile health applications on customer retention, 12 respondents have indicated that the impact could be higher which slightly supports the idea that the business model can be innovated in terms of providing a new customer benefit. There is however also a negative side to this idea. One respondent has pointed out that mobile health-related apps are most likely coming and going comparable to marketing trends. Another respondent has indicated that mobile health-related applications are somewhat interchangeable once these applications achieve the stage of market penetration. Thus it is extremely important for health insurance firms to create a coherent digital strategy and position oneself in the market with this strategy concerning both the service sector and the care sector. This is where the app-enabled business innovation cycle becomes relevant. This framework describes the way in which business value can be created through four linked dynamic capabilities. For health insurance companies this would be as follows. First it would be important to chose for an enabling technology such as mobile technology as well as the operating and distribution platforms which can help in creating value. The outcomes of the choosing capability are then used for the matching capability. Based on learning from the first capability a health insurance company now looks into what kind of economic opportunities can be achieved. This includes aspects from business model innovation as it is concerned with what can be done different to provide a better solution to the customer segment. A holistic application which covers multiple aspects of the various types of health apps could be a way to differentiate oneself from other health insurance firms. The next capability is the executing capability which focuses on the execution of the designed plan to achieve business value. In the case of this research this means that resources are used to develop the idea into a product. This can be done for instance in-house or the insurance company collaborates with a technology firm that is specified in apps. Once the application is finalized it can be taken to the market to be assessed by the target market. Furthermore it is crucial that health insurance companies are constantly learning from the market and that knowledge from the market is incorporated within each step of the circle in order to constantly be able to provide what customers need. Health insurance companies can track the customer value by engaging with customers to find out what their needs are, analyze reviews and feedback that is provided on the distribution platforms or analyze the number of

downloads and the general customer behavior to identify which aspects are used more commonly and where improvements can be made.

 All of the four capabilities are seen as a circular evolution based on learning and feedback between each of the capabilities. It is therefor important for health insurance firms to constantly provide feedback and rethink the options in order to generate business value.

The next subquestion was „what possibilities for health insurance companies exist from Mobile Health Applications?". (Note: This paragraph looks only into the responses from the questionnaire. The following section, section 6.2 discusses the possibilities on a statistical basis). In order to answer this question it is interesting to take a closer look at the responses where the answer option ‚average' was not selected most commonly. The first case was question 12 which indicates that health-apps have a large potential in increasing coherence to suggested preventative check-ups. This is further supported by an answer to question 25 where one respondent states that the value for insurant and insurer lies mainly in the following aspects, increasing compliance during chronic diseases in terms of support within disease management programs as well as reminding patients of preventative and other check-ups. The responses to question 13 show that there is a high belief that preventative check-ups are related to the early detection of diseases. Another question which highlights the possibilities of health-related applications is question 14 regarding the motivational potential of health apps to follow a healthier lifestyle. The prevailing answer was that health-related applications do have a motivating potential to follow a healthier lifestyle. All of the above mentioned aspects can potentially decrease costs for health insurance companies as customers are motivated to follow a healthier lifestyle as well as to adhere to suggested preventative check-ups which in turn can lead to an earlier detection of diseases. The outcomes to question 17 reveal that there is also a tendency towards the belief that health-related applications can improve customer relationships. With regard to health insurance companies this implies that the deployment of health-related applications that evolve around building a connection between the insurer and the customer. Another possibility for health insurance companies lies within providing targeted offers for customers. The results of the survey reveal high influence of customer knowledge on creating targeted offers. With the use of data from health-related applications health insurance companies can generate knowledge about the customer entirety and then use this knowledge to offer more targeted options.

The last subquestion was concerned with possible limitations of the use of data from mobile applications. Question 25 asked respondents whether they had any further comments or remarks to

this study. The answers that have been given to this open question are presented in Appendix D. These answers give a few insights into the limiting factors of mobile health-related apps. The main limiting factor are stringent regulations given to health insurance companies in Germany as to what is possible and what is permitted to happen with customer data. It has also been argued by one respondent that customers are rather confused by the complex topic of data privacy which indicates that there has to be some form of enlightenment of the issue to make it more transparent for customers and to what they are willing in if they use health-related applications from health insurance companies. It has already been mentioned before but especially statutory health insurance companies in Germany underlie strict statutory specifications as to what services they need to offer, which leaves only little room for additional offers and / or more targeted offers. Therefore one of the biggest challenges can be said to be the intense regulations of the German health insurance market. Another limitation is that smart phone use is not spread equally over all age groups which eventually means that a lot of the data that is generated comes from only a few age groups and might therefore not be generalizable across all ages groups.

6.2   Discussion of the statical analysis

The generalization of this study's sample is very difficult due to the fact that there was a large number of non-responses and the low sample size. The results are therefore only interpretable with utter caution. The original questionnaire was split into three different sections, namely cost reductions, customer retention and custom acquisition and asked respondents to assess questions within these sections. Since the questionnaire was not built based on a validated scale, a common factor analysis was conducted to find whether some of the survey questions cluster together to then build a new overarching construct. The Common Factor analysis resulted in four factors covering altogether 14 of the 16 analyzed questions. Due to the exploratory nature of this research all of the four original factors were further looked into. These four factors are 'Customer Retention', 'Targeted Customer Offering', 'Big Data Possibilities' and 'App Use'. The outcomes show very clear that Factor 1 'Customer Retention' reaches the highest factor loadings and the highest value for Cronbach's alpha. Questions concerning customer retention and customer relationships clustered together within this first factor which might be an indication that one major advantage of health insurance health applications lies in building relationship with the customer so that customer retention is achieved.

The second factor 'Targeted Customer Offering' consisting of four variables that are not directly outcomes of the provision of health-related apps but indicate that they together can be influenced by health insurance companies though the provision of health apps.

Thridly, the factor 'Big Data Possibilities', is concerned with the possibilities that open up through the large amount of data that is provided by customers using health apps. For health insurance firms this would mean that health applications are

The last factor is 'App Use'. This factor has a Cronbach's alpha value of .588 which is classified as being poor. This factor consists of three variables that are difficult to be be explained by one distinct label. Therefore, this factor is left out of the suggested model for mobile health apps and their potential business value (Figure 5).

The remaining findings show how the questions of the questionnaire have clustered together. Interestingly, two of the the questions that have been valued most positively have been removed from the common factor analysis as well as the model presented in Figure 5. These questions were concerned with the influence of health apps on the adherence to suggestive preventative check-ups (Question 12) and the motivational potential of health apps to follow a healthier

Figure 5: Suggested model for mobile health apps and their underlying

lifestyle (Question 14). The left side of figure 5 shows the health apps that based on the survey were among the most popular deployed applications. On the right side of the figure the constructs of the common factor analysis are presented. The model shows the three major findings of the research. The first one being that there seems to be a correlation between health apps and customer retention

and customer relationship. The second finding is that health apps hold an underlying potential in four aspects. Namely they aid in the prevention of widespread diseases, early detection of diseases, treatment of diseases and offering targeted customer offers. These parts can be reached by increasing overall health consciousness among insurants. The third finding is concerned with the possibilities that arise from the vast amount of data that is generated by customers through app usage. This data could be further analyzed to make statements about latent correlations within the large data set. In addition, the third finding does also include the aspect of providing targeted offers to customers based on knowledge about the customer. Important in that sense is knowledge of the collectivity in order to detect coherences within the data rather than knowledge about each individual customer. Under the current strict regulation and especially in light of privacy concerns and data protection, this finding is harder to implement and to harvest at this time.

The research has also looked into differences between five distinct groups within the sample. There is however not a statistically relevant relationship between all groups and variables from the four factors. The first group, respondents that work for private health insurance companies have overall indicated a higher influence of health applications on customer relationships and customer retention. No particular reason can be found as to why their answers are significantly higher than the respondents that work for a statutory health insurance companies. A next group within respondents are those that currently offer a health-related application based around the idea of a customer health and fitness community. This group has indicated a significantly higher influence of health apps on customer retention as well as on the ability to build deeper and longer lasting relationships. Assuming that apps revolving around providing a health and fitness community to customers increases active intercommunication between users and between users and the insurance provider this can be an explanation for why this group perceives a higher rate of customer retention. Next, respondents said that their company does not currently offer a health app perceive a significantly lower influence of health apps on the provision of targeted customers offers. Overall the values for all variables are lower compared to respondents whose firm offers health applications. This can be explained by bias or by lack of knowledge of the potential relationships. Lastly, respondents that are employed by a company that offers informative health-related applications sees a significantly lower potential of health apps to prevent diseases. This can be due to the fact that these respondents only employ an application based around informing customers about tariffs and bonus programs and can thus not make the connection to the actual value potential of health apps.

7. Conclusion, limitations and further research

7.1 Conclusion

The previous chapter discussed the results of the research. In order to come to a final conclusion to the research question of „*How can the use of mobile health applications enable business development in terms of business model innovation/customer value creation in German Health Insurance Companies?*" the results of the previous chapters will be tied together. This chapter will furthermore deliberate on limitations of this study, consider theoretical and practical implications and provide suggestions for further research.

First of all, from the responses to several questions it can be concluded that the attitudes towards health-related mobile applications are divergent. While some say that health-related apps are a temporary phenomenon and that there is only little interest on the customer side in using health-related applications from health insurance companies, others see a larger potential in them. There are different ways in which medical insurance companies can make use of health-related applications in order to increase customer value. Service Applications where paperwork can be handed it increases administrative efficiency for customers and might solve an issue of bureaucracy. A major aspect on the way of creating business value is however to follow the ABIC. This framework sets out how to implement the business innovation process to arrive at business value. Four steps and intermediary learning and feedback from each step and the customers is needed to create a thought through application which includes desired outcomes and ways to achieve these outcomes in order to create an advantage over other health insurance companies. One recommendation in order to harvest the potential business value of health and fitness applications is for health insurance providers to integrate different concepts of the types of health applications into one application. This way a sort of one-stop shop kind of application is created with the specific functionalities of each type of application combined, where customers can retrieve information, submit documents, be reminded of certain tasks such as measuring blood sugar levels, track health and fitness data like for blood sugar levels and interact with one another and with the health insurance company.

Even though the potential business value derived from health apps seems promising there are limitations and even barriers. For example, the current legal situation is very restricting and it is thus interesting to observe how this subject matter might shift in the future. Overall due to the split opinions it is a topic that needs to be considered with caution to not get carried away with overly

positive assumptions of outcomes. The German health insurance industry is a mature market and creating a differentiation is hard to achieve.

Lastly, the results of this study are to be viewed with caution and not to be accepted over-enthusiastically as they are not generalizable.

7.2 Limitations of the research

Despite the previously presented contributions this research is also subject to limitations. The first and largest limitation of this research is the sample. The Sample size is very small which results in an extremely limited representativeness and overall significance. Moreover, the response rate of 12,03% is also a limiting factor. Furthermore, the sampling of the sample is based on job descriptions. The contacted individuals might be biased based on the fact that they are part of the team that is responsible for digitalization, social media and / or customer relationship management. Another limitation is resting upon the choice of data collection method of this study. Survey research in and of itself contains of a few limitations, the first one being that this study is conducted at one specific point in time. It cannot be know whether the results will be the same or similar at a different point in time. This holds especially true since the topic of digital health is growing and becoming ever more interesting for firms which might result in a shift of perceptions. Furthermore based on the selection of the sample the respondents can be biased and have thus influenced the results of the survey. A further limitation is that this study does not focus on one specific type of health-related mobile application only, but rather includes a large amount of different types of mobile applications. On the one hand this allows for a broader spectrum of information but on the other hand it was more difficult for respondents to answer the general questions. This might be an explanation for the fact that the answer option ‚average‘ was selected most commonly. A further limitation of this study is the type of response that respondents were asked to give. The questions demanded for an assessment of a relationship or an assessment of the impact of health-related mobile applications on certain business aspects. Thus the outcomes of the survey are only estimates and opinions of the respondents. For this research it was assumed that health insurance companies would harness their own mobile health-related applications. It might even so also be the chance that a health insurance company might be in a partnership with a technology corporation or wants to enter a partnership with a technology corporation that is specified on health applications. This idea was excluded from the study but could have provided potentially different outcomes which is why this aspect could be seen as a limitation. Another limitation of this thesis is that the factor buildup

and constellation might have looked different if one considers that there may be noisy data or noisy factors within the data set that might interfere with the generation of a clear picture.

Lastly, respondents were contacted based on their profile and job description on a business networking site. Due to the fact that not all employees of health insurance companies are members on this site there is a potential that the survey was sent to someone that was not the ultimate fit for answering the questionnaire which might lead to sampling error in the data.

7.3 Relevance

The following sections will discuss the relevance of this research in terms of theoretical as well as practical implications. Sections 7.3.1 and 7.3.2 will discuss these topics respectively.

7.3.1 Theoretical implications

This study has looked at various theoretical concepts and ideas such as Big Data Analytics, Business Model Innovation as well as the App-enabled business innovation cycle. Big Data Analytics is concerned with the analysis of large data sets to filter out underlying trends or specific hidden aspects within large sets of data. Business Model Innovation can be explained as reconfiguring what the company currently does and how it does it with the purpose of creating a new value proposition to its customers (Souto, 2015). The Business Model Canvas has been used to explain what company aspects are important to best leverage the potential of health apps and to create customer value. Additionally, the app-enabled business innovation cycle has been utilized to give tips on how to create business value using applications. The ABIC includes routines for how start-ups can leverage business value though apps, interactions between the four capabilities and moreover four types of app-enabled business value.

Due to the nature and results of this thesis the academic contributions are to a greater degree of theoretical nature rather than of empirical nature. This research however holds theoretical relevance due to the fact that it combine aspects from each of these above mentioned theories to draw conclusions of a relatively recent research area, namely of the possibilities for German health insurance companies of employing mobile health applications. This paper shows for example a new area of employment, a re-contextualization, of the app-enabled business innovation cycle for existing health insurance firms which originally was developed to uncover how start-ups can create business value with mobile applications. As far as the business model concept goes, this study

shows theoretical relevance as it shows that health insurance companies can use mobile health-related applications to create business value by increasing customer relationships, using a new channel to reach customers as well as targeting customers in a more specific way. A combined aspect of all theories has been attempted to fill the research gap between mobile health applications and their potential business value. Moreover, the study has worked out an overview of three types of business outcomes that can be achieved though the deployment of health-related applications. This can be used as a basis for further critical research in order to validate the model or in order to build new theories from this model.

7.3.2 Practical implications

The goal of the study was to identify the potential of mobile health applications for German health insurance companies and to investigate the current situation of health-related apps in the German insurance market. The results have shown show that around half of the participating insurance providers are currently offering a health-related application, however around 82% of respondents have indicated that their company plans to offer a health-related application in the future. The most commonly deployed applications at the moment within the sample are as follows: (ranked by decreasing selection) (1) Informative health apps, (2) Service apps that for instance digitize processes, (3) Health and Fitness Journals, (4) Reminders, and (5) Health and Fitness Communities. However, as the German health insurance industry is very competitive and highly regulated in Germany it is difficult for health insure companies to offer differentiated value to customers. With regard to the potential of health applications four different factors have been worked out. Out of these four, three are presented within a framework that tries to explain how business value is created for German health insurance companies through the provision of customer-targeted health apps. This study yields practical relevance as it shows that health applications hold the potential to increase customer retention, contribute to aspects such as early disease detection, treatment of diseases, and prevention of widespread diseases like obesity as well as hold the potential for further data analysis based on big data possibilities. As Ehrenhard et al. (2017) state, value is not just created through the sole provision of an application but rather through an interplay between three points, the technology, the user and the purpose of use. Moreover, an application needs to be well developed and implemented in order to attain some sort of business value from it (Ehrenhard et al., 2017). The framework that has been developed within this research gives an overview as to what

kind of potential lies in health-related apps. The research also explains how health insurance companies can leverage business value by using the app-enabled business innovation cycle.

7. 4   Recommendations for further research

This study tries to provide insights into a relatively young research topic as well as to generate and gather as much information about the current status and potential benefits of providing health-related mobile applications for customers. However, based on the limitations of this research there are some recommendations for future research. It would for instance be interesting to conduct in-depth interviews with experts in this area of research. This will result in more extensive information which might then result in a better understanding of the effects that health-related applications might have. Furthermore, during interviews the interviewee could raise new aspects of the matter which might not be acknowledged otherwise.

A more extensive study analyzing each of the discussed aspects would be needed to verify and validate the findings of this research. Therefore, in order to successfully exploit the potential positive aspects of health apps in the German health insurance domain and in order to generate reliable results, deeper experiments and research has to be conducted in the future. This holds also true for a deeper analysis of which type of health application has how much and what kind of influence on each of the three presented constructs.

In light of the responses to question 24, that asked respondents to assess the interest of customers in using health-related mobile apps from health insurance companies, where the most striking answers were average and low, an especially interesting research would be the perspective of customers on the topic of health apps from health insurance companies. Therefore, for the purpose of creating a comprehensive picture and to provide practical information to health insurance companies a further research should look into the customer perspective on mobile health-related apps.

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Appendix A - Survey Questionnaire (German Format, answer options marked blue)

Umfrage zu Gesundheits-Apps

Einleitung für Teilnehmer

Vielen Dank für Ihr Interesse an dieser Umfrage.

Ziel der Umfrage ist es, einen Überblick über den Einsatz von Gesundheits-Apps bei deutschen Krankenkassen und mögliche Auswirkungen auf das Krankenkassengeschäft zu bekommen.

Der Begriff Gesundheits-Apps ist ein weit reichender Begriff und beinhaltet eine große Anzahl verschiedener Apps. In dieser Umfrage sind wir jedoch nur an jenen Apps interessiert, die für Kunden von Krankenkassen konzipiert wurden. Die Apps sollen für die Nutzung auf Smartphones oder Tablet-PC's gestaltet sein und eventuell auch mit weiteren Geräten wie Smartwatches, Fitness-Armbändern etc. gekoppelt werden können. Des Weiteren beinhaltet der Begriff Gesundheits-App in dieser Umfrage Apps, die Nutzer zum Beispiel daran erinnern, Medikamente einzunehmen, Apps, die Nutzern eine Gemeinschaft von Gleichgesinnten bereitstellen, Apps, die Informationen über ihre Krankenversicherung anbieten und Apps, die Nutzer als Tagebuch verwenden können, um zum Beispiel Aktivitäten, Mahlzeiten, Medikamenteneinnahme oder Nebenwirkungen zu protokollieren. Die Angaben in diesem Fragebogen werden streng vertraulich behandelt.

Anleitung für den Fragebogen

Das Ausfüllen des Fragebogens wird in etwa 10 Minuten dauern.

Der Fragebogen besteht aus 6 Teilen, in denen Ihre persönliche Meinung zu Einsatz und Auswirkungen von Gesundheits-Apps erfragt wird.

Bitte klicken sie am Ende des Fragebogens auf 'Senden' um ihre Angaben abzuschicken.

Teil 1: Allgemeine Fragen über ihr Unternehmen und die Krankenkassenlandschaft

1. Wie lautet der Name der Krankenkasse bei der Sie beschäftigt sind? (Angaben werden vertraulich behandelt und bleiben anonym)
2. Was ist Ihre Position in Ihrem Unternehmen? (Angaben werden vertraulich behandelt und bleiben anonym)
3. Bietet Ihr Unternehmen gesetzliche oder private Krankenversicherung an?
4. Wie bewerten Sie die Wettbewerbsintensität in Ihrer Branche?

Teil 2: Fragen zu Gesundheits-Apps

5. Bietet Ihr Unternehmen eine oder mehrere Gesundheits-App/s an? Wenn nein: Weiter mit Frage 7!

    Ja (weiter mit Frage 6!) / Nein (weiter mit Frage 7!)

6. Welche Art von Gesundheits-App/s bietet Ihre Unternehmen an? Bitte geben Sie eine kurze Beschreibung.

7. Plant Ihr Unternehmen in Zukunft Gesundheits-Apps anzubieten? Wenn nein: Wieso nicht?

    Ja / Nein, wieso? _____

8. In welche Kategorie würden Sie die Gesundheits-App/s einordnen, die Ihr Unternehmen bereitstellt?

    Gesundheits- und Fitness Tagebuch

    Gesundheits- und Fitness Community

    Informative Gesundheits-App

    Erinnerungs App

    Sonstige (bitte benennen): _____

Teil 3: Kostenreduzierung

9. Wie schätzen Sie das Potential von Gesundheits-Apps in der Früherkennung von Krankheiten ein?

    Sehr niedrig / Niedrig / Mittel / Hoch / Sehr hoch

10. Wie schätzen Sie das Potential von Gesundheits-Apps in der Behandlung von Krankheiten ein?

    Sehr niedrig / Niedrig / Mittel / Hoch / Sehr hoch

11. Wie schätzen Sie das Potenzial von Gesundheits-Apps ein, insbesondere Volkskrankheiten wie Übergewicht und Diabetes zu therapieren?

    Sehr niedrig / Niedrig / Mittel / Hoch / Sehr hoch

12. Wie schätzen Sie das Potenzial von Gesundheits-Apps ein, bei der Einhaltung von vorgeschlagenen präventiven Untersuchungen unterstützend zu wirken?

    Sehr niedrig / Niedrig / Mittel / Hoch / Sehr hoch

13. Wie schätzen Sie den Zusammenhand zwischen Vorsorgeuntersuchungen und der frühzeitigen Erkennung von Krankheiten ein?

14. Wie schätzen Sie das motivierende Potenzial von Gesundheits-Apps ein, einem gesünderem Lebensstil zu folgen?

Sehr niedrig / Niedrig / Mittel / Hoch / Sehr hoch

15. Wie schätzen Sie das Potenzial von Gesundheits-Apps ein, durch die möglichen digitalen Geschäftsprozesse administrative Kosten zu senken?

Sehr niedrig / Niedrig / Mittel / Hoch / Sehr hoch

Teil 4: Kundenbindung

16. Wie schätzen Sie den Einfluss von Gesundheits-Apps auf die Kundenbindung ein?

Sehr niedrig / Niedrig / Mittel / Hoch / Sehr hoch

17. Wie schätzen Sie den Einfluss von Gesundheits-Apps auf die Verbesserung von Kundenbeziehungen ein?

Sehr niedrig / Niedrig / Mittel / Hoch / Sehr hoch

18. Wie schätzen Sie die Fähigkeit ein, aus großen Datenmengen gesundheitsbezogene Trends zu erkennen?

Sehr niedrig / Niedrig / Mittel / Hoch / Sehr hoch

19. Falls Ihr Unternehmen eine Gesundheits-App anbietet, wie beurteilen Sie den Einfluss der App auf die Kundenbindung?

Sehr niedrig / Niedrig / Mittel / Hoch / Sehr hoch

20. Wie schätzen Sie die Wirkung von durch Gesundheits-Apps ermöglichten Kundennutzen auf die Kundentreue ein?

Teil 5: Kundengewinnung

21. Wie beurteilen Sie den Einfluss von Wissen über den Kunden und sein Verhalten auf das Erstellen kundenindividueller Angebote?

Sehr niedrig / Niedrig / Mittel / Hoch / Sehr hoch

22. Wie schätzen Sie die Möglichkeiten für das Anbieten von kundenspezifischen Angeboten durch den Einsatz von Gesundheits-Apps ein?

Sehr niedrig / Niedrig / Mittel / Hoch / Sehr hoch

23. Wie schätzen Sie den Einfluss von Gesundheits-Apps auf das Bilden von intensiven und langanhaltenden Kundenbeziehungen ein?

Sehr niedrig / Niedrig / Mittel / Hoch / Sehr hoch

24. Wie schätzen Sie das Interesse von Kunden ein, Gesundheits-Apps von Krankenkassen zu nutzen?

Sehr niedrig / Niedrig / Mittel / Hoch / Sehr hoch

25. Haben Sie ergänzende Kommentare oder Ausführungen zu dieser Umfrage?

Appendix B - Survey Questionnaire (English Format; answer options marked blue)

Health App Survey

Introduction for Participants

Thank you for your interest in this survey

The purpose of this study is to generate an overview of the deployment of health-related mobile applications and their potential impacts on the health insurance business. The term mobile health-related applications is a broad term and can include a vast amount of applications. In this survey we are mainly interested in those applications that are designed for customers of your health insurance offerings. This includes apps that are designed for the use on either smartphones and / or tablet computers and can potentially be linked with other devices such as smart watches or other tracking devices. Furthermore the term health-related mobile application can also comprise apps that for instance remind users to take medications, offer a community of like-minded people, provide insurance related information to the user and logbook or diary apps in which users can log for instance physical activity, nutritional information or side effects of certain medications.

Your responses to this survey will be treated confidential.

Instructions for the questionnaire

It will take approximately 10 minutes to complete this questionnaire.

The questionnaire consists of 6 parts that will ask for your personal opinion on the deployment and impact of health-related mobile applications.

To submit the completed questionnaire please click on ‚send' at the end of the questionnaire.

Part 1: General questions about the firm and the insurance industry market:

1. What is the name of the health insurance company that you work for? (Information will be treated confidential)

2. What is your position within your organization? (Information will be treated confidential)

3. Does your company offer statutory or private health insurance?

   Statutory / Private

4. How would you assess the competitiveness within the health insurance market?

5. Does your company offer one or more health-related apps? If no: Continue with question 7!

    Yes (continue with question 6!) / No 8 (continue with question 7!)

6. What kind of mobile health application does your company offer? Please describe shortly!

7. Does your company plan to offer a mobile health application in the future? If not: why not?

    Yes / No, why not? _____

8. In which category would you classify the mobile health applications that your organization employs or plans to employ?

    Health and Fitness Logbook

    Health and Fitness Community

    Informative Health App

    Reminder

    Other (please name) _____

Part 3: Cost reduction

9. How do you assess the potential of health-related mobile apps to assist in the early detection of diseases?

    Very low / low / average / high / very high

10. How do you assess the potential of health-related mobile apps to support treatment of diseases?

    Very low / low / average / high / very high

11. How do you assess the potential of health-related mobile apps to prevent diseases, especially widespread diseases such as obesity and diabetes?

    Very low / low / average / high / very high

12. How do you assess the potential of health-related mobile apps to enable compliance to suggested preventative check-ups?

    Very low / low / average / high / very high

13. How do you assess the relationship between preventative check-ups and early detection of diseases?

    Very low / low / average / high / very high

14. How do you assess the motivational potential of health-related mobile apps to follow a healthier lifestyle?

    Very low / low / average / high / very high

15. How do you assess the potential of health-related apps in reducing administrative costs through possible digital business processes?

Very low / low / average / high / very high

Part 4: Customer retention

16. How do you assess the impact of health-related mobile apps on customer retention?

Very low / low / average / high / very high

17. How do you assess the influence of health-related mobile apps on the ability to influence customer relations?

Very low / low / average / high / very high

18. How do you assess the ability to detect underlying health related trends in big data sets?

Very low / low / average / high / very high

19. If your company offers a health-related mobile app, how would you assess the impact of that app on customer retention?

Very low / low / average / high / very high

20. How do you assess the impact of customer benefit established though health-related mobile apps on customer retention?

Very low / low / average / high / very high

Part 5: Customer acquisition

21. How do you assess the impact of customer knowledge on providing targeted offers to customers?

Very low / low / average / high / very high

22. How do you assess the impact of health-related mobile apps to offer more targeted options to customers?

Very low / low / average / high / very high

23. How do you assess the influence of health-related mobile apps on building deeper and longer lasting customer relationships?

Very low / low / average / high / very high

24. How do you assess the interest of customers to use health-related mobile apps from health insurance companies?

Very low / low / average / high / very high

25. Do you have additional comments or remarks concerning this study?

Appendix C - List of participating health insurance companies (in alphabetical order)

Name of the insurance company	Providing private or statutory health insurance	Position of respondent(s) within their company
actimonda Krankenkasse 2x	Statutory	Head of division strategic marketing; Assistant marketing and communications
AOK Baden-Württemberg 2x	Statutory	Marketing Assistant; Social Media and Marketing
AOK NORDWEST	Statutory	Division manager online marketing
AOK PLUS	Statutory	Online marketing assistant
AOK Rheinland/Hamburg	Statutory	Organizational Development
AXA Krankenversicherung AG	Private	Specialist
BKK firmus	Statutory	Head of marketing
BKK Freudenberg	Statutory	Executive board advisor Marketing and Communications
BKK HMR 2x	Statutory	Marketing Assistant; Member of the executive board
BKK Linde	Statutory	Head of marketing
BKK Melitta Plus	Statutory	Chief executive officer
BKK Pfalz	Statutory	Member of the executive board
BKK ProVita	Statutory	Head of organization and IT department
BKK VBU 2x	Statutory	Social media manager; Group leader
BKK Wirtschaft & Finanzen	Statutory	Member of the executive board
Central Krankenversicherung AG 2x	Private	Head of innovation and digitalization; Company and process organization

Name of the insurance company	Providing private or statutory health insurance	Position of respondent(s) within their company
Daimler BKK	Statutory	Team leader sales management
DAK-Gesundheit	Statutory	Head of management of electronic media
Deutsche BKK 2x	Statutory	Member of the executive board; Marketing abstractor
DKV Deutsche Krankenversicherung AG	Private	Abstractor
Hanse Merkur Krankenversicherung AG	Private	Head of performance and health management
Heimat Krankenkasse	Statutory	Head of marketing, communications and sales department
hkk Krankenkasse	Statutory	Division manager customer service and sales
INTER Krankenversicherung AG	Private	Data processing administrator
KKH Kaufmännische Krankenkasse 2x	Statutory	Anonymous; Product manager
Münchner Verein Krankenversicherung AG	Private	Senior project manager
R+V Betriebskrankenkasse	Statutory	Marketing and sales assistant
TK - Techniker Krankenkasse	Statutory	Unit manager
UniVersa Krankenversicherung AG	Private	Group leader online marketing, communication and technology
VIACTIV Krankenkasse 2x	Statutory	Marketing and sales management; Products and online
Anonym	Unknown	Unknown

Appendix D - Answers to the open question 25

„Das Angebot an apps ist unübersichtlich und es sind zu viele"

„Ich hätte persönlich noch den Faktor Datenschutz (als Körperschaft des öffentlichen rechts unterliegen die Krankenkassen recht restriktiven Bestimmungen) in die Befragung implementiert sowie wearables. Weiterhin wäre es vllt noch spannend gewesen zu hinterfragen ob Partnerschaften mit Technologieunternehmen vorhanden respektive geplant sind"

„Da grundsätzlich sehr viele arten an Gesundheitsapps denkbar sind, sind die pauschalen fragen schwer zu beantworten"

„Kunden nehmen Self-Service-Lösungen sehr gut an. Allerdings werden die Angebote austauschbar sein, sobald sie eine Wettbewerbsdurchdringung finden. Die Unternehmen müssen sich mit einer Digitalen Strategie positionieren, sowohl im Service als auch im Versorgungsbereich."

„Den Nutzen für Kunden und Versicherer sehe ich im wesentlichen mit den folgenden Punkten: - Erhöhung der Compliance bei chronischen Erkrankungen zur Begleitung von Disease-Management-Programmen; - Erhebung von vielen Daten in schneller Zeit bei Studien und Krankheitsbefragungen; - Reminder-Services für Vorsorge- und sonstigen Untersuchungen;- Empfehlungen und Vereinfachungen die richtigen ärztlichen Experten zu finden und Zweitmeinungen einzuholen. Letztlich werden G-Apps aber starken Marketingcharakter haben. D.h. viele G-Apps werden kommen und wieder gehen."

„Bei den Möglichkeiten der Apps sehe ich extremen Bedarf an zusätzlichen Sensoren (z.B. Blutzucker Messung o.ä.) für die Hardwaregeräte. Die bisherigen Apps sind unübersichtlich und die Datenschutz Thematik verwirrt die Versicherten eher. Das wiederum ist ein ‚Verkaufsargument' für die Krankenkassen."

Appendix E - Reliability of the Factors

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Falls Ihr Unternhemen eine Gesundheits-App anbietet, wie beurteilen Sie den Einfluss der App auf die Kundenbindung?	19,96	13,739	,794	,768	,890
Wie schätzen Sie den Einfluss von Gesundheits-Apps auf die Kundenbindung ein?	19,64	13,127	,896	,875	,878
Wie schätzen Sie den Einfluss von Gesundheits-Apps auf das Bilden von intensiven und langanhaltenden Kundenbeziehungen ein?	19,75	14,269	,880	,864	,884
Wie schätzen Sie die Wirkung von durch Gesundheits-Apps ermöglichte Kundennutzen auf die Kundentreue ein?	19,64	13,720	,839	,834	,885
Wie schätzen Sie den Einfluss von Gesundheits-Apps auf die Verbesserung von Kundenbeziehungen ein?	19,39	14,544	,711	,668	,899
Wie schätzen Sie das Potenzial von Gesunheits-Apps ein, durch die möglichen digitalen Geschäftsprozesse administrative Kosten zu senken ?	19,39	13,507	,629	,481	,915
Wie schätzen Sie das Potenzial von Gesundheits-Apps ein, bei der Einhaltung von vorgeschlagenen präventativen Untersuchungen unterstützend zu wirken?	19,14	16,868	,433	,299	,923

Table E1: Reliability of Factor 1 'Customer Retention' (α = 0.911)

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Wie schätzen Sie das Potential von Gesundheits-Apps in der Behandlung von Krankheiten ein?	9,53	3,337	,569	,339	,628
Wie schätzen Sie die Möglichkeiten für das Anbieten von kundenspezifischen Angeboten durch den Einsatz von Gesundheits-Apps ein?	9,03	3,756	,508	,304	,666
Wie schätzen Sie das Potenzial von Gesundheits-Apps ein, insbesondere Volkskrankheiten wie Übergewicht und Diabetes zu therapieren?	9,13	3,901	,442	,242	,702
Wie schätzen Sie das Potenzial von Gesundheits-Apps in der Früherkennung von Krankheiten ein?	9,50	3,554	,535	,330	,650

Table E2: Reliability of Factor 2 'Targeted Customer Offering' (α = 0.724)

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Wie schätzen Sie die Fähigkeit ein, aus großen Datenmengen gesundheitsbezogene Trends zu erkennen?	3,53	,797	,531	,281	.
Wie beurteilen Sie den Einfluss von Wissen über den Kunden und sein Verhalten auf das Erstellen kundenindividueller Angebote?	3,66	,718	,531	,281	.

Table E3: Reliability of Factor 3 'Big Data Possibilities' (α = (0.693)

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Wie schätzen Sie den Zusammenhang zwischen Vorsorgeuntersuchungen und der frühzeitigen Erkennung von Krankheiten ein?	6,29	2,103	,267	,090	,652
Wie schätzen Sie das Interesse von Kunden ein, Gesundheits-Apps von Krankenkassen zu nutzen?	7,29	1,346	,426	,243	,456
Wie schätzen Sie das motivierende Potenzial von Gesundheits-Apps ein, einem gesünderem Lebensstil zu folgen?	6,68	1,519	,530	,288	,288

Table E4: Reliability of Factor 4 'App Use' (α = 0.588)