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ABSTRACT

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Abstract

The costs of health care are going up in many countries. In order to provide affordable and effective health care solutions, new technologies and approaches are constantly being developed. In this research, video games are presented as a possible solution to the problem. Video games are fun, and nowadays most people like to spend time on them. In addition, recent studies have pointed out that video games can have notable health benefits. Health games have already been developed, used in practice, and researched. However, the bulk of health game studies have been concerned with the design or the effectiveness of the games; no actual business studies have been conducted on the subject, even though health games often lack commercial success despite their health benefits. This thesis seeks to fill this gap. The specific aim of this thesis is to develop a conceptual business model framework and empirically use it in explorative medical game business model research.

In the first stage of this research, a literature review was conducted and the existing literature analyzed and synthesized into a conceptual business model framework consisting of six dimensions. The motivation behind the synthesis is the ongoing ambiguity around the business model concept. In the second stage, 22 semi-structured interviews were conducted with different professionals within the value network for medical games. The business model framework was present in all stages of the empirical research: First, in the data collection stage, the framework acted as a guiding instrument, focusing the interview process. Then, the interviews were coded and analyzed using the framework as a structure. The results were then reported following the structure of the framework. In the results, the interviewees highlighted several important considerations and issues for medical games concerning the six dimensions of the business model framework.

Based on the key findings of this research, several key components of business models for medical games were identified and illustrated in a single figure. Furthermore, five notable challenges for business models for medical games were presented, and possible solutions for the challenges were postulated. Theoretically, these findings provide pioneering information on the untouched subject of business models for medical games. Moreover, the conceptual business model framework and its use in the novel context of medical games provide a contribution to the business model literature. Regarding practice, this thesis further accentuates that medical games can offer notable benefits to several stakeholder groups and offers advice to companies seeking to commercialize these games.

Key words	Business models, medical games, health games, health care
Further information	

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Tiivistelmä

Terveydenhuollon kustannukset ovat monissa maissa nousussa. Uusia teknologioita ja hoitomuotoja kehitetään jatkuvasti edullisempien ja tehokkaampien hoitomuotojen tarjoamiseksi. Tässä tutkielmassa terveyspelejä tarkastellaan mahdollisena ratkaisuna terveydenhuollon ongelmiin. Videopelit ovat hauskoja ja useimmat ihmiset viettävätkin niiden parissa aikaansa. Tämän lisäksi tutkimuksissa on osoitettu, että videopeleillä voi olla merkittäviä terveyshyötyjä. Terveyspelejä onkin jo kehitetty, käytetty ja tutkittu. Suurin osa tutkimuksista on keskittynyt lähinnä terveyspelien suunnitteluun ja tehokkuuden osoittamiseen. Terveyspelejä ei ole juuri tutkittu liiketoiminnan näkökulmasta. Tähän tulisi puuttua, sillä monet terveyspelit jäävät vaille kaupallista menestystä positiivisista terveysvaikutuksistaan huolimatta. Tämän tutkielman tarkoitus on paikata kyseinen tutkimusaukko. Tutkielman tavoite on kehittää käsitteellinen liiketoimintamalliviitekehys ja käyttää sitä empirian tukena kartoittavassa terveyspelien liiketoimintamallitutkimuksessa.

Tämän tutkielman ensimmäinen vaihe koostui liiketoimintamalleja käsittelevästä kirjallisuuskatsauksesta, jonka tuloksena muodostettiin uusi, kuudesta osa-alueesta koostuva käsitteellinen liiketoimintamalliviitekehys. Synteesi tehtiin, koska liiketoimintamallin käsitteeseen liittyy huomattavia epäselvyyksiä. Tutkielman toisessa vaiheessa toteutettiin 22 teemahaastattelua erilaisten, terveyspelien arvoverkostoon kuuluvien ammattilaisten kanssa. Liiketoimintamalliviitekehys oli läsnä empiirisen tutkimuksen jokaisessa vaiheessa: Ensin viitekehystä käytettiin haastattelujen tukena ja huomion kohdentamisen apuna. Tämän jälkeen viitekehys tarjosi rakenteen haastattelujen koodaukselle ja analysoinnille. Lopuksi tulokset raportoitiin noudattaen viitekehyksen sisältämää rakennetta. Tuloksissa haastateltavat nostivat esille useita näkökohtia ja kysymyksiä liittyen terveyspelien liiketoimintamallien eri osa-alueisiin.

Tulosten pohjalta voitiin tunnistaa useita terveyspelien liiketoimintamallien avainkomponentteja, jotka havainnollistettiin yhteenvetona kuvion avulla. Tämän lisäksi nostettiin esiin viisi merkittävää haastetta terveyspelien liiketoimintamalleille mahdollisine ratkaisuineen. Tämän tutkielman tieteellinen kontribuutio on kaksitahoinen: Ensinnäkin esitetyt löydökset tarjoavat uraauurtavaa tietoa terveyspelien liiketoimintamalleista. Toiseksi kehitetty liiketoimintamalliviitekehys ja sen uudenlainen käyttö terveyspelien kontekstissa edistää liiketoimintamallien tutkimusta. Käytännön kannalta tämä tutkielma sekä tuo esille terveyspelien merkittävät hyödyt useille sidosryhmille että tarjoaa avustusta niille yrityksille, jotka pyrkivät terveyspelejä kaupallistamaan.

Asiasanat	Liiketoimintamallit, videopelit, terveydenhuolto, terveyspelit
Muita tietoja	

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EXPLORING BUSINESS MODELS FOR MEDICAL GAMES: KEY COMPONENTS AND CHALLENGES

Master's Thesis
in Information Systems Science

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12.5.2015
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1 INTRODUCTION

1.1 Background and motivation

When asked about the most important things in life, people nearly always mention health among their first few answers. In a perfect world, everyone would be entitled to adequate and high-quality health care. For this reason it is a frightening trend that costs of health care are going up: "The growth in health-care spending in the United States regularly outpaces the growth of the overall economy" (Christensen, Grossman, & Hwang 2009, xv). Simply, health care is in a cost crisis (Kaplan & Porter 2011). In order to combat the rising costs of health care, new technologies and health care approaches are constantly being developed. For example, the popular concept of health 2.0 or medicine 2.0 is related to the growing use of Internet, social media, and new technologies that pursue benefits such as patient empowerment, better collaboration, and more-efficient health care (Van De Belt, Engelen, Berben, & Schoonhoven 2010). In this thesis, video games are examined as a technology that in a new context presents a possible solution to improve the state of health care.

A video game can be defined as a "game which we play thanks to an audiovisual apparatus and that can be based on a story." Video games are games that are based on human-computer interaction, and good video games often seek to provide substantial fun to the people playing them (Esposito 2005). Video games are very popular nowadays: at least every other Finn plays them (Mäyrä & Ermi 2014, 15). It is not exceptional to see an ordinary mother playing Candy Crush Saga on the bus. Given the popularity of games, it is positive news for gamers that many studies have pointed out the promising positive side effects of playing games: Playing games can, for example, enhance cognitive control (Anguera et al. 2013), induce structural brain plasticity (Kühn, Gleich, & Gallinat 2013), and improve academic performance (Ventura, Shute, & Kim 2012). Furthermore, game-related phenomena such as gamification and brain training have received a significant amount of positive publicity during the past few years.

In addition to leisure gaming having possible benefits, the positive effects of video games have been harnessed in the health care sector to some degree already. For example, there are tailored games designed to help with pain management, diabetes, asthma, cancer treatment, and medical education (Kato 2010, 116–118). In addition to the early examples of games in health care, the future of health games looks very promising. For example, Finnish newspaper *Savon Sanomat* published an article where health games were predicted to become a new gigantic and international area of business (Gråsten 2014). However, although health games have a large amount of potential, health game markets and ecosystems are still very underdeveloped (Kaleva et al. 2013, 12).

It has been argued that one of the reasons behind health games' lack of success is the fact that proper business models for these new games have not yet been developed (Kaleva et al. 2013, 37–38). Thus, in addition to the rising importance of using games and other technological innovations in health care improvement, the significance of business models forms the underlying need for this thesis.

In addition to being critical of health games' success, the literature often brings up the general importance of business model innovation: Business models function in a key role in commercializing new technological innovations (Chesbrough & Rosenbloom 2002), and business models can provide a company with significant competitive advantage (Morris et al. 2005). Furthermore, novelty-based business models have been found to increase firm performance, and thus it is crucial to think of new ways of conducting business (Zott & Amit 2007, 2008). The importance of business models is summed up well by Teece (2010, 192): "Great technological achievements commonly fail commercially because little attention has been given to designing a business model to take them to market properly. This can and should be remedied." Thus, it can be argued that studying health games from a business model perspective appears important.

1.2 Previous research and the research gap

The research areas related to this study are video games, health care, and business models. All of these three areas have been researched widely. This study focuses on the intersection of these areas, which is where the research gap lies (see figure 1 below). Moreover, the primary perspective of this thesis is on business models, highlighted in figure 1 with a darker color. Video games and health care thus provide the context while business models provide the dominant point of view. The novelty of this study, in turn, is provided by the unique combination of these three subject areas.

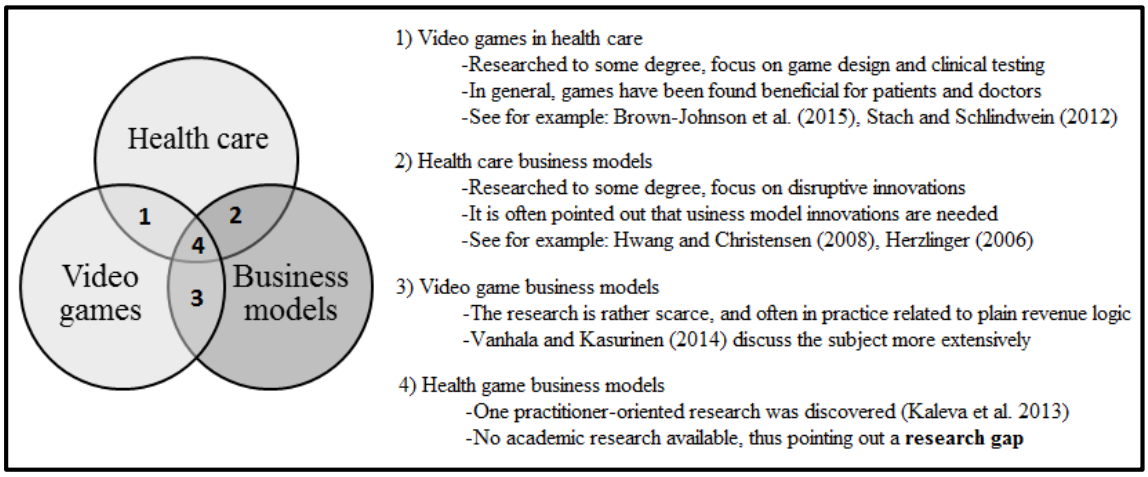

Figure 1 The relevant research areas and the research gap

As figure 1 depicts, games used in health care (1) have been studied to some degree.[1] However, the bulk of these studies have been concerned with the design or the effectiveness of the games. For example, Brown-Johnson, Berrean, and Cataldo (2015) discussed the usability evaluation and development of games for lung cancer and concluded that the virtual-world health game helped the patient and improved patient-clinician communication. Similarly, Stach and Schlindwein (2012) studied the design and implementation of a diabetes treatment game, also finding the game beneficial for the patient and the doctor. Along the same lines, Poole, Eiríksdóttir, Miller, Xu, Catrambone, and Mynatt (2013) listed design recommendations for social support that encouraged pervasive health games, pointing out that games can spur physical activity through social support.

Business models in the health care context (2) have also been studied to some degree. The most-cited article[2] points out the need for disruptive business model innovations in health care delivery (Hwang & Christensen 2008). In addition, Christensen et al. (2009) discussed the topic more extensively in their popular book, *The Innovator's Prescription*, where they call for more affordable and customer-driven health care that can be achieved partly through business model innovations. Similarly, Herzlinger (2006) points out the need for health care renovation and discusses difficulties that are linked with business model innovation in the health care sector. Furthermore, the use of social media as an enabling platform for business model innovations in health care is also discussed in the literature (see, for example, Hawn 2009). Based on the literature, conducting research that promotes business model advancements in the health care sector is needed.

The business model aspects of video games (3) are seldom discussed directly,[3] and often even then in a specific context. For example, Nae, Prodan, Iosup, and Fahringer (2011) present a new business model designed for massively multiplayer online games, and Waldner, Zsifkovits, Lauren, and Heidenberger (2011) talk about how the business models of the video game industry can be transferred to the music industry. However, in practice, the business models of games are usually reduced to the games' possible revenue model. For example, Morel (2012) discusses the four standard business models for games or applications, and according to him, these are premium (the game is chargeable), freemium (the game is free, but the players can purchase extra content), ad supported (the revenues come from advertising), and hybrid (a mix of the former three). Similarly,

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[1] For example, a Scopus search for terms (in title) "health game*" OR "medical game*" returns 36 documents.

[2] This specification takes into account articles that have both *business model* and *health care* in their title. The article itself has 153 Google Scholar citations (confirmed 13.3.2015).

[3] A Scopus search (conducted in April 2015) returns only 13 documents that have the term *business model* in the title, and of these, 5 articles are irrelevant to video games.

Harrison (2015) writes about freemium being the best business model for multiplayer video games. As an exception, Vanhala and Kasurinen (2014) discuss the business models of game companies more extensively, taking into account other factors in addition to the revenue model. However, the literature on game business models is scarce, and thus more research is needed.

However, studies that examine health games from a business perspective (4) are conspicuous by their absence. The only exception is the market potential mapping of health games produced by Sitra, the Finnish Innovation Fund (referred to as Kaleva et al. 2013). Therefore, a substantial research gap is identified. Given the importance of business models in commercializing new technologies (Chesbrough & Rosenbloom 2002), and the fact that exemplary business models are still lacking in the medical game industry (Kaleva et al. 37–38), the business model perspective of medical games is an important and topical area of research that has not been sufficiently discussed.

Although medical games are the subject of examination in this thesis, this research is characterized dominantly by the business model perspective. As a result, the prime literature review of this thesis examines business models. An extensive look on the subject is needed as although notable strides have been made during the past decade in the field of business model research, there still remains ambiguity around the concept (Zott, Amit & Massa 2011). Similarly, the business model concept is widely used and found useful as a descriptive and analytical construct, but there is no consensus on the definition and composition of the business model (Lambert & Davidson 2014). This study contributes to the lack of consensus by analyzing and synthesizing the existing literature, resulting in a more refined interpretation of the business model concept. This conceptual framework is then taken into a novel context of health care–related games and used as a research instrument in seeking to establish pioneering descriptions of business models for medical games.

In conclusion, this thesis strives to contribute to the research thusly:

- Firstly, this study seeks to fill the research gap that is formed by the completely missing academic literature on business models for medical games.
- Secondly, this research contributes to the business model literature by refining the existing literature further into a conceptual framework. The framework is tested in practice as a research instrument, thus providing evidence of its usefulness as a business model innovation tool in an industry-wide context.

Furthermore, this study aspires to provide a strong practical contribution. This research gathers the opinions and outlooks of 23 industry experts into a single, conclusive output. As a result, entrepreneurs and practitioners interested in the commercialization of health

and medical games can gain a large amount of useful information from this research. Moreover, this thesis strives to be part of the larger context of improving the quality and affordability of health care. As pointed out in the literature, medical games can possibly advance the state of health care. Thus, researching how they can be profitably provided to patients and health care professionals is valuable and provides a societal contribution.

1.3 The study aims and research questions

This thesis seeks to examine the underlying business model issues and characteristics related to the commercial environment of medical games. In essence, business models explain how "firms do business" (Zott & Amit 2010, 221). To be more specific, business models often strive to describe how value is both created and captured (Shafer, Smith, & Linder 2005, 202). The health care potential that medical games have shown in previous studies is wasted if producing and delivering medical games is unprofitable. Thus, the issues related to value creation and capture of medical games have to be examined. As a result, the specific aim of this thesis is *to develop a conceptual business model framework and empirically use it in explorative medical game business model research*. The research questions are the following:

- What are the key components of business models for medical games?
- What are the most notable challenges related to business models for medical games, and how can they be overcome?

In this study, the business model is used as a component-based analytical tool in explaining the business conduct of medical games. As a result of a review and an analysis of existing business model frameworks, a new business model framework is proposed and used as the basis of analysis for the empirical material. By breaking the concept down into its components, the different components of the medical game business model can be analyzed and discussed individually. The business model framework is present in all stages of the empirical research: First, in the data collection stage, the framework acts as a guiding instrument, focusing the interview process. Then, the interviews are coded and analyzed using the framework as a structure. The results are reported following the structure of the framework. Finally, a conclusive summarization is built from the separate components, highlighting the most important findings in one picture.

1.4 Research scope and the concept of medical games

The use of games in a health care context is examined in this thesis. According to the definition by Kaleva et al. (2013, 9), which is used in this thesis, games with some kind of health benefits can be classified as *health games.* Health games can be further divided into *wellness games* and *medical games.* The main difference between these two is that wellness games focus more on health-related promotion or prevention, whereas medical games are essentially used in curing and rehabilitation processes. Because of this, wellness games can be seen as targeting a broader audience, whereas medical games are used in more-specific settings. As a result, whereas wellness games are treated as entertaining games with potential health benefits, medical games can be seen as health care products that comply with stricter regulations (Kaleva et al. 2013, 9–14). Medical games reside at the focal point of this thesis, although some issues discussed are related to health games in general. The different game-related terms are illustrated in figure 2 below.

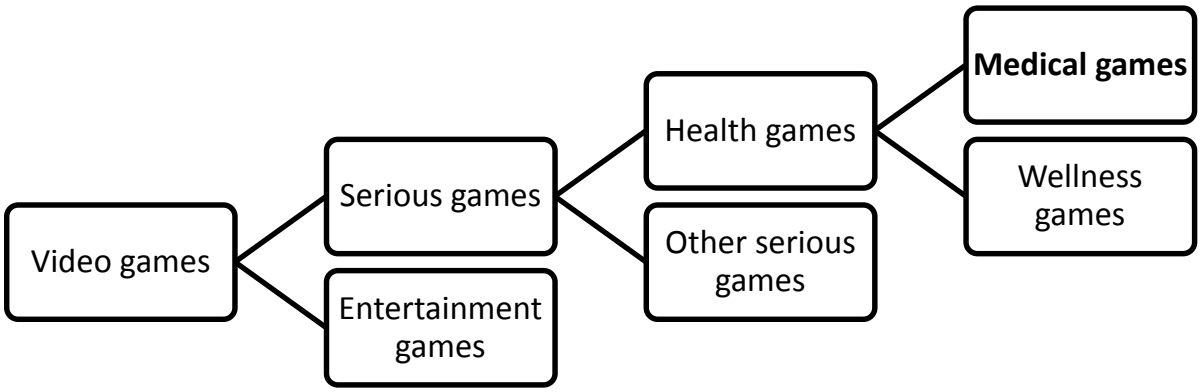

Figure 2 The place of medical games in the context of video games (based on Connolly et al. 2012, 662 and Kaleva et al. 2013, 14)

Furthermore, health games fall under the umbrella term of *serious games.* According to Connolly et al. (2012), whereas traditional video games are developed primarily to provide fun, serious games are created to enhance learning or to change behavior. The essential element in serious games is thus their twofold goal; they should be fun to play, but they are also aimed at producing benefits in addition to plain entertainment (Connolly, Boyle, MacArthur, Hainey, & Boyle 2012, 662).

In order to narrow the research scope further, the study uses brain rehabilitation games as a case example of medical games. As a result, the interview material is gathered mostly from the perspective of business models for brain rehabilitation games, hence taking into account the special features of this specific area of health care. However, although brain rehabilitation acts as a focusing device for this research, some interviewees represent

game companies or serious-game companies in general. This approach was taken in order to enable the examination of the subject from different perspectives, resulting in a deeper and richer understanding of the underlying issues. Moreover, the study is geographically focused; the research is conducted in Finland and thus is subject to Finnish laws, regulations, and cultural characteristics.

1.5 Play for Reward research project

The research was performed as a part of the research project Play for Reward, a proof-of-concept research project examining rewarding game experience and its use in medical game development. The two-year-long Play for Reward project is conducted by the game research network Up Your Game, founded by the University of Turku in 2014. The research is funded primarily by Tekes, and several companies are also involved in the project as partners.[4] The main research question of the project is the following: How can new understanding about rewarding game experience aid both B2C game developers to design more-engaging games and B2B medical game networks to develop more-effective game-based health care solutions? Play for Reward seeks to answer this research question by taking an interdisciplinary approach including experts from economics, neuropsychology, cognitive psychology and neurology, psychiatry, nursing science, evolutionary biology, information systems science, and cultural studies.

This thesis represents the viewpoint of information systems science and contributes to the Play for Reward project by examining medical games from a business model point of view. Because the project as a whole approaches medical games from a multifaceted perspective, the focus of this thesis was intended to be rather narrow and specific. As a result, the other aspects of medical games, such as clinical or technical details, are not profoundly covered in this thesis; everything is discussed through the conceptual framework of the business model. For readers interested in learning more about rewarding game experience and/or medical games in general, familiarization with the rest of the Play for Reward project is highly recommended.

[4] Partner companies: Tribeflame Oy, GoodLife Technology / Serious Games Finland Oy, Invalidiliiton kuntoutus Oy, Orton Oy, BCB Medical Oy, and Oy Nordisk Film Ab / PlayStation

1.6 Research strategy and structure

The term *strategy* can be defined as "a careful plan or method for achieving a particular goal usually over a long period of time."[5] In research context, strategy can be explicated as the blueprint of the study. Simply put, the strategy of this research involved first delving into the business model literature in search of a clear understanding of the concept and then taking this concept as an instrument into the field by conducting a wide array of expert interviews. The business model then gave the structure for the data analysis, resulting in easily categorized information. This information was in turn analyzed. As a conclusion, an illustrative depiction of the business model entirety was formed.

Furthermore, this study takes an *instrumentalist* stance on the subject. In short, instrumentalism, a school of thought close to *pragmatism*, does not necessarily seek to build theories that reflect universal truths about reality but rather aims to develop intellectual structures that are useful in solving problems in a given domain (Cacioppo, Semin, & Berntson 2004, 214). This stance suits this research well; business models are seen as analytical constructs or tools that help in explaining the conduct of business. Moreover, a qualitative research approach was chosen as the study aim is to produce rich and detailed descriptions of the business models for medical games, which can best be achieved with qualitative methods (Gephart 2004, 455). The underpinning philosophical and methodological standpoints are discussed more in depth in chapter 3.

The strategy and also the structure of this thesis are built partly on the conceptual map presented by Osterwalder, Pigneur, and Tucci (2004, 5). The framework, depicted on the next page in figure 3, acts as a guiding framework emphasizing the different aspects of the business model concept. A research strategy based on this hierarchy was chosen as "the three levels make the most sense when they are hierarchically linked to each other through a comprehensive approach" (Osterwalder et al. 2004, 5). The purpose of using this structure is simply to direct the focus of the research into the different levels of business models. In order to examine the real world examples in a sensible way, the conceptual level has to be discussed and analyzed first.

[5] http://www.merriam-webster.com/dictionary/strategy

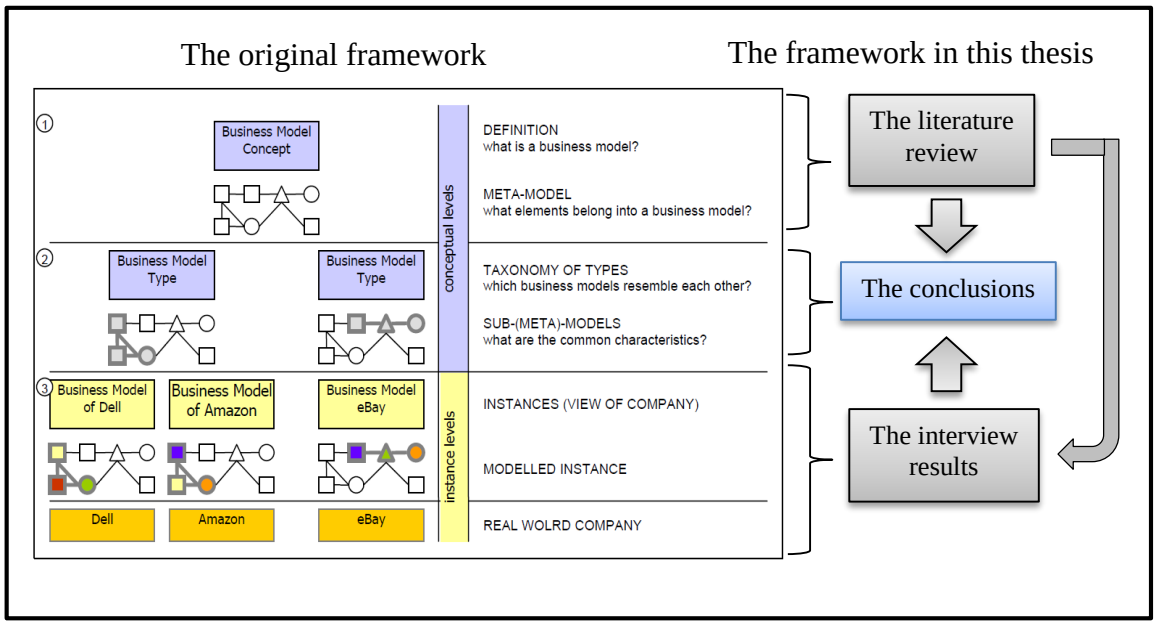

Figure 3 Business model concept hierarchy (based on Osterwalder et al. 2004, 5)

The structure of this thesis thus follows the conceptual business model hierarchy (figure 3) to some degree: First, the literature review discusses the different definitions of the business model and the different business model metamodels. The literature review seeks to find out what a business model is and what elements belong into a business model. As a result, a new conceptual business model framework is presented. In the empirical part of this thesis, industry experts discuss their views and experiences related to medical games and health games in general, and real-world companies are used as examples. The business model framework is present in the empirical research as an instrument. Finally, conclusions are drawn based on the empirical results and the existing literature, resulting in a comprehensive summary of the key components and challenges of business models for medical games. These components and challenges can be seen as the common characteristics of business models for medical games.

2 BUSINESS MODELS AND INNOVATION

2.1 Literature review aims and methods

The aim of this literature review is to clarify what a business model is and how it can be used as a unit of analysis in business model innovation. Furthermore, another objective is to build a component-based business model framework based on a literature synthesis. In order to achieve the aims, the business model is first viewed as a concept to examine its origins and different meanings. After this, the literature is scoured in order to find out what kinds of problems are associated with business models and what makes a business model successful. Then different business model frameworks are discussed, and a new framework is presented as the result of a content analysis of nine existing frameworks. In the final subchapters, business models are discussed in the context of innovation: First, the role of business models in technological innovation is explored. After that, the literature review seeks to answer what business model innovation is and how it should be performed. The literature review constitutes the foundation of the study, giving structure to the empirical research by providing the business model framework as an instrument.

The body of literature on business models is very large. When conducting a search in the Scopus database for documents that have "business model*" in the title, more than 3,000 results are returned. Given the large body of literature, conducting an exhaustive literature review is practically impossible. Therefore, a selective portfolio of the literature was formed based on four types of possible sources (figure 4). As a result of this material triangulation, the business model concept can be looked at from different perspectives.

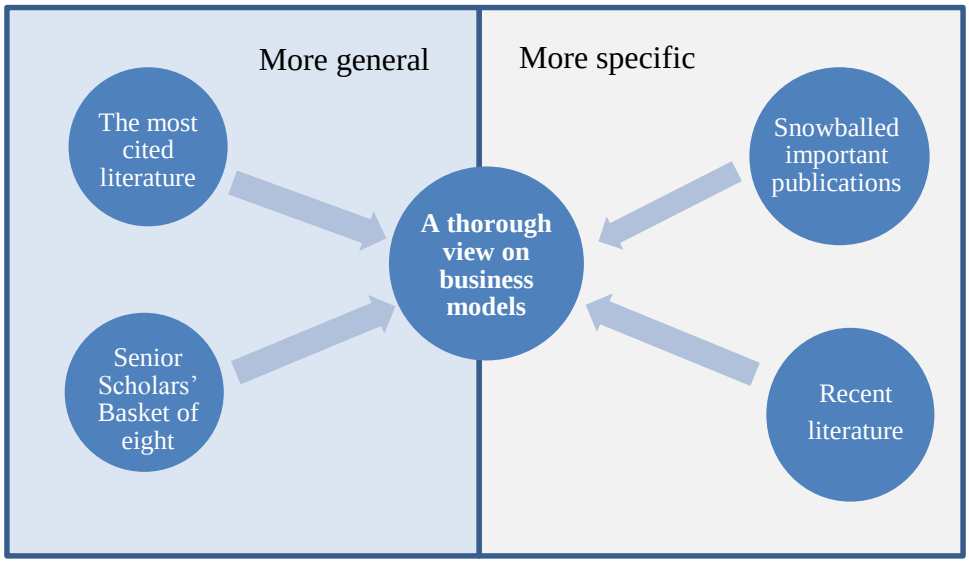

Figure 4 Different types of literature used in the review

The most-cited articles provide a general overview of the state-of-the-art literature that is often used as the basis of other studies. Furthermore, articles from publications in the Senior Scholars' basket of eight were searched for. This listing is provided by the Association for Information Systems, which seeks to present the top journals in the field of information systems.[6] By bibliometric measures, the list includes three A+ journals and five A journals (Lowry et al. 2013). In addition, some articles were snowball sampled in order to take into account literature that is often mentioned in other articles. Recent literature is included as it provides the newest information and recent developments in the field of business models.

For the data collection, the databases Scopus and Web of Science were used as the main sources. The main reason for the use of these two databases is twofold: Firstly, the databases allow for citation analysis of the documents. As a result, the most popular publications are easy to find. Secondly, the databases have extensive coverage. The strength of Scopus is its wide range of journals, whereas Web of Science has more user-friendly citation analysis tools (Falagas, Pitsouni, Malietzis, & Pappas 2008). Databases EBSCO and ProQuest were used as complementing sources. In addition, Google Scholar also was used to provide the citation count for the most important business model definitions in order to highlight the importance of the definitions. Even though Scholar's citation information is irregularly updated (Falagas et al. 2008, 342), it still provides the most extensive citation count in practice and thus is best used in this particular task.

The search terms varied slightly. The most-cited articles were chosen by searching for articles that have the term "business model*" in the title. Furthermore, the same search term was used when searching the basket of eight journals. For the recent literature, more search freedom was allowed while still maintaining the business model context.

In addition, a number of further criteria were used in the selection of the articles. Firstly, the abstracts of promising articles were read, and the relevance of the articles was evaluated. Articles that were narrowly focused on a certain subject not relevant to this study were discarded. For example, business models in the context of deep poverty (Seelos & Mair 2007) were not considered relevant even though the article is very popular. From the 20 most-cited articles in both Scopus and Web of Science, 16 articles were selected in total, and 6 articles were left out (see appendix 1 for more detail). From the basket of eight journals, only three articles were considered relevant. For snowballed publications, perceived high frequency of occurrence in important sources or a single significant reference was the criterion for selection in addition to relevance. The recent literature was selected from the years 2012–2015. In addition, in the selection of snowballed or recent literature, specificity played a greater role; business model innovation and either video game or health care context was emphasized.

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[6] http://aisnet.org/?SeniorScholarBasket

2.2 The business model as a concept

2.2.1 The recent explosion of interest in business models

The business model is a complex phenomenon that has gained a huge amount of popularity during the past 15 years. Although companies have always implicitly had some kind of business model, the discussion of the exact concept of business models is rather new (Teece 2010, 174). In February 2015, a Google search for "business model" returned more than 30 million results. Chesbrough and Rosenbloom (2002, 532) conducted the same search in May 2000, when it returned 107,000 references. Conducting a Scopus search for documents that have the term "business model*"[7] in the article title returns 3,072 search results. As figure 5 below depicts, business models were very rarely discussed before the recent change of millennium, and the vast majority of business model documents have been produced in the past 10 years. In addition to the large number of peer-reviewed academic articles where business models are discussed, many practitioners have also embraced the concept of business models in their studies (Zott et al. 2011, 1020). Furthermore, in their literature review, Lambert and Davidson (2013) found 69 articles from 1996 to 2010 where the business model concept was used in empirical studies. Thus, it is safe to argue that there has been a huge explosion of interest in business models.

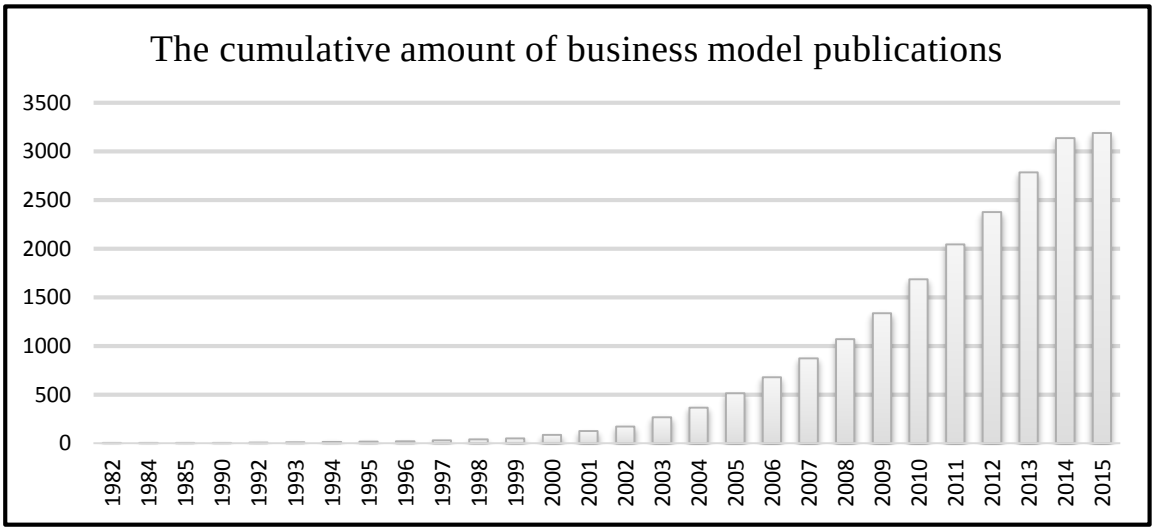

Figure 5 Publications that have "business model" in the title (Scopus 22.4.2015)

[7] Using "business model*" as the search term includes terms such as *business models* and *business modelling*, in addition to just the basic term *business model*.

Regarding the subject areas of the 3,072 documents found in the previously mentioned search, computer science and business and management studies are the most prominent. However, it can also be noted that business models are today applied in many different industries and research fields. This thesis represents information systems science, a subject area that is partly computer science, partly business and management. Scopus lists "information systems" under computer science, whereas "management information systems" is listed under business, management, and accounting.[8]

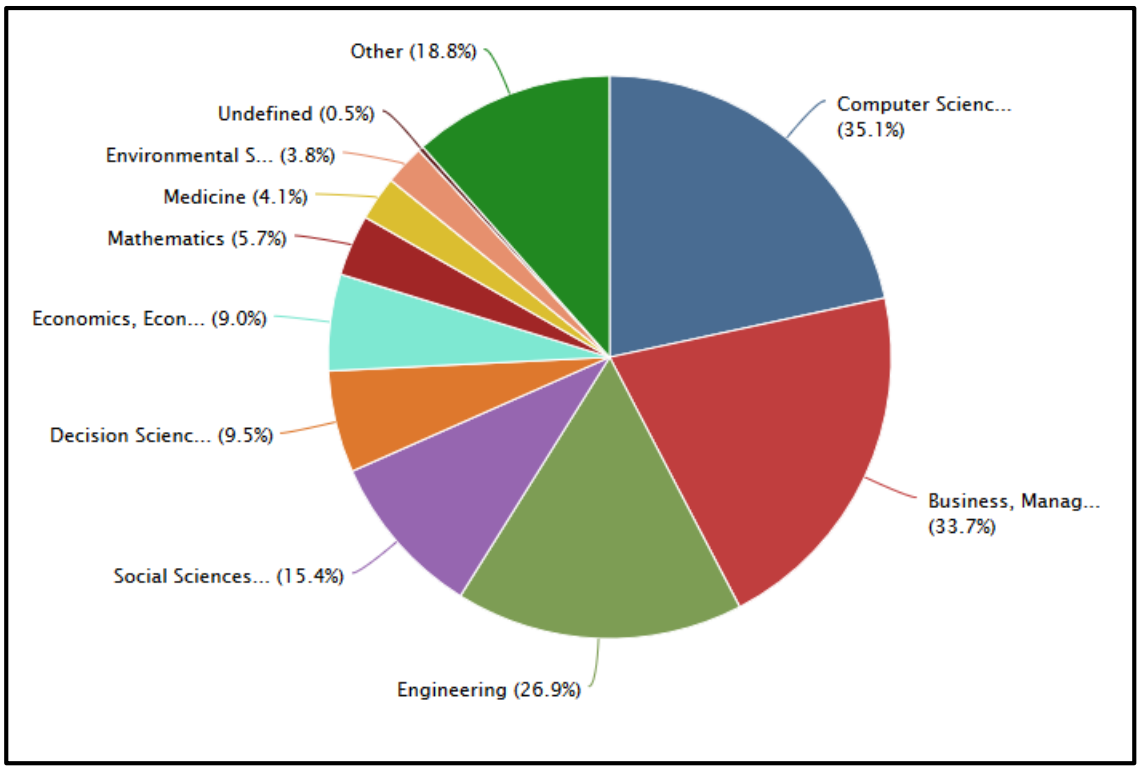

Figure 6 Business model documents by subject area (Scopus 10.2.2015)

Most of the business model studies were conducted within computer science. This finding goes hand in hand with the statement that *business model* as a term gained significant popularity during the dot-com era when e-commerce was starting to gain momentum (Shafer et al. 2005, 202). During the Internet boom, the business model was first considered a fashionable new concept. Many investors and venture capitalists gladly financed new businesses with Internet-based business models and promises of future profits. However, many of these companies failed miserably. In part, this led the business model to receive a rather negative reputation as just a buzzword (Magretta 2002, 86). This view is supported by a finding pointed out by Osterwalder, Pigneur, and Tucci (2005, 4): the NASDAQ stock market index and the popularity of the term *business model* in

[8] http://ores.su/en/journals/scopus/

business journals both follow a rather similar pattern during the years 1996–2003, where a steep rise was followed by a notable crash.

Based on the literature, it can be said that the main reason for the rapid growth of interest in business models is because the business of today is rather different from what it was a few decades ago. Mainly, the growing number of e-commerce companies doing business in new ways has brought business models into discussion (Chesbrough & Rosenbloom 2002, 523). In the same way, Teece (2010, 172) states that the supply side–driven logic of the industrial era is unfit for the business environment that has developed alongside technology and the Internet. The business model gained popularity during the time period that can be called the "new economy" (Morris et al. 2005, 727). Today companies need to be more customer centric and consider new ways of doing business in order to properly create and capture value. Customers of the Internet era often expect many services to be free, thus forcing companies to invent new business models (Teece 2010, 172). In addition, Internet and digital downloading have brought new ways of distribution, and customers have more information available to them than before (Teece 2010, 174). A further factor relates to the network aspect: as technological evolution has enabled companies to interact with different stakeholders in new ways, the focus of organizational design is not on just the internal structures anymore; external stakeholders have to be taken into account more carefully (Zott & Amit 2008, 2). However, despite the business model originally being a concept tightly related to e-commerce, it is these days applicable to any industry (Shafer et al. 2005, 202). This argument is further supported by the breadth of the range of subject areas of business model articles in figure 6 (p. 16).

2.2.2 The different definitions of the business model

Based on the state of the literature, explaining the meaning of the business model concept is not always a straightforward task. Although business models are widely discussed and researched, there is no consensus about the definition of the term *business model* (see, for example, Lambert & Davidson 2013 and Zott et al. 2011). Many studies are conducted without giving a precise definition of a business model, thus implying that the term is sometimes taken for granted. Although numerous studies have explicitly defined the business model, existing definitions do not give a coherent view on the term as they overlap only partially (Zott et al. 2011, 1022). At the most basic level, definitions of the business model view it simply as the firm's economic model (Morris et al. 2005, 726). *Business model* can even be seen as a term that is sloppily used and often ends up meaning nothing (Magretta 2002, 92). In the e-business industry, the term has been used by consultants and practitioners in describing "a unique aspect of a particular Internet business venture" (Mahadevan 2000, 56). From researcher's point of view, the situation

is slightly problematic because the lack of a proper definition and common language has made investigating and evaluating business models difficult (Morris et al. 2005, 727). As a whole, the concept of business models is still somewhat unclear and vague (Al-Debei & Avison 2010, 365), despite the fact that numerous studies (e.g., Zott & Amit 2001; Magretta 2002; Morris et al. 2005) proposed a solid definition in the early phase of the business model literature life cycle.

Some researchers have offered explanations for the missing consensus. Al-Debei and Avison (2010) point out three main reasons why there is so much confusion around the concept: Firstly, the business model is rather new as a concept. Secondly, business models are researched within diverse disciplines. Finally, business models are often linked with sectors that are fairly new themselves, such as Internet-based commerce (Al-Debei & Avison 2010, 360). Furthermore, the business model literature is developing in silos. It can be seen that the three largest streams of literature are (1) e-business and the use of information technology, (2) strategic issues, and (3) innovation and technology management (Zott et al. 2011, 1020). As the business model is a rather interdisciplinary topic, it lacks an "intellectual home" (Teece 2010, 176). Along the same lines, Shafer et al. (2005, 200) consider the lack of consensus to stem from the fact that researchers have different perspectives; different authors look at business models through their own lenses, and this leads to different outcomes regarding the exact definition. A fundamental factor that has to be taken into account is the simple fact that "the word *model* is polysemous," or has many different meanings (Doganova & Eyquem-Renault 2009, 1568). Moreover, Teece (2010, 175) points out that business models are created to solve complex and dynamic real-world problems and thus the business model concept is often tailored to the needs of the specific situation.

Regardless of the lack of consensus on the exact definition of the business model, there have been significant developments in the subject, and there are many things researchers agree on. The field can be seen as moving toward conceptual consolidation (Zott et al. 2011, 1039). Zott et al. (2011) point out four emerging themes that can be found underlying the business model literature. Firstly, it is generally acknowledged that the business model can be used as a tool for analysis that spans the boundaries of a focal firm. Secondly, business models seek to holistically explain how companies conduct business. Thirdly, business model conceptualizations often focus on the activities of the focal firm and its stakeholders. And finally, business models attempt to explain how value is both created and captured (Zott et al. 2011, 1020). Moreover, the popularity of the concept in both academic and practitioner-oriented literature suggests that the business model is seen as a useful descriptive and analytical construct (Lambert & Davidson 2013, 668).

In the following pages, seven different but widely used definitions of the business model are presented and discussed. The definitions are listed in table 6 below. In addition to the definition itself, the table shows three other variables. First, the Google Scholar

citation count is listed in order to give an overview of the popularity of the definition. Second, the scientific background of the definition is given as it helps the reader to place the definition into context and partially aids in explaining the differences between the definitions. Third, in the last column is a summarization of how the respective authors see the business model based on their definition. This information highlights that business models can be viewed from many different perspectives, all leading to slightly different outcomes.

Table 1 Different business model definitions

Author(s)	Year	Definition	Google Scholar citations 9.2.2015	Scientific background	The business model is mainly seen as
Amit & Zott	2001	"The content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities." (p. 511)	3396	E-business	A unit of analysis
Chesbrough & Rosenbloom	2002	"The business model provides a coherent framework that takes technological characteristics and potentials as inputs, and converts them through customers and markets into economic outputs." (p. 532)	2219	Technology and innovation management	A focusing device, a mediator
Magretta	2002	(Business models are) “stories that explain how enterprises work. A good business model answers Peter Drucker’s age old questions: Who is the customer? And what does the customer value? It also answers the fundamental questions every manager must ask: How do we make money in this business? What is the underlying economic logic that explains how we can deliver value to customers at an appropriate cost?” (p. 87)	1903	Strategy, competitive advantage	A story
Morris et al.	2005	"A business model is a concise representation of how an interrelated set of decision variables in the areas of venture strategy, architecture, and economics are addressed to create sustainable competitive advantage in defined markets." (p. 727)	1137	Entrepreneurship, strategy	A set of decision variables
Osterwalder, Pigneur & Tucci	2005	"A business model is a conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific firm. It is a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams." (p. 10)	1365	Information systems	An element-based conceptual tool
Al-Debei & Avison	2010	"This paper defines the BM as an abstract representation of an organization, be it conceptual, textual, and/or graphical, of all core interrelated architectural, co-operational, and financial arrangements designed and developed by an organization presently and in the future, as well all core products and/or services the organization offers, or will offer, based on these arrangements that are needed to achieve its strategic goals and objectives." (p. 372)	185	Information systems	An abstract representation of an organization
Teece	2010	"A business model articulates the logic and provides data and other evidence that demonstrates how a business creates and delivers value to customers. It also outlines the architecture of revenues, costs, and profits associated with the business enterprise delivering that value" (p. 173)	1436	Strategy, innovation management	A possible source of competitive advantage

Zott and Amit (2001, 511) emphasize that the business model is a unit of analysis. The definition is built around business transactions and their content, structure, and governance. *Content* refers to two sets of things: The first is the unit of exchange, either goods or information. The second is the resources and capabilities needed for the exchange to happen. *Structure* describes the participants of the transactions, the way they are connected, and the order and the exchange mechanisms of the transactions.

Governance refers to how the exchanges are controlled, the legal form of organization, and the participants' incentives for the transactions (Zott & Amit 2001, 511). Zott and Amit propose this definition of the business model based both on their analysis of how 59 e-business companies create value and on different theories of strategy and entrepreneurship. The definition draws on value chain frameworks, transaction cost economics, Schumpeterian innovation theory, a resource-based view of the firm, and strategic networks (Zott & Amit 2001, 509–511). In their later work, Zott and Amit (2010) take an activity system perspective on business models, accentuating the activities a firm performs. However, in essence, this view is very similar to their original transaction-based view as "transactions link activities, and transactions and activities can be viewed as two sides of the same coin" (Zott & Amit 2010, 219).

Chesbrough and Rosenbloom (2002) consider business model constructs that mediate the value creation process. Business models take technological innovations and turn them into economical outcomes in a suitable target market. In their view, business models and technological innovations are closely linked; successful companies need to have both in good shape in order to succeed (Chesbrough & Rosenbloom 2002, 550). They emphasize that the business model is a focusing device that mediates between technology and value creation. Furthermore, business models have a cognitive role in commercializing new innovations as the present business model of the company steers the company's perceptions of suitable new technologies (Chesbrough & Rosenbloom 2002, 532). The background of their definition is based on case studies where business models had a strong role in unlocking the potential value of technological innovations. Chesbrough's later works (2007, 2010), discussed later in this literature review, also have a strong technology and innovation focus.

Magretta (2002), on the other hand, thinks that business models are, in essence, stories. She considers business model design to be a lot like story writing. In addition, Magretta's definition is very customer centric as it starts with the question of what the customers want. The definition is twofold in two ways: First, the main definition includes the narrative side, which takes care of customers and their needs, and also the financial side, which emphasizes calculating profits and losses. Second, Magretta points out that business models are variations of the generic value chain, which can be divided into two parts: producing something and selling it (Magretta 2002, 87–88). She argues that when business models are used in the form of good stories, they can help in aligning the employees around the value creation plan of the company, thus providing a "powerful tool for improving execution" (Magretta 2002, 92). Magretta's background as a management consultant and writer can be clearly seen in the simplicity, approachability, and slight entertainment value of the definition.

Morris et al. (2005) synthesized the literature in order to improve the consensus on business models. Based on their analysis, existing business model definitions can be

placed in three categories based on their primary emphasis: economic, operational, and strategic. Of these three, economic definitions are the most rudimentary as they are concerned mainly with the logic of profit generation. Definitions that emphasize the operational level focus on the internal processes and the architecture of the firm that enable value creation. Strategically oriented definitions take into account elements like competitive advantage, growth, and interorganizational interaction. Related to these three categories are the many decision variables included in each one. The definition proposed by Morris et al. (2005, 726–727) is based on these findings. Furthermore, Morris et al. point out that that the business model can be used as a focusing device to guide the actions of entrepreneurs and employees. This can be further supported by the use of rules or guidelines that provide criteria for the selection of customers, for example, or set the limit for maximum daily costs (Morris et al. 2005, 731, 734).

Osterwalder et al. (2005) analyzed the literature in order to build a framework based on the building blocks of the business model (presented later in this study), and in the process, they developed a definition of the business model. Their definition emphasizes that the business model is a conceptual tool based on a set of interconnected elements. They underline that breaking the business model down this way helps to provide a common language (Osterwalder et al. 2005, 10–11). In addition, Osterwalder et al. point out that there is strong link between business models and information systems because information technology (IT) is a strong driving force behind new and innovative business models. Moreover, business models could provide a helpful tool to improve the use of IT in organizations by providing a common understanding between business and information systems. This would lead to a better alignment between business needs and information systems. Thus, the link between business models and information systems is twofold (Osterwalder et al. 2005, 17–18).

Al-Debei and Avison (2010) conducted a comprehensive literature review and content analysis in order to provide a unified conceptual framework for the business model. The authors argue that their definition is applicable to the complex nature of today's business. Among the different definitions in table 1 (p. 22), the definition by Al-Debei and Avison stands out as the most comprehensive, but it can also be seen as the most complicated. For this reason, it can be speculated that this definition, despite its completeness, has not been widely embraced by other researchers, which can be seen by the relatively low number of citations.

Teece (2010) has a similar view on the business model as Chesbrough and Rosenbloom (2002). According to Teece (2010, 172), "Without a well-developed business model, innovators will fail to either deliver—or to capture—value from their innovations." Teece points out that the role of the business model is to define how value is created and delivered to customer and how payments are converted to profits. Technology has a significant role in the business model; it provides a starting point for

the value creation. Thus, first selecting the appropriate technology and outlining its benefits to customers is crucial in business model development. Furthermore, Teece emphasizes that business model innovation can itself be a source of competitive advantage (2010, 173).

In conclusion, the definitions discussed here highlight the complexity of business models. Although all of the definitions have something in common, there is a notable amount of variance in how business models are seen. It can be argued based on the definitions that the main role of business models is to describe or analyze how the focal company works. The business model can be seen as, for example, a tool (Osterwalder et al. 2005, 10), a representation (Morris et al. 2005, 727; Al-Debei & Avison 2010, 372), or a story (Magretta 2002, 87). As noted by Zott et al. (2011, 1020), value creation and value capture are present in every definition, either implicitly or explicitly. Simply put, all business models in a way describe how an organization can first produce something valued by customers and then profit from it. The differences between the definitions are often related to the way different authors take slightly different perspectives on how value is created or captured: For example, Zott and Amit (2001) emphasize transactions as the focal point of business model design, whereas Chesbrough and Rosenbloom (2002) and Teece (2010) highlight the interplay of technological innovations and business models in value creation.

This research adopts the definition by Osterwalder et al. (2005). The reason for this is twofold: First of all, in this thesis the business model is analyzed through its components, an approach similar to that of Osterwalder et al. Secondly, the definition by Osterwalder et al. excels at explaining the concept of the business model in a clear and comprehensive way.

2.2.3 Business models versus strategy

Since it is sometimes difficult to define precisely what a business model is, many researchers attempt to make the concept clearer by comparing business models to concepts that are often linked with them, often strategy. Magretta (2002) and Shafer et al. (2005) separate business models from company strategy, whereas Zott and Amit (2008) take a more focused stance on strategy and compare business models to product market strategy. Casadesus-Masanell and Ricart (2010) go even further, devoting a whole article to explaining the differences in the concepts strategy, business model, and tactic.

Magretta (2002) explains that the difference between a strategy and a business model is related to competition. Whereas a business model gives a system-oriented description of the components of a company and their mutual fit, a strategy is supposed to explain how the company is going to be better than its rivals. Strategy, in Magretta’s view, is in

essence about being different from competitors. The same business model can be used in many ways. For example, Wal-Mart uses the same discount-retailing business model as many other companies. However, Wal-Mart became successful by following a strategy of serving different customers in different markets. Many competitors focused on large cities, whereas Wal-Mart decided to locate in small towns. Because of this strategy and despite Wal-Mart having the same business model as its competitors, Wal-Mart became very successful as it was able to reclaim a territory that was left untouched (Magretta 2002, 91).

Shafer et al. (2005, 203) consider that although there are many definitions of strategy, they all share the common element of making choices. The role of the business model is to reflect these choices and the implications they have on the operational side. Shafer et al. demonstrate these two concepts by comparing them to the construction of a custom home. First, a vision of the future home and a design laying out the rough structure of the house are planned. Then, according to the choices made, a detailed floor plan and elevation are designed. The former symbolizes the strategy and the latter the business model. The business model helps in analyzing and understanding the strategy as it concretizes the choices made into possible operational options (Shafer et al. 2005, 203).

Zott and Amit argue that the company's product market strategy and business model are two separate, independent constructs (2008, 2). The product market strategy addresses the main question of how the company should position itself against its rivals. The choice of products, customers, and markets is considered when discussing product market strategy, as well as the timing of market entrance. Often, product market strategy is about the decision whether to adopt cost leadership and/or differentiation. The business model, on the other hand, is seen as the structure in which the focal firm conducts business with its different stakeholders. The stakeholders include, among others, customers and suppliers, and the focal firm should consider, for example, what to exchange with whom and how the transactions should be made. The scope is thus much broader and spans the boundaries of the focal firm (Zott & Amit 2008, 5). After pointing out that the business model and product market strategy are distinct constructs in theory, Zott and Amit prove their point by conducting an empirical, quantitative analysis (Zott & Amit 2008, 19). However, they also highlight that both the business model and the product market strategy are of strategic importance to the company and that the design of either one affects the other (Zott & Amit 2008, 20).

According to Casadesus-Masanell and Ricart, the business model is the logic of the firm—that is to say, the way the company creates value by its operations. By contrast, strategy is essentially the choice of business model. In other words, when planning a strategy, the company selects a business model that it uses to compete against its rivals. The strategy thus defines the business model. In addition, Casadesus-Masanell and Ricart point out the concept of tactics, which refers to residual, minor choices that can be made

based on the chosen business model. These tactical choices can be related to pricing or advertising, for example, but their options are restricted by the chosen business model. As an illustration, Casadesus-Masanell and Ricart use an analogy of an automobile: The strategy can be compared to the design of an automobile, the choices related to its engine and seats, for example. The automobile in turn represents the business model. Tactics, however, can be compared to how the automobile is driven. The driver can, for example, go fast or slow and make choices whether to keep windows down or the radio silent (Casadesus-Masanell & Ricart 2010, 196, 204–206).

In conclusion, all of the aforementioned authors highlight that strategy is different from business model. However, the way they differ varies slightly between the authors. Shafer et al. (2005) and Casadesus-Masanell and Ricart (2010) seem to agree that strategy is a fundamental choice or design that precedes or determines the business model of a company. They both emphasize that the business model is a reflection of the strategy. By contrast, Magretta (2002), and Zott and Amit (2008) point out that these are two separate concepts, and their main difference is related to competition and positioning against rivals. Strategy is seen as the way a company differentiates itself. This competition aspect is also present in the definitions of Casadesus-Masanell and Ricart (2010) and Shafer et al. (2005), but their view differs by the ontological order of these two concepts: strategy is decided first and then the business model, whereas Zott and Amit (2008) and Magretta (2002) consider them to be present simultaneously but on different levels and with different purposes. As a further note, based on Google search trends, Osterwalder and Pigneur's concept of the Business Model Canvas is gaining popularity whereas strategic plan is losing popularity, thus possibly implying that some companies are replacing their strategy with business model thinking (Amarsy 2015).

2.3 Factors behind a business model's success

2.3.1 Common problems associated with business models

Chesbrough (2010, 354) points out the significant role of business models: "the same idea or technology taken to market through two different business models will yield two different economic outcomes." After all, many companies fail even though they seem to have great ideas and the necessary resources to turn these ideas into profitable businesses. These failures can often be traced back to lack of a proper business model (Morris et al. 2005, 726). Thus, given the importance of business models, taking the common problems of business models into consideration is important for a company's success.

Shafer et al. (2005) discuss four problems of business models associated with their creation and use: (1) *Flawed assumptions underlying the core logic*. The business model faces significant risks when the cause-and-effect relationships and assumptions about the future are not well grounded, tested, or logical. Furthermore, the components of the business model should be internally consistent and mutually supportive. (2) *Limitations in the strategic choices considered*. In other words, the business model should cover all the issues related to the firm's value capture and creation. (3) *Misunderstandings about value creation and value capture*. Shafer et al. point out that many executives are focused on creating value but forget to think about proper ways to capture it. A further common problem occurs when executives confuse potential value with actual value. (4) *Flawed assumptions about the value network.* It can be detrimental to assume that the value network of the firm resides in a stable and secure state. In this case, when a partner changes its course of action, the focal firm can end up having severe problems (Shafer et al. 2005, 204–206).

In relation to the flawed assumptions, Chesbrough (2010, 358–359) points out that inside companies it is often far from clear to the executives and managers what the right or best business model ought to be. In addition, companies tend to close their eyes when it comes to conflicting information about their business models and thus are resistant to changing their business model even when needed. When companies have invested time and money into building their structures and products, they tend to filter out information that conflicts with their existing views and, in turn, muster information that supports their current course of action (Chesbrough 2010, 358–359). Chesbrough points out as an example that the traditional business models of the music recording industry have been problematic for some time already, but new business models are only slowly emerging because the incumbent firms are not willing to experiment (2010, 357).

2.3.2 The elements of successful business models

Evaluating business models it not an easy and straightforward task. At the most basic level, a business model can be considered good if the company is successful. However, it is not always the business model that leads to success (Chesbrough & Rosenbloom 2002, 551). Zott and Amit (2007, 183) point out that by increasing customers' willingness to pay or by lowering the opportunity costs of partners, business models can create value. Thus, a good business model should seek to carry out at least one these two objectives. Similarly, Magretta (2002) suggests that business models should pass two critical tests. The first one is the narrative test. This means that the business model should, in essence, offer an attractive value proposition to a defined set of customers. The second one is the numbers test. Simply put, the profits and costs have to make sense in order for the

company to succeed (Magretta 2002, 90). Along the same lines, Gordijn and Akkermans (2001) emphasize economic feasibility in business model evaluation. In their view, all actors involved in the model have to make a profit or gain economic utility in order for the business model to feasible. In ensuring feasibility, profit sheets and what-if scenarios can provide valuable tools and should be extensively used (Gordijn & Akkermans 2001, 16–17).

Furthermore, a good business model is easily communicated and used as a communication device. According to Gordijn and Akkermans (2001, 14), the e-business environment is very dynamic, and thus it can be advantageous for a business idea to rapidly be defined, explored, and executed with an agile business model. Similarly, Osterwalder et al. (2005, 10–11) emphasize that successful business models are easily communicated with a shared language. Along the same lines, Doganova and Eyquem-Renault (2009) consider that good business models allow the demonstration of the company's narrative and basic economic calculations in a simple form.

In addition, the performance indication factors of business models have been empirically studied to some degree. According to the results of statistical analyses conducted by Zott and Amit (2007; 2008), novelty-based business models (providing new ways of making transactions) are often more successful than efficiency-based business models (providing more cost-effective transactions). In addition, their results showed that a company can gain significant competitive advantage by having a superior business model (Zott & Amit 2008, 19). Sánchez and Ricart (2010) compared isolated and interactive business models in the context of low-income markets, finding interactive business models (focused on utilizing external resources also) more promising. However, by contrast, Camisón and Villar-López (2010, 29) found that different business models do not statistically significantly affect the performance of companies at all.

2.4 Different business model frameworks

The term *analysis* originates from the Greek word *analyein*, which refers to breaking something up.[9] Similarly, the philosophy of *logical atomism* (see, for example, Russell 1919) is based on the belief that understanding the world requires understanding its individual components. In business model literature, component-based frameworks are often used to clarify the concept of the business model. In addition to component-based frameworks, use case maps (Gordijn & Akkermans 2001) and causal loop diagrams (Casadesus-Masanell & Ricart 2010), among others, also have been developed to describe business models. These frameworks focus more on the business process and the cause-and-effect relationships of the business models. Although they provide a way to potentially analyze business models, component-based frameworks are the focus of this study. However, for the sake of comparison, use case maps and causal loop diagrams are briefly discussed before the concentration shifts to component-based frameworks.

Gordijn and Akkermans (2001) have developed the e3-value business modeling approach that links rigorous IT architecture analysis with economic value perspective. Their business modeling method is focused on describing the whole process and thus emphasizes how value is added along a chain (Gordijn & Akkermans 2001, 12–13). The e3-value modeling method is best depicted by an illustrative example, in figure 7 below.

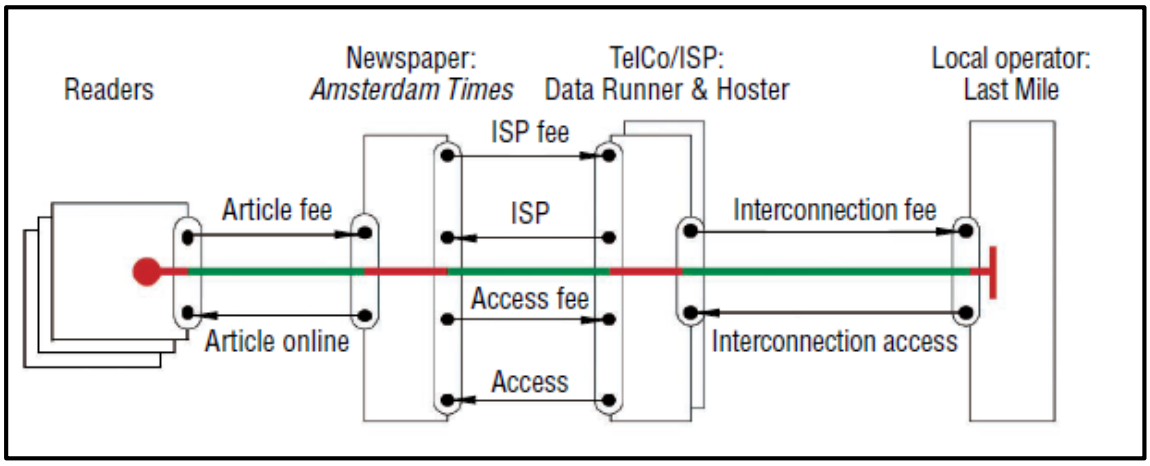

Figure 7 A business model depicted using the e3-value approach (Gordijn & Akkermans 2001, 13)

This approach not only describes who is conducting business with whom but also illustrates what kinds of value transactions are included in the business model chain. Gordijn and Akkermans emphasize that it is important for the company to know where the value comes from and who is creating the value in order to remove or add new parties

[9] Source: http://www.merriam-webster.com/dictionary/analysis

to the business model. The approach was developed as the authors believe lightweight modeling techniques are needed that can quickly express and communicate the business model ontology to important stakeholders (Gordijn & Akkermans 2001, 13–14).

Casadesus-Masanell and Ricart (2010) approach business modeling by presenting causal loop diagrams that reflect business model–related choices and their consequences. Their framework integrates choices related to strategy, business models, and tactics (as discussed in chapter 2.2.3) and points out how these different choices affect the business model. An example of a causal loop diagram is depicted below in figure 8.

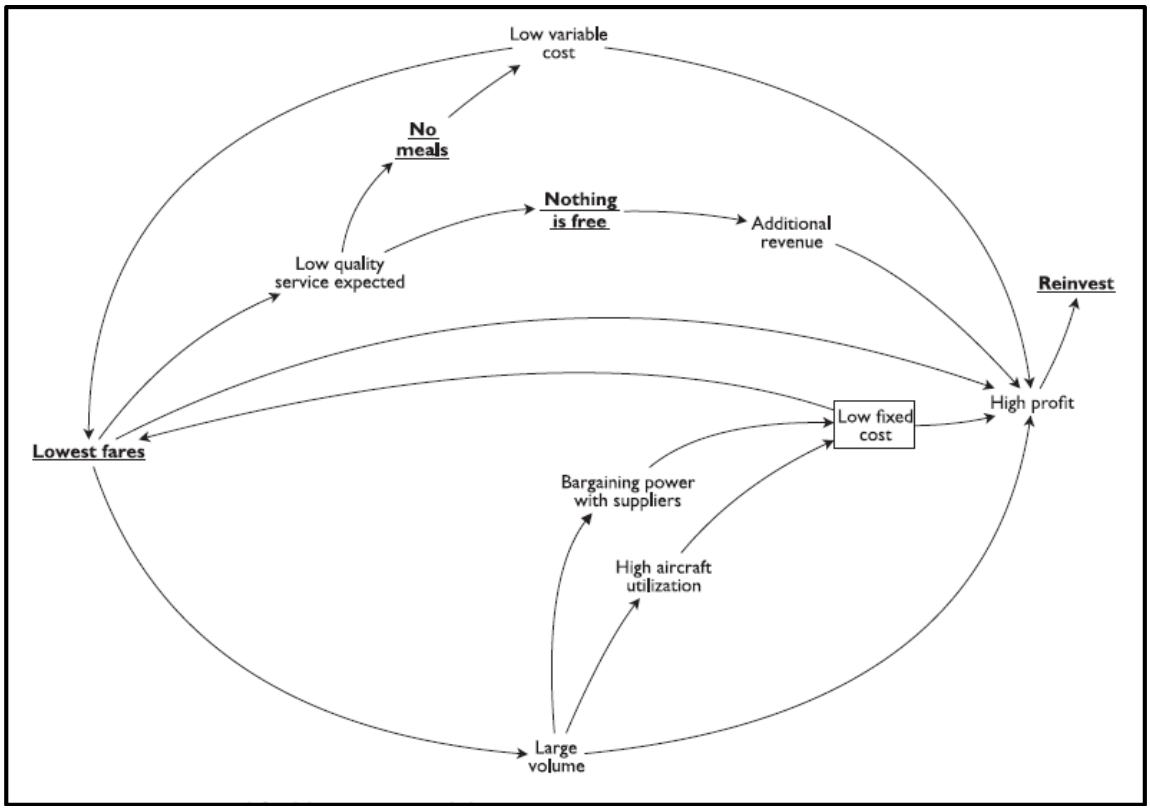

Figure 8 An example of a causal loop diagram (Casadesus-Masanell & Ricart 2010, 201)

Casadesus-Masanell and Ricart emphasize that companies can make choices related to their policies, assets, and governance structures. These choices have consequences that are either *rigid*, or slow to change, or *flexible*, or rapidly changing in response to the choices that generate it. For example, a reputation for affordable prices is a consequence that is rigid and thus changes slowly over time, whereas large sales volume is a flexible consequence that depends on pricing choices. Business models are reinforced by *virtuous cycles* that can strengthen rigid components as the business cycles spin. For example, low prices first cause high volumes, and high volumes in turn increase the company's bargaining power with suppliers (Casadesus-Masanell & Ricart 2010, 198–202).

Nevertheless, in this thesis, component-based business model frameworks are used as the main unit of analysis. The main reason is that breaking business models down to components helps in providing a common language (Osterwalder et al. 2005, 10–11). However, emphasizing component-based structures does not exclude the use of other approaches, and the different modeling techniques can complement each other. As Casadesus-Masanell and Ricart (2010, 197) pointed out, "to better understand business models, one needs to understand their component parts and their relationships."

The Business Model Canvas by Osterwalder and Pigneur (2010) is one of the most popular business model frameworks: Kajanus, Iire, Eskelinen and Heinonen (2014, 603) pointed out that they have used it on many occasions during research and real-world business planning. Later in their article, Kajanus et al. (2014, 605) stated that the Business Model Canvas "has become quite popular (especially among practitioners) and even become a de facto standard when formulating business models." This argument was reinforced when it was reported that the framework has been downloaded over 5,000,000 times, and some top-ranked business schools such as Stanford and Harvard are using it in business model teaching and research (Amarsy 2015).

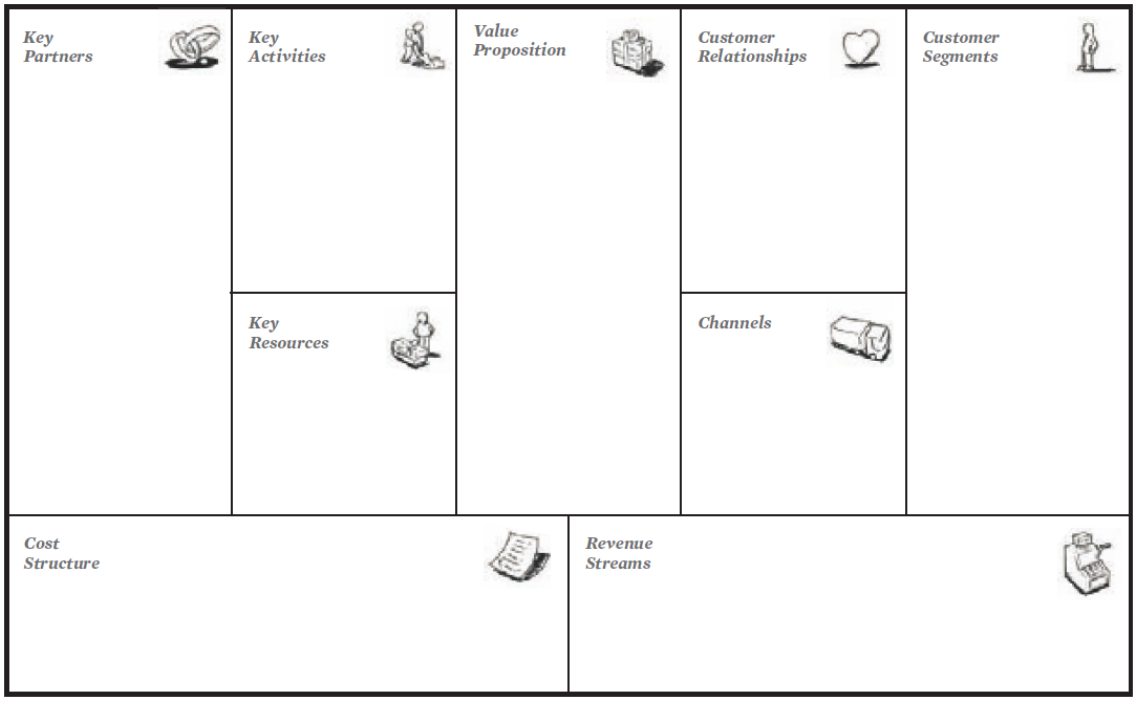

Figure 9 The Business Model Canvas (Osterwalder & Pigneur 2010)

Although the Business Model Canvas (figure 9) has gained a notable amount of advocates, it is not by any means the only popular component-based business model framework. For this research, altogether nine component-based business model frameworks were selected for further analysis. The selected frameworks are listed in table 2 on the next page.

Table 2 Component-based business model frameworks

Authors	Components
Chesbrough & Rosenbloom 2002	Value proposition, Market segment, Revenue generating mechanism, Stucture of the value chain, Complementary assets needed, Revenue mechanism, Cost structure, Profit potential, Value network position, Competitors and complementaries, Competitive strategy
Hedman & Kalling 2003	Customers, Competitors, Offering, Activities and organisation, Resources, Suppliers, Longitudinal process component
Morris et al. 2005	Offering (value proposition, distribution, bundling, product or service type, level of customization), Market factors (customer segment, customer relationship), Internal capability factors (key resources and activities, value network), Competitive strategy factors (Brand, differentiation), Economic factors (Revenue model, operating leverage, margins, volumes), Personal / investor factors (growth plans)
Shafer et al. 2005	Strategic choices (Customer, Value proposition, Capabilities/competencies, Revenue/pricing, Competitors, Output (offering), Strategy, Branding, Differentiation, Mission), Value network (Suppliers, Customer information, Customer relationship, Information flows, Product/service flows), Create Value (Resources/assets, Processes/Activities) Capture value (Cost, Financial aspects, Profit)
Johnson et al. 2008	Customer Value Proposition (Target customer, Job to be done, Offering), Profit formula (Revenue model, Cost structure, Margin model, Resource velocity), Key resources (People, Technology, Products, Equipment, Information, Channels, Partnerships, Alliances, Brand), Key processes (Processes, Rules and metrics, Norms)
Hwang & Christensen 2008	The value proposition, Profit formula (cost structure, margins, velocity), Processes, Resources (people, technology, products, facilities, equipment, brands and cash)
Osterwalder & Pigneur 2010	Customer segments, Value propositions, Channels, Customer relationships, Revenue streams, Key resources, Key activities, Key partnerships, Cost structures
Vanhala & Kasurinen 2014	Customer relationship, Customer segment, Financing, Human capital, Innovation process, Key activities, Key partners, Key resources, Marketing
Hartmann et al. 2014	Key resources (data), Key activities, Value proposition, Customer segment, Revenue model, Cost structure

The first seven frameworks were chosen for their popularity: The first five frameworks are among the 20 most-cited business model articles (see appendix 1). Hwang and Christensen (2008) and Osterwalder and Pigneur (2010) represent a more practitioner-oriented perspective as they have all authored best-selling books about business models. However, the last two frameworks were selected because they have a more focused approach. The framework by Vanhala and Kasurinen (2014) is used because it represents the components that are typical for computer game start-ups. In addition, Hartmann et al. (2014) have proposed a framework for data-driven business models that accentuates data as the key resource for a firm. In the context of medical games, both focus areas – games and data – appear important, thus justifying the use of these two frameworks in this study. It should be noted that the synthesized framework is not restricted to the context of medical games but is suitable in all industries. Thus, the last two selected frameworks are seen as extending the scope instead of limiting it.

2.5 A synthesis of the existing business model frameworks

As a major part of this literature review, the component-based frameworks presented in the previous chapter (table 2, p. 33) were broken down and analyzed. The aim of this analysis was to develop the concept of the business model further by synthesizing the literature. The motivation behind the synthesis was the ongoing ambiguity of the business model concept, as pointed out in chapter 2.2.2. Furthermore, Morris et al. (2005, 727) argued that "progress in the field has been hindered by lack of consensus over the key components of a model."

Regarding the nine frameworks (table 2, p. 33), it is obvious that they have common components but also some variance in their content. In this synthesis, the objective was not to leave any elements out but to build a comprehensive model that provides a priority-based classification for the different components. Further criteria for the synthesis were that (1) the resulting framework had to be based on the literature, (2) the synthesis had to develop the concept further, (3) the resulting framework had to contain all the important elements but still maintain a simple layout, and (4) the framework needed to offer many business component options but using of all of them should not be required. As a result, the framework could act as an instrument in business model design and innovation, offering structure and clarity to complex situations.

The synthesis was conducted by performing a content analysis on the selected nine business model frameworks. The material-driven content analysis followed the template and guidelines of Tuomi and Sarajärvi (2002, 110–112). The process is depicted in figure 10 below.

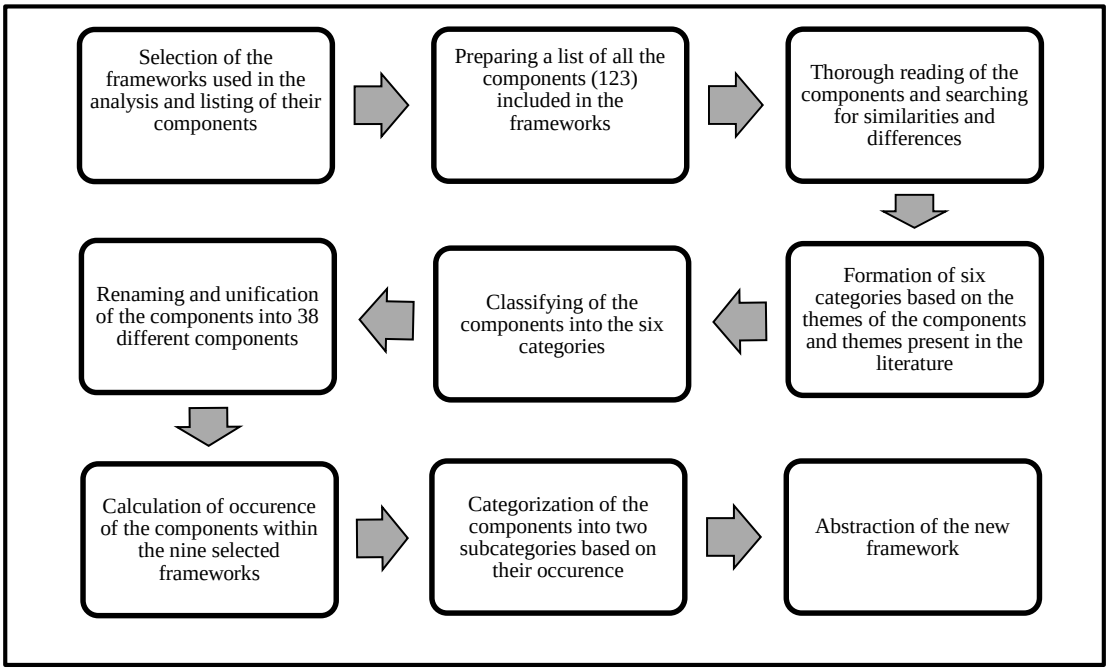

Figure 10 The framework-building process

The nine frameworks were first broken down and their elements listed, resulting in 123 components. Next, the list of the components was carefully read and analyzed for similarities and differences. After an understanding of the nature of the components was established, six categories were formed that reflect the different dimensions of a business model. These categories are internal capabilities, customer, value proposition, profit formula, value network, and strategic factors. Next, the components were unified and renamed (see appendix 2), and the occurrence of each component in the nine frameworks was calculated. The occurrence of the different components is shown below in figure 11.

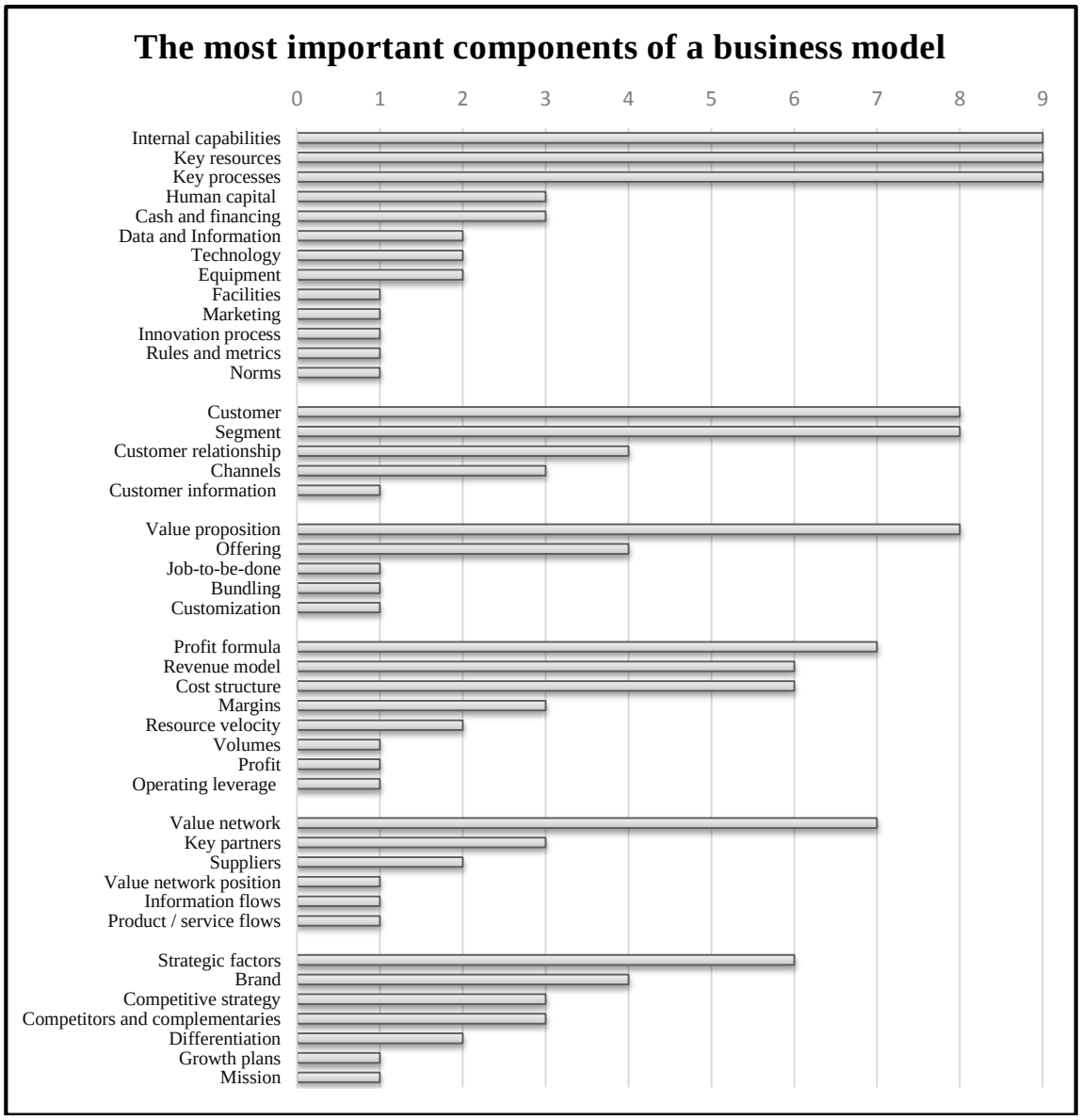

Figure 11 The proportional occurrence of the different business model components in existing business model frameworks

Based on the results of the content analysis, a new framework is proposed (depicted in figure 12 below). The framework consists of six dimensions: value proposition, customer,

internal capabilities, profit formula, value network, and strategic factors. The criteria for the formation of these dimensions were that they had to cover all the possible aspects of a business model present in the literature and needed to clearly separate concepts that differed.

As a classifying factor, the dimensions, except for value proposition, are split into two tiers: *The first tier* includes components that are more general by nature and occurred more often in the literature. *The second tier* is composed of components that are more situational and more specific to individual companies, and components that were rarely mentioned in the literature.

Furthermore, the construction of the framework follows the basic advice provided by Miles and Huberman concerning simplicity (1994, 22): conceptual frameworks are best depicted graphically instead of in text, and the framework should fit on a single page.

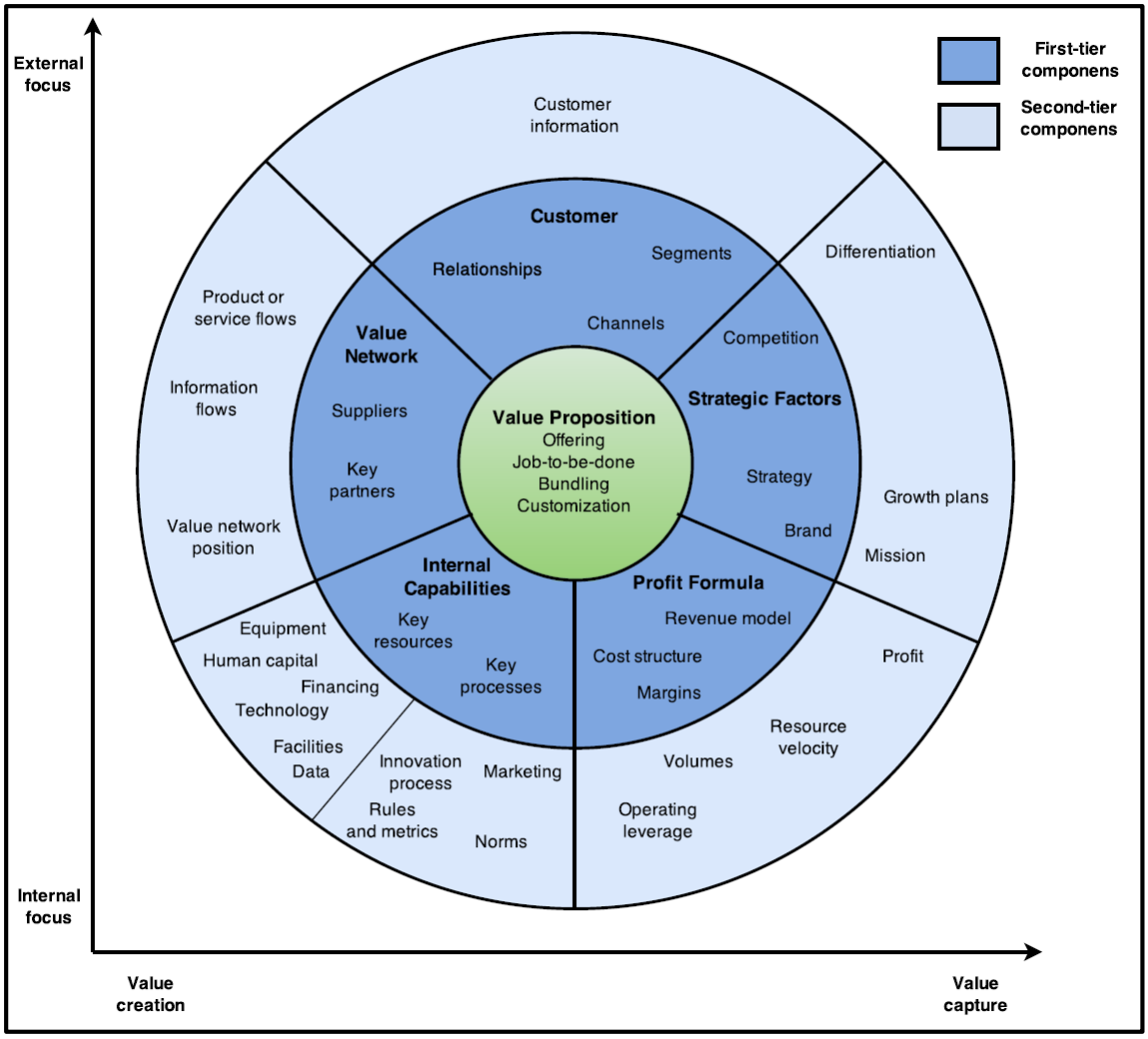

Figure 12 The conceptual business model framework

In order to add more depth to the conceptual framework, the business model dimensions and their respective components are placed in the figure according to their

position in two different scales: On the vertical axis, the dimensions are measured based on their rate of internal (within the focal firm) or external (outside the focal firm) focus. On the horizontal axis, the dimensions are classified based on their relation to value creation and capture. Value creation refers to producing products or services that are valuable to certain customer segments, whereas value capture refers to the company taking a profit based on the created value (e.g., Shafer et al. 2005, 202). The dimensions are briefly discussed next.

The value proposition refers to the way the company can create value for the customer by, for example, getting an important job done (e.g., Johnson et al. 2008, 52). Thus, the value proposition essentially describes the offering and its value to the customer. In addition, the decisions regarding bundling products and/or services into a package and the level of customization are closely related to the value proposition (Morris et al. 2005, 730). In this framework, the value proposition is the centerpiece of the business model: it is both the manifestation of value creation and the antecedent of value capture, and it requires both internal and external stakeholders' participation to be delivered.

The customer dimension articulates to whom the value is created. Different customer segments define the different groups the company wants to serve. Customer channels in turn describe how the value is delivered to the customers, and customer relationships define how the company keeps in touch with the customers (e.g., Osterwalder & Pigneur 2010, 20). Customers are closely related to the value proposition; they are the target of the value that is created by the company (Magretta 2002, 87).

The internal capabilities describe the most important processes and resources needed for value creation. Key resources and processes were the only components that were present in all selected nine frameworks (see figure 11, p. 33).

The value network is formed by the most important partners and suppliers that are needed for the business to work. The value network thus describes the capabilities of the company that are not internal. A value network is needed as "neither value creation nor value capture occurs in a vacuum" (Shafer et al. 2005, 202).

Profit formula describes how the company captures value. In order for value to be captured, the revenue streams from customers have to exceed the costs of value-creating activities (Osterwalder & Pigneur 2010, 30, 40). Furthermore, companies can differ significantly in regard to the volumes, margins, and operating leverages related to the profit formula (Morris et al. 2005, 730).

Furthermore, although strategy is a different concept from the business model, a business model should still take into account certain strategic factors, such as the brand, competition, and the strategy the competition is attacked with (e.g., Shafer et al. 2005, 202).

2.6 The role of business models in technological innovation

Business models can be seen as devices that either improve or hinder the rate of technological innovation. Initially, a fitting business model unlocks the hidden potential of a new product or service. However, the logic of the business model then restricts the search for new technologies or business models later on (Chesbrough & Rosenbloom 2002, 529). If a company comes up with a possibly remarkable innovation but the innovation does not fit the company's current and familiar business models, the innovation is often abandoned for being too difficult to utilize. Because of this, the majority of innovations sit on the shelf, unused and dormant. The disuse of innovations is further increased due to two factors: innovation costs are rising and products have shorter time cycles than before (Chesbrough 2007, 23–24). The case of Xerox Corporation demonstrates the significant effect that business models have on new technological innovations: Xerox first gained huge success by employing a totally new business model on a new copier technology. The copiers were very powerful and produced high-quality copies, but they were expensive to manufacture and thus hard to sell as they could not be given to customers for a low price. Other manufacturers abandoned the technology as they thought it was doomed to fail. Xerox then came up with the idea to lease the machines for a small monthly payment and charge for the number of copies made. This new business model changed the whole industry and made Xerox a very successful company. However, many new promising technologies were later invented in Xerox's laboratories, but the old business model of Xerox was not suitable for them. Eventually, the new technologies became successful only after spin-off companies from Xerox pursued them with completely new business models (Chesbrough & Rosenbloom 2002). From this case it can be concluded that a business model can thus be considered great only when paired with a suitable technology, and vice versa.

Chesbrough (2007) strongly suggests that companies should open up their business models in order to improve the rate of innovation. This means that companies should seek new ideas developed outside the focal company and allow their own dormant innovations to be used by other firms. Open business models can enhance both value creation and value capture. Value creation is improved because the company can leverage ideas that come from external sources, thus allowing the company to have a bigger pool of innovations to exploit. Value capture is easier as the company can utilize its own innovation resources better: some great innovations that are difficult to commercialize in-house can be sold to other companies (Chesbrough 2007, 22).

2.7 Business model innovation

2.7.1 Business model innovation as a source of advantage

Zott and Amit (2007) emphasize that for entrepreneurs, business model design is a crucial task that can be an important source of wealth creation. In their later work, Zott and Amit also highlight that for general managers of larger companies, business models are a pivotal decision-making area (2010, 217). Business model innovation should not be limited to recombination of the focal firm's internal resources. The focal firm should seek to harness the resources possessed by the partners, suppliers, and customers included in the business model (Zott & Amit 2007, 195). Competitive advantage can be achieved through business model innovation, but the new business model has to be different enough and hard to replicate (Teece 2010, 173). Moreover, as Chesbrough and Rosenbloom (2002) pointed out, without business model innovation, even groundbreaking innovations can be left without commercial success.

Although business model innovation is widely stated to be crucial for success in the literature, slightly dissident views can be found. Aspara, Hietanen, and Tikkanen (2010) analyzed approximately 500 companies, looking for financial performance implications in relation to the strategic emphases on business model innovation (creating completely new business models) and replication (using an existing successful business model in a new market). The most notable findings are related to company size: Large firms that emphasize both business model innovation and replication have superior average performance, whereas focusing on just business model innovation is linked with lower average performance. Given the perceived importance of business model innovation, it is rather surprising that large companies focusing on neither performed better than those emphasizing just business model innovation. For small companies, it sufficed to emphasize only business model innovation to reap superior results (Aspara et al. 2010, 51–53).

A further argument against the importance of business models innovation is provided by Camisón and Villar-López (2010, 29), who found, using a variance analysis, that no significant difference in performance between different business models can be found. However, it should be noted that Camisón and Villar-López, deviating slightly from other business model definitions, define the business model concept through three key dimensions: organizational structure, degree of diversification, and management of the value chain.

2.7.2 Considerations for business model innovation

According to Gordijn and Akkermans (2001), the business model design, at least in the context of e-business, should take three viewpoints and their requirements carefully into account: Firstly, the business model should consider the business value viewpoint and how the model creates value for the company and its stakeholders. Secondly, the business process viewpoint should be taken into account; the business model should fit with the company's processes and not cause problems for the workers' daily tasks. Thirdly, the business model should be compatible with the IT architecture of the company (Gordijn & Akkermans 2001, 10).

Some researchers suggest approaching business model innovation through trial and error. According to Chesbrough (2010), business modeling tools such as mapping can offer significant help to companies who want to innovate new business models. These tools enable companies to examine and plan different options before making any real investments. However, in order to achieve real change, companies have to introduce organizational processes that enforce business model innovation. Chesbrough recommends three sets of processes: The first ones are related to experimentation. Companies should strive to quickly and often experiment with new business models, preferably with real customers. Experimentation allows the company to gather information about how the market responds to new ways of doing business. The second set of processes concerns effectuation. These processes encourage companies to act instead of just analyzing. This means that the results from experimentation should be put to use in larger scale. Taking action provides companies with further information about the success of new business models. The third set of processes focuses on change management. This is especially important in situations where existing business models are changed or replaced. The company should clearly identify the leaders for business model change and nourish an organizational culture that supports the transformation process (Chesbrough 2010, 359–362). Magretta (2002) has a similar view on business model design: "Business modeling is the managerial equivalent of the scientific method—you start with a hypothesis, which you then test in action and revise when necessary" (5).

In the literature, component-based business frameworks are often used as tools in business model innovation or design. Kajanus et al. (2014) used a slightly modified Business Model Canvas (Osterwalder & Pigneur 2010) as a tool in designing a new business model for a medium-sized manufacturer of value-added wood products. The tool was used in combination with a workshop-based design process, and the executives of the case company reported that their business model understanding improved, the business model vision was created more rapidly, and the action plans were faster finalized (Kajanus et al. 2014, 612). Barquet, Oliveira, Amigo, Cunha, and Rozenfeld (2013)

reported similar results in their research, where the Business Model Canvas was used as a research tool in the adoption of product-service systems. The use of the framework guided the process of business model analysis and allowed an improved understanding and discussion to be achieved concerning the company's business models (Barquet et al. 2013, 702). Furthermore, Osterwalder and Pigneur (2013, 240) point out that in addition to frameworks, computer-aided design tools can be of help in business model design and visualization when, for example, prototyping and simulating different versions.

Furthermore, Zott and Amit (2001) have developed a framework for the common design themes of business models. These design themes are used to describe the business model's dominant value creation drivers in their later work also (Zott & Amit 2010, 221). The framework (figure 7 below) is presented here as it represents one of the classical theories related to business models. Additionally, the four design themes provide a solid foundation and further considerations for business model design and innovation.

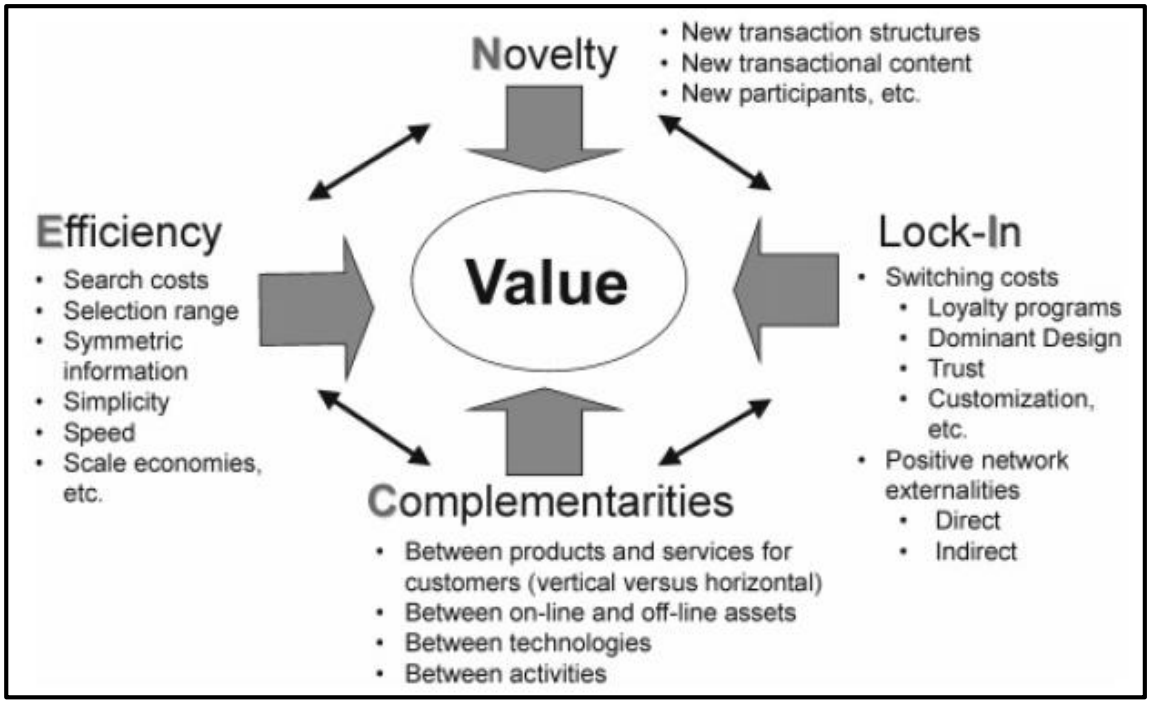

Figure 13 Sources of value creation in e-business (Zott & Amit 2001, 504)

Zott and Amit (2001, 504) suggest that business models should seek to increase novelty by introducing new ways of doing transactions, and efficiency by improving the speed of processes and reducing costs. Furthermore, locking customers in by, for example, structuring switching costs helps the company to create value. Moreover, providing complementary products and services can create a significant amount of value for the company (Zott & Amit 2001, 504). These complementary aspects, also known as bundling, are also often pointed out in the business model literature (e.g., Morris et al. 2005, 730).

Osterwalder and Pigneur (2010) have divided the business model design process into five phases: (1) In the first phase, “Mobilize,” the need for a new business model is established, in addition to a common language. (2) In the second phase, “Understand,” the elements of the business model are researched by, for example, conducting interviews. (3) The third phase, “Design,” comprises the actual design of different business model prototypes. Furthermore, the prototypes are then tested. (4) In the fourth phase, “Implement,” the selected business model is implemented. (5) In the final phase, “Manage,” the business model is constantly monitored, evaluated, and modified in order to evolve it even further (Osterwalder & Pigneur 2010, 248–249).

Furthermore, concerning the business innovation process, Chesbrough (2007) highlights several considerations for the implementation phase. If a company wants to change its business model, the top management has to completely support the idea and show clear commitment. Repeated experimentation is often needed, and the company has to act on the information the experimentation yields. When trying out a new business model, companies usually run at least two business models at once: the old and the new. This can sometimes be difficult. At some point, the company should transform itself completely to the new business model. This requires two things: First, the company has to make sure the new business model can handle significant volume. Second, all the important stakeholders of the company must accept the new business model before it is transformed into the main business model. The change will usually encounter some resistance, which has to be rapidly dealt with. (Chesbrough 2007, 27–28.)

Moreover, Chesbrough (2010) points out three major barriers to business model innovation that the previous literature has helped to identify. First, some business managers do not want to test out new business models as they might threaten their own position in the firm. For example, if a new and better way of customer acquisition is invented, the old way might be abandoned. Second, new and disruptive technologies sometimes require new business models that are initially less profitable. Because of this, companies tend to favor the old business models as they are safer and more profitable at the moment. Third, companies often have dominant logics that drive them to gather information that reinforces their present business models, so conflicting information is rejected (Chesbrough 2010, 358–359).

In addition, many companies simply lack processes for business model innovation. Furthermore, companies usually do not have a single person responsible for the business model, and the managers who could experiment with new business models often do not want to assume the risks involved in it. The brand of the company can also be damaged if the business model experimentation goes wrong (Chesbrough 2007, 24–25). Similarly, Zott and Amit (2010, 217) state, “Once the template is set, the activities are in place, and the resources have been developed and honed, that template will be difficult to change, due to forces of inertia and resistance to change.”

2.7.3 Business model considerations for medical games

Medical games are, essentially, games that used in health care. For this reason, the business models related to medical games have to first and foremost take into account the characteristics of health care business models. Hwang and Christensen (2008), and Herzlinger (2006) discuss the business model issues of the health care sector. Furtheremore, Kalevat et al. (2013) provide considerations for business models related to medical games and health games in general. These issues are discussed next.

When considering the barriers for business models particularly in the health care sector, Hwang and Christensen (2008) highlight four major challenges: First, health care is rather fragmented as an industry. New business models can further increase this problem as they often reduce the centralization of health care delivery. This problem highlights the need for interoperable and coherent health information systems that glue the different parts together. Second, there is no proper retail market for health care services. Third parties such as insurance companies and the government have strong influence on the selection of health care services for the patient. Because of this, patients might not be aware of new business models available to them. Third, health care is swamped with different regulations. This can impose some barriers for new business models. Fourth, fixing health care is often approached by cutting costs. As reimbursements are reduced, service providers can become even less inclined to try out new innovations (Hwang & Christensen 2008, 1334–1335). Although these four barriers are related to the situation of health care in the United States, they are at least partly transferable to the situation in Finland as well.

Also Herzlinger (2006, 7) points out that business innovation in the health care sector can face notable challenges. First of all, small companies that seek to provide new ways to conduct business are often bullied by the large incumbent industry *players*, which, for example, raise antitrust concerns and prejudices against new ideas. Some companies have even faced problems as they made people too healthy: hospitals receive funding based on the amount of sick people, and improving health care outcomes can thus make hospitals lose money. Furthermore, Herzlinger points out that the messy IT infrastructures in the health care sector can possible hinder the adaptation of new innovations by making the potential benefits harder to deliver due to technical problems (2006, 7).

As pointed out in the introduction, direct research on business models for medical games is almost nonexistent. However, Kaleva et al. (2013) provide an outlook on the subject based on five expert interviews. They list the business model considerations of health and medical games, discussing the possibilities and challenges of different types of business models (Kaleva et al. 2013, 24–28). According to their view, business models are seen, for the most part, though the revenue mechanism and the customer segment and channel of the game. In the B2C retail business model, the product is distributed via

traditional retailers to consumers. Regarding digital distribution, the B2C premium model means that the customers have to pay for the product, whereas the B2C freemium model is based on giving products away for free but gathering profits through other means, such as advertising or microtransactions. The B2B business model refers to targeting other companies as customers, often using revenue models such as subcontracting and licensing (Kaleva et al. 2013, 24–26). The different business models and considerations related to them are listed in table 3 below.

Table 3 Health and medical game business model considerations (based on Kaleva et al. 2013, 24–28)

Business model type	Considerations
B2C retail	Health games can be seen as competing against normal games and health care products. The problem is that health games do not excel in either category. The game industry is moving away from traditional retail distribution, and large incumbent companies dominate the retail markets. Regarding B2C retail, health games seem to have the most, although little, potential when distributed through the retail chains of normal health or medical products. Partnerships with leading retail products are recommended.
B2C premium	B2C premium prices are often low. However, some customers are willing to pay significant sums for niche products (e.g., nautical maps). This might have some implications for B2C premium potential. In addition, different licenses for personal and business use should be considered.
B2C freemium	For health games such as jogging trackers, B2C freemium can be a valid option. However, medical games are linked with sensitive user information, and thus typical freemium marketing methods, such as community management, are likely to be excluded. This creates a problem as social platforms are often vital to freemium game success. Advertising has some potential when linked with a targeted audience, such as diabetics. Unfortunately, health games often appeal only to a small audience, thus decreasing the potential of advertising. Microtransactions can work if the payments do not place major constraints on the game play.
B2B	B2B business models can be a suitable option for medical games especially. However, in order to succeed, companies

	should provide a full service to their target market instead of a game designed to cover a single and narrow health issue. The role of value networks in the medical game production process is key. The games should aim to reduce the administrative burden of health professionals and help them with customer relationship management. However, the sensitivity of medical data has to be taken into account. Clinical trials are necessary but burdensome. This problem can perhaps be fixed by separating game producers from platform providers and conducting the trials for the platforms themselves, leaving out the testing of single games. The platform holders should seek ways to monetize the medical data, and consider the advertisement potential of their platform. The prejudices of health care professionals toward games pose a significant challenge for medical games.

Furthermore, Kaleva et al. (2013, 16) consider that wellness games can be developed based on similar business models as entertainment games, whereas medical games are perhaps required to follow a game-as-a-service approach. Moreover, they point out that medical games are required to go through clinical tests and scientific validation. In addition, they emphasize that ensuring the clinical effectiveness of medical games is not enough; the games have to be “good games” as well. As a further factor, they point out that good partnerships should be secured with public institutions and insurance companies, which act as powerful gatekeepers in the health care industry.

In conclusion, medical games face significant business model barriers due to the general business model challenges in the health care sector, as pointed out by Herzlinger (2006) and Hwang and Christensen (2008). In addition, medical games have their own specific challenges that are partly related to the typical business models for traditional entertainment games. The difficulties of business models for medical games can thus be partly caused by the combination of two different industries: games and health care.

3 RESEARCH METHODS

3.1 Research philosophy

Regarding research philosophy, the paradigms of *positivism* and *interpretivism* are commonly brought up as two possible alternatives (see, for example, Chen & Hirschheim 2004). In the field of information systems, positivism has historically been the dominant paradigm; among articles published from 1983 to 1988, positivist studies represented 96.8% (Orlikowski & Baroudi 1991), and from 1991 to 2001, the share of positivist studies was 81%. Although the popularity of interpretive studies has increased, they still represented only 19% of all studies done during 1991–2001 (Chen & Hirschheim 2004, 207).

Typically, positivist research tests existing theories with structured instrumentation. Positive research is often associated with quantitative methods, hypotheses testing, and an aim of increasing predictive understanding of a phenomenon. By contrast, interpretive research is focused on people and their subjective meanings. Interpretive research usually seeks not a global generalization about the phenomenon but an understanding the deeper structure of the phenomenon within its cultural context from the perspective of the participants (Orlikowski & Baroudi 1991, 5). Ontologically, positivists believe the world exists independently, and human behavior is assumed to be rational. By contrast, interpretive research assumes that the social world is created through human action and interaction. While positivists seek to discover an objective truth, interpretivists think that only interpretations of the social world can be acquired. Epistemologically, positivists believe knowledge is created by verifying and falsifying existing theories empirically, whereas interpretivists believe the truth is subjective and related to the context (e.g., people, culture, norms, and language) of the phenomenon. Thus, interpretive research is often conducted in real social settings, using field studies and observing participants in their natural environment (Orlikowski & Baroudi 1991, 9–14).

Given the characteristics of positivist and interpretivist research, this thesis does not adapt either one absolutely but leans toward interpretivism. This study seeks to gain a deeper understanding of the key components and challenges of business models in the context of medical games. Ontologically, it is assumed that these phenomena do not exist independently but are products of human interaction and are subject to cultural context. Therefore, the most suitable way to understand the phenomena is to find out how different people related to the subject feel and think about it. This goes against the positivist paradigm, which has been criticized for its assumption that “people are not active makers of their physical and social reality” (Orlikowski & Baroudi 1991, 12). Based on this, this research seems purely interpretive by nature. However, puritan interpretivists avoid going

to the field with predefined frameworks and instruments, instead attempting to derive knowledge merely from the observations conducted in the social settings (Orlikowski & Baroudi 1991, 14). Regarding this matter, this research has some positivist traits, since the business model framework is used as an instrument in data collection and analysis, and furthermore, the data is partly analyzed quantitatively using computer-aided tools.

When thinking outside the context of positivism versus interpretivism, this study is best represented by the paradigm of *instrumentalism*. A clear definition of instrumentalism is provided by Cacioppo et al. (2004, 214): "Scientific instrumentalism posits that scientific theories are intellectual structures that provide adequate predictions of what is observed and useful frameworks for answering questions and solving problems in a given domain." Instrumental theories do not necessarily try to explain any "real" world but rather are intended to help structure scientific observations (May & Williams 2002, 44). The school of *pragmatism* is rather similar, as pragmatists consider that it is not crucial to know whether something is true or false, as long as the knowledge is useful (May & Williams, 102). By contrast, *realists* consider that the purpose of scientific theories is to perfectly describe reality and that they can be either true or false (Gardner 1979, 2). Simply, realists consider that theories actually describe things that exist (May & Williams 2002, 44).

This difference between instrumentalism and realism can be seen in the use of the business model: the business model frameworks are not evaluated by their accuracy in describing the reality, but they are rather thought of as useful devices in explaining and analyzing the conduct of business. Simply put, business model frameworks are *instrumental* in explaining how business is done, but they are not explicitly either true or false depictions of reality. Not every company has an explicitly defined "business model," but nevertheless all business can be observed through the business model theory.

However, a common problem related to instrumentalism is *theory ladenness*: the exploitation of a theory can impinge on the perceptions of the investigator and thus skew the results of the research (May & Williams 2002, 44). In this research, the business model concept is strongly present through all stages of the research, and thus its dominant role has to be taken into account as a possible limitation.

3.2 Research approach

Research approaches are often classified as either quantitative or qualitative, both having their own weaknesses and strengths. In the literature, the two are often compared: Where quantitative research focuses on numbers by quantifying and counting phenomena, qualitative research is primarily about words and speech that describe phenomena from a person's experience. Furthermore, quantitative research is often presented as more

suitable for testing existing theories and searching for statistical patterns in large datasets. By contrast, qualitative research seeks to offer rich descriptions that are based on real-world conditions and human experience (Yin 2010, 7–9; Gephart 2004, 455; Thorpe & Holt 2008, 4). The rich descriptions and human experience form the strength of qualitative research, allowing the examination and articulation of processes (Pratt 2009, 856). The rich real-life descriptions produced by qualitative research often provide the basis for new theories (Thorpe & Holt 2008, 6–7). Gephart (2004, 461) concludes that qualitative research is particularly important in creating new knowledge: "Qualitative research often advances the field by providing unique, memorable, socially important and theoretically meaningful contributions to scholarly discourse and organizational life."

Given the characteristics and strengths of both qualitative and quantitative research, this thesis approaches the research question in a qualitative way, since it suits the nature of this study: Essentially, this research seeks to understand and describe the complex business environment related to medical games and provide suggestions for how to conduct business in this environment. In addition, the business model concept itself is a rather complex construct that is hard to examine by using numerical variables. Moreover, doing statistical analysis on business models for medical games is hard, since there are very few relevant companies in the field. In sum, since this study seeks to provide pioneering knowledge on the subject, a qualitative approach is deemed more appropriate

Furthermore, research approaches can be generally classified into inductive or deductive studies. Simply put, inductive research aims to generate theory based on empirical observations, whereas in deductive studies, a theoretical structure is built prior to empirical research and tested through observations (Thorpe & Holt 2008, 112). In this research, the approach is not purely inductive or deductive: The business model concept is used as a guiding framework that directs the data collection and analysis to certain issues. This is inductive by nature, since in deduction, theoretical concepts guide the researcher to the relevant data (Yin 2010, 94).

However, this research also builds a theory based primarily on the empirical observations; the key components and challenges of business models for medical games stem primarily from the interviewees' experiences, not from existing theories. Although the business model framework gives structure to the research, the theory resulting from this study is generated primarily via inductive thinking. Such a combination of inductive and deductive thinking is called abduction. Abductive reasoning is characterized by starting with an incomplete theory and using observations to generate new knowledge about the phenomenon (Patton 2002, 470). In this research, the business model concept provides the starting point, but the observations generate a new theory.

The objectives of research can be classified into four categories, according to Runciman (1983): reportage, explanation, description, and evaluation. Thorpe and Holt (2008, 4–9) discuss these four objectives in the context of management research.

According to Thorpe and Holt, qualitative research can seek to fill any of these four objectives, whereas quantitative research focuses usually on the first two. In addition, they emphasize that one of these four objectives should not be enthroned above others; research can contain a mixture of these objectives instead of just one (Thorpe & Holt 2008, 4).

Table 4 Four types of research (Thorpe & Holt 2008, 9)

	Reportage	Explanation	Description	Evaluation
Question type	What exists or happened	Why does it exist or happen?	What was the experience like?	Was it desirable?
Informing spirit	Clarity	Coherence	Comprehension	Improvement
Adverbial mode of inquiry	Inquisitive	Systematic	Imaginative	Ethical
Aim of inquiry	Representation	Objectivity	Depth	Progress

This research is at its core focused on reportage and explanation. According to Thorpe and Holt (2008, 5), “Reportage involves breaking a phenomenon into elemental parts in order to have a clearer understanding of how those parts are made up, how they relate to one another, and how they are influenced by other phenomena.” Similarly, in this study, business models are viewed in a component-based fashion, and this thesis seeks to find out what key components and challenges business models have in the context of medical games. Thus, reportage is at the heart of this research. However, in addition to cataloguing the common business model components and challenges, this study seeks to explain their existence and significance. Generative conditions, intentions, and causal connections between actions are often discussed in explanation-based research (Thorpe & Holt 2008, 5–6). In conclusion, this thesis tackles business models for medical games in two ways: what common key components and challenges exist, and why.

3.3 Research design overview

There is no clear consensus among qualitative researchers on whether to have a clear research design before data collection starts. If the design is rigid in early phases of the study, the research questions have a strong influence on the process. By contrast, having no research design lets the fieldwork dictate the direction of the study. Both approaches have their strengths and weaknesses (Yin 2010, 77). This thesis attempts to balance these two approaches. In the initial phase of the study, a guiding research question was defined. Furthermore, the material collection was designed to be semistructured interviews, and the sampling was based on a network analysis conducted during the first few preliminary interviews. In addition, based on the literature review, a framework describing the generic structure of business models was developed. This framework was used as an instrument

during the interviews, guiding the focus of the inquiry. Furthermore, the framework was early on chosen to give structure to the material analysis process. Based on these notions, it can be stated that a solid research design was established before the material collection process was conducted.

However, although a solid structure for the research design was built, it was not unwavering by nature. The research design process can and should be seen as a recursive one; once the research plan is set and the study is put to action, some portions of the design can be often revisited (Yin 2010, 77). This recursion affected many parts of the research design and occurred rather often. The exact research question was not formed until late in the study. Nevertheless, the nature of the research question remained the same during the whole study; the key components and challenges of business models in medical game industry was the focal point of examination throughout the research process. Furthermore, the interview themes were slightly adjusted to suit the expertise of each interviewee. For example, brain rehabilitation professionals were able to provide more insight on medical requirements for the game and its business model, whereas education game developers could point out commercialization barriers for serious games in general.

It was decided in the early stages of the research to use a conceptual framework developed in the literature review as the basis for the empirical part of this study. The role of conceptual frameworks is to present the main things to be studied (Miles & Huberman 1994, 18). The use of a conceptual framework in this study can be easily justified by the complexity of the underlying unit of analysis. The literature review has highlighted the ambiguity and lack of consensus surrounding business models. Furthermore, business models for medical games as a subject is also rather untouched, further increasing the ambiguity of the research. Thus, it is crucial to alleviate this obscurity by providing a solid conceptual framework that guides the focus of this study.

3.4 Data collection and analysis methods

3.4.1 Data collection

Sampling, or bounding the collection of data, is a crucial task as it is impossible to study “everyone everywhere doing everything” (Miles & Huberman 1994, 27). Patton (2002, 34) also emphasizes sampling’s role in qualitative study design. Thus, despite having the objective of conducting a large number of interviews, it was critical to define a clear frame for the possible interviewees given the complexity of the subject. The goal was to not sacrifice quality for quantity. This was achieved by first conducting four preliminary interviews with informants perceived as essential to the research and then, during the

interviews, asking them to outline the network of actors related to the subject. In addition, the research by Kaleva et al. (2013) provided existing information on the subject of medical game value networks. As a result, a value network map was constructed that functioned as a frame for interview sampling. This simplified medical game value network is portrayed in figure 14 below.

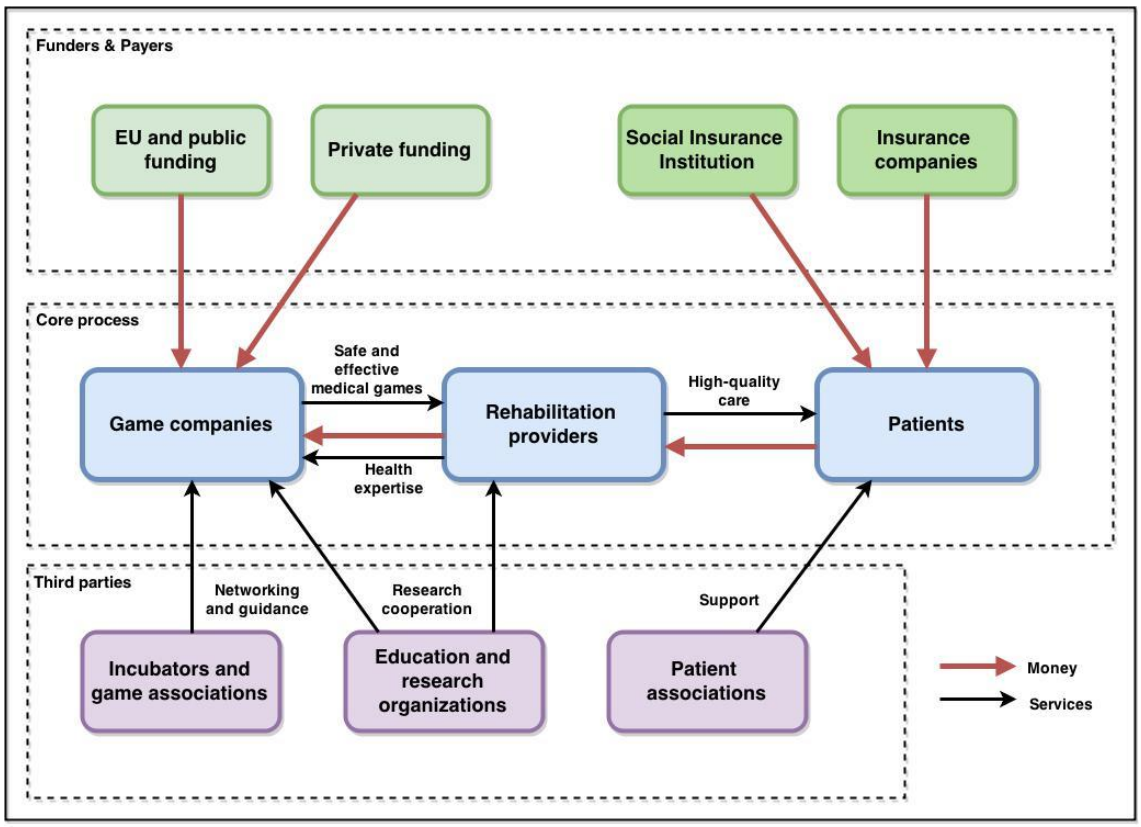

Figure 14 Simplified medical game value network

After the structure of the value network was initially clarified, it was possible to point out the different actor groups within the framework and seek interviewees within these groups. The goal was to interview several representatives of each major stakeholder group. As the major stakeholder groups, health game company representatives, rehabilitation and health care professionals, patients, and finance providers were considered. In accordance with the guidelines of Miles and Huberman (1994, 34), in addition to the most relevant and “meatiest” sources, peripheral sources were also used as they can provide useful and even contrasting information on the subject. As peripheral sources, general game industry experts and scholars, government officials, and game companies not focused on health games were considered. Although a brain rehabilitation game differs notably from an entertainment game, there are inevitably some similarities. For this reason, using non–health game companies and experts as peripheral informants

was justified. As for the government officials, Kela and Tekes, they can be considered borderline major stakeholders and thus relevant to this study.

After the major stakeholder groups and peripheral groups were identified, a combination of snowball sampling and intensity sampling were used. Snowball sampling "identifies cases of interest from people who know people who know what cases are information-rich," and intensity sampling seeks to emphasize information-rich cases that are, however, not extreme cases (Miles and Huberman 1994, 28).

Altogether, the interview material comprises 22 interviews with 23 people. The interviews were conducted from November 2014 to March 2015. In addition, *investigator triangulation* was used in 10 out of 22 interviews. Denzin (1978, 303) defines investigator triangulation as employing multiple observers instead of a single one and points out its role in removing potential bias stemming from a single person, improving the reliability in observations. In practice, the interviews were conducted by two researchers: 10 of the interviews were carried out by two interviewers at the same time, and 12 interviews were conducted by a single interviewer. However, in the interviews where only a single interviewer was used, the interview themes and questions were discussed together before the interview was carried out. This allowed the researchers to focus the design of data collection more towards issues that were considered important.

As presented in table 5 on the next page, the backgrounds of the interviewees varied. However, all of the interviewees had expertise related to medical games—either directly by having experience with the subject or indirectly by belonging to an important stakeholder group with respect to medical games. In order to make the discussion of results simpler, the interviewees were given aliases, which are used in the results section of this research. The aliases loosely refer to the backgrounds of the interviewees: "GP" refers to game professionals and "HP" refers to healthcare professionals. However, this classification is artificial and does not perfectly reflect the professional background of each interviewee. The purpose of this classification is to allow the reader to place the observations into context; GP-interviewees tend to have more expertise related to the "game" part of medical games, whereas HP-interviewees are more likely to have most of their expertise related to the "medical" part of medical games.

Table 5 List of the interviewees

Date	Name	Organization	Position at the time of the interview	Alias	Number of interviewers
16.12.2014	Patrik Uhinki	Turku Science Park	Project Manager (Game Turku)	GP1	2
8.1.2015	Mika Luimula	Turku University of Applied Sciences	Principal Lecturer	GP2	2
21.1.2015	Henrik Jürgens	GoodLife Technology	CEO	GP3	1
27.1.2015	Torulf Jernström	Tribeflame	CEO & Founder	GP4	2
27.1.2015	Arto Holopainen	Kuopio Innovation	Senior Advisor (Business Development, Technology and Business Foresight)	GP5	1
5.2.2015	Tatu Laine	NordicEdu	Creative Director & Co-Founder	GP6	2
11.2.2015	Kari Korhonen	Tekes	Programme Manager (Skene)	GP7	1
18.2.2015	(Anonymous)	(Rehabilitation software provider)	Co-Founder	GP8	1
23.2.2015	Harri Ketamo	SkillPixels	Founder & Chief Scientist	GP9	1
24.2.2015	Mikko Honkakorpi	(Various)	Digital Media and Video Games Professional	GP10	1
27.2.2015	Hannu Vuola	GoodLife Technology	Chairman of the Board	GP11	1
6.3.2015	Reidar Wasenius	BRIIM	Founder, Personal Brainer	GP12	1
13.3.2015	Johannes Koponen	Herring	Co-Founder	GP13	1
24.11.2014	Heli Vehkala	The Finnish Brain Research and rehabilitation center Neuron	Project Manager	HP1	1
27.11.2014	Jyrki Korkeila	University of Turku	Professor of Psychiatry	HP2	2
28.11.2014	Olli Tenovuo	Turku University Hospital	Chief of Rehabilitation and Traumatic Brain Injury Care	HP3	2
21.1.2015	Pekka Rantanen	Validia Rehabilitation	Director, Head of Medical Services	HP4	2
21.1.2015	Jaana Sarajuuri	Validia Rehabilitation	Chief Psychologist	HP5	2
6.3.2015	Anu Korhonen	Aivovammaliitto	Rehabilitation planner	HP6	1
11.3.2015	Tage Orenius	Orton Ltd.	Chief Psychologist	HP7	2
12.3.2015	Katariina Kallio-Laine	Kela	Neurologist, Medical Advisor	HP8	2
13.3.2015	Anna-Kaarina Lipsanen	FiBAN	Angel Investor, Board Member	HP9	1
13.3.2015	Jere Elonen	-	Patient	HP10	1

In qualitative research, interviews should have a flexible structure, as pointed out by Yin (2010, 134): “the researcher will have a mental framework of study questions, but the specifically verbalized questions as posed to any given participant will differ according to the context and setting of the interview.” For this reason, semistructured interviews were selected as the data collection method. In practice, the interview guide was built around certain themes, but the questions were not highly specified. The theme-based structure allowed the discussion of relevant topics but left the interview agenda open enough for the interviewees to express themselves freely. Furthermore, the business model framework provided focus areas for the interview, guiding the asking of the questions to provide information related to relevant business model issues.

The interviews were built around several themes (see appendix 3). The themes concerned the following topics: brain rehabilitation as a process, using games in health care, the value networks in health care, the production and commercialization processes of (medical) games, (medical) game markets, and the value networks in the (medical) game industry. For each interview, the three or four most prominent themes were chosen and discussed. With health care professionals, the themes were related mostly to health care and the possibilities of games as tools for them. With game professionals, the themes

related directly to medical games if possible, or to games in general when the interviewee was not experienced with medical games. The objective was to achieve an open discussion about the themes, but possible supporting questions were used if the interviewees did not have much to say on their own. For more detail, see appendix 3. As a further note, the interviews were recorded and transcribed.

3.4.2 Data analysis

As Miles and Huberman (1994, 2) pointed out, "Some qualitative researchers still consider analysis to be an art form and insist on intuitive approaches to it." By contrast, the data analysis methods for this research were designed before the interview process started. According to Patton (2002, 34), this is important as knowing the analysis methods allows for better data collection. The conceptual framework that was built based on the existing business model literature was used as the basis for data collection and analysis. The data analysis process involved several stages.

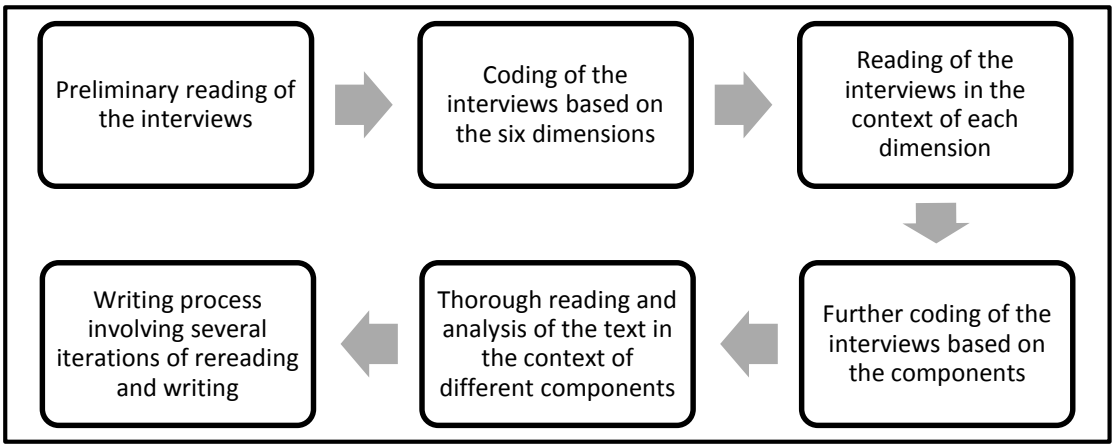

Figure 15 Overview of the interview analysis process

At the start of the analysis, the interview transcripts were first carefully read through. Next, the coding process started. Coding refers to giving certain codes to pieces of information that include certain content (Patton 2002, 463). This enables the researcher to classify information items into similar and dissimilar groups (Yin 2010, 187). For this research, the coding themes were given by the conceptual business model framework, which served as the research instrument. First, the transcripts were carefully examined and the information items roughly coded per the six business model framework dimensions (see figure 12, p. 36). Then all the information coded into the dimensions was read through one dimension at a time. The next coding phase involved coding the information according to the business model components in the framework. After this

phase, the information was carefully examined one component-related group of information at a time, and the writing process, involving several iterations between reading and writing, started. Furthermore, in order to preserve the big picture, the interviews were read as a whole from time to time.

The data analysis process was conducted with the help of the qualitative data analysis software NVivo. As Patton (2002, 442;447) points out, computer-assisted methods can *assist* in the data management and analysis processes in qualitative research—just like computers are useful in statistical analysis—but the real work has to take place in the researcher's head. Patton writes that software can speed up the process by, for example, easily locating coded themes and grouping data together by categories (2002, 442). Similarly, Welsh (2002, 4) discusses how computer-assisted analysis tools can enhance the quality, rigor, and trustworthiness of research, especially when the data sets are large. According to Welsh (2002, 6), tools like NVivo allow the *interrogation* of the data with the use of searching tools. However, both Patton and Welsh emphasize that there are advantages to manual analysis and that creative thinking is crucial for qualitative research. Hence, they both recommend combining manual and computer-assisted methods for the best results (Patton 2002, 442; Welsh 2002, 6).

NVivo was found particularly helpful in coding the data, classifying the data into segments based on coding, and searching for particular keywords. As a result, the data analysis process was quick and effective despite the fact that the transcribed interviews comprised over 300 pages of text altogether. The computer-aided coding was particularly helpful in this research, since the business model framework provided codes directly in the form of dimensions and components. However, given the limitations of computer-assisted data analysis, it was paired with manual analysis methods: The interview transcripts were carefully read numerous times. In addition, manual notes were taken based on the ideas that emerged during several reading iterations. By combining computer-aided methods with manual analysis work, most limitations related to both approaches were notably reduced.

3.5 Ethical considerations and trustworthiness of the research

Bringing a sense of ethics to research is important, especially in the case of qualitative research, since it often involves close interaction with human informants (Yin 2010, 38). Protecting human participants should be a top priority. Potential risks should be assessed, the research purpose and material usage should be explained, possible confidentiality and anonymity has to be honored, and harm to the interviewees should be avoided at all costs (Yin 2010, 38–42; Patton 2002, 408–409).

Given the subject of the study, the potential risks were rather low as the interviews did not discuss very sensitive or personal topics. The interviewees were asked for permission to record the interviews, and they were briefed that they could stop the interview without a reason at any given time. Furthermore, the interview themes were discussed before the recording started, and it was ensured that the interviewees had the right impression of the interview process. In addition, it was confirmed whether the informants wanted to remain anonymous. As a further factor, the results were proofread by the interviewees before publishing the research so they could correct possible interpretation mistakes or remove information they did not want to share.

A further factor to take into account is evaluating the quality of the research. Whereas quantitative research is often evaluated using validity and reliability, it is frequently pointed out in the literature that it is not sensible to evaluate qualitative research the same way (Horsburgh 2003, 312). One of the most popular ways to evaluate qualitative research is provided by Guba (1983). Guba considers that for qualitative research, *trustworthiness* should be evaluated through four criteria: credibility, transferability, dependability, and confirmability. These four criteria are discussed next in light of this study.

Credibility refers to how truthfully reality is reflected in the research. It can be enhanced by, for example, triangulation, peer debriefing, and importantly, checking the truthfulness of results with the informants (Guba 1983, 84–85). Also, things like providing thick descriptions in the results section and ensuring the honesty of the informants can help notably (Shenton 2004, 66–69). In this research, researcher triangulation was used in research design and data collection; two researchers were able to consider these issues together. In addition, peer reviews and debriefing were often conducted with the other participants in the research project. Furthermore, the informants were provided with the option to remain anonymous in order to enhance their level of honesty. The interview results are provided in rich format in order to reflect the opinions of the interviewees, and furthermore, the results were proofread with the informants to enhance credibility.

Transferability is related to how well the findings of the research can be transferred to other contexts. This can be enhanced by using sampling that maximizes the range of information uncovered and by developing thick descriptions (Guba 1983, 86). Additionally, providing sufficient information about the research context is needed in order to allow the readers to place the research into its context (Shenton 2004, 68–70). In this research, a large number of informants from varying backgrounds were interviewed in order to maximize the range of information. As per the guidelines of Miles and Huberman (1994, 34), both the most relevant sources and peripheral sources were used. The results were written in a fashion that seeks to provide a substantial amount of contextual information. However, ultimately it should be understood that the nature of

qualitative inquiry is that results are dependent on the given context (Guba 1983, 86; Shenton 2004, 70).

Dependability is linked with the reliability of the research—how well another researcher would be able to duplicate the results using the same methods, with the same participants, in the same context. It can be enhanced by establishing an "audit trail" that allows the reader to transparently follow the research process (Guba 1983, 86–87). The research design and the research process have been reported in this study with the knowledge in mind that transparency and openness allow the reader to better evaluate the dependability of the research. The sampling design, interview themes, interviewees, conceptual frameworks used, and data analysis process and tools are all provided in the report, thus allowing another researcher to reproduce the research if desired.

Confirmability refers to how well the results objectively reflect the views of the informants, rather than the personal traits and opinions of the researcher. For example, triangulation, detailed methodological descriptions, and an audit trail of the research can allow the reader to evaluate the confirmability of the research (Guba 1983; Shenton 2004, 72). As noted above, the aim of research reporting was to provide transparent information about the research process. In addition, investigator triangulation was used to some degree. The proofreading of the results by interviewees also enhanced the confirmability of the research, allowing for the reduction of bias stemming from the researcher's personal views and interpretations.

4 RESULTS

4.1 Overview of the results

In the following chapters, the results from the 22 interviews are presented and discussed. The discussion follows a structure based on the business model framework that was developed during the literature review. Thus, the results are analyzed within the six dimensions of the business model framework: value proposition, customer, profit formula, internal capabilities, value network, and strategic factors. In addition, chapters are divided into subchapters based on the components of the business model framework. However, not all components were thoroughly discussed, and thus only the relevant and emergent components are listed as subchapter headings. In order to give an overview of which dimensions were discussed the most, the number of observations per each dimension is illustrated in figure 16 below.

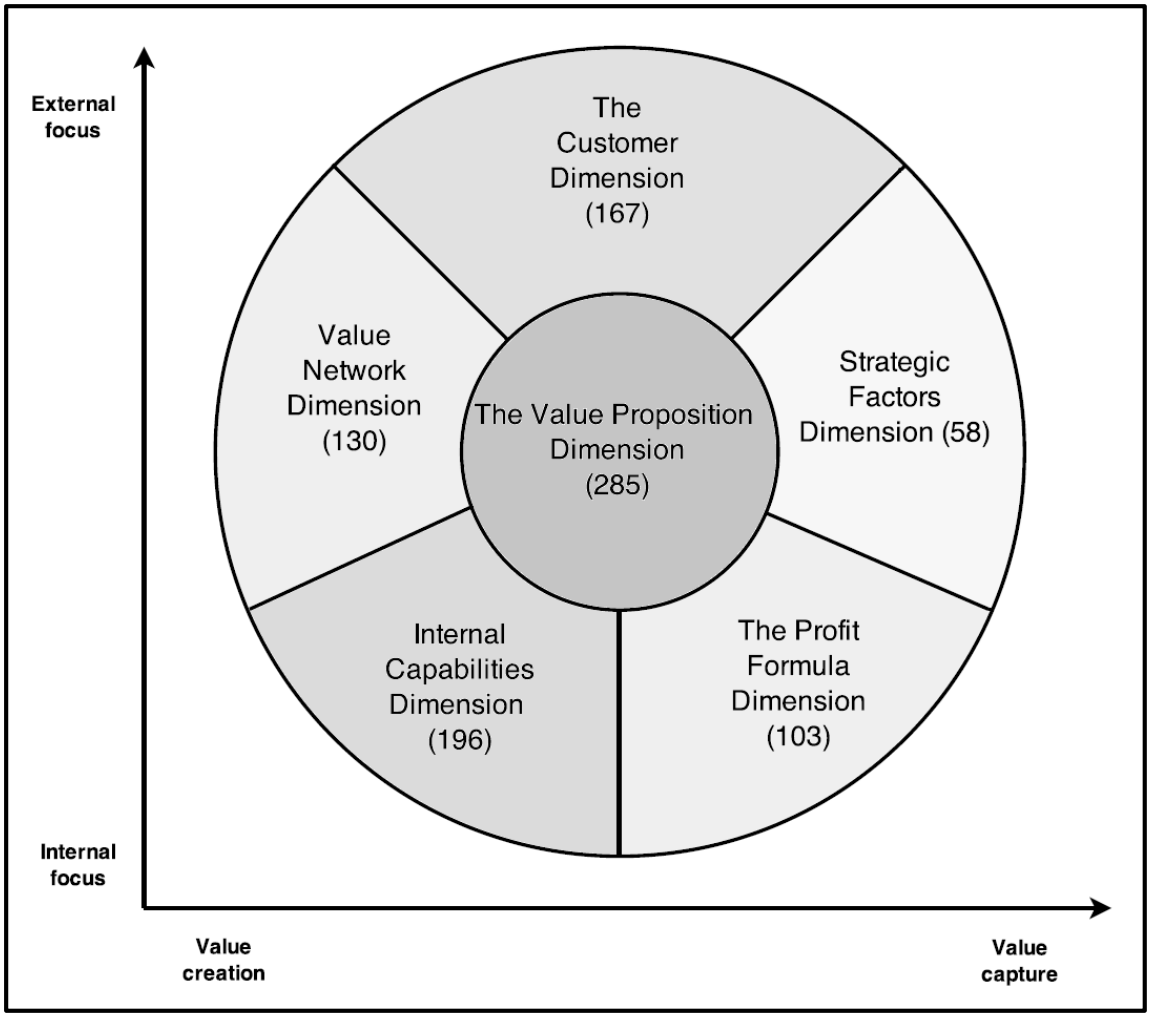

Figure 16 The number of observations per each business model dimension

The observations refer to both single sentences and sets of consecutive, consistent sentences that were coded based on their relation to different components. Based on the number of observations, the value proposition dimension was discussed by far the most during the interviews, whereas strategic factors were discussed the least. A brief overview of the main themes of each dimension is provided next.

Value proposition–related discussion covered issues about the product or service itself. The observations related to four subcomponents: Firstly, potential or recommended features for medical games were extensively talked about (143 observations). Secondly, the possible jobs-to-be-done for medical games were often discussed (106 observations). Thirdly, bundling related information was found explicitly in 21 observations. And fourthly, issues related to customization were emphasized in 15 observations.

Internal capabilities were also extensively covered in the interviews. The most discussed topic was the key processes (97 observations). Key resources were also talked about in 61 observations. However, most issues related to key processes were also closely related to key resources: key resources are often used in key processes. In addition, data-related issues also received a significant amount of attention (38 observations), and thus they are placed in their own subchapter.

Customer-related affairs were also thoroughly discussed. The most attention was directed at customer segments (115 observations). Due to the large amount of segmentation-related information, the subchapter about the subject is divided in two: the first part presents the interviewees' opinions on the B2C and B2B segments in general, whereas the second part provides further segmentation considerations. In addition, issues concerning customer channels received notable attention (50 observations). By contrast, customer relationships were explicitly discussed in only two observations, and consequently, the subject is analyzed in the same subchapter as customer channels.

Value network considerations were related mostly to key partners and suppliers (94 observations). Key partners are somewhat closely related to key processes, nearly all of which can be easily outsourced to a partner. In addition, the different possible value network positions for the medical game company were also discussed in 36 observations.

Profit formula was the second-least discussed topic. This might have been caused by the fact that the interviewees did not have much to say about the issue. It seemed hard to speculate about possible revenue models, although they were mentioned in 74 observations. The cost structure was also discussed in 29 observations, but often briefly. Components like margins and resource velocity, which are often particular to a single company and its individual economic parameter, were not explicitly emphasized.

Strategic factors were the least discussed issue. This may be because strategy is also very specific to one single company, and thus it is a hard topic to talk about on a general level. Competitors were mentioned in 32 observations, strategy in 19 observations, and brand-related issues in 7 observations.

4.2 Value proposition dimension

4.2.1 Jobs-to-be-done

Based on the interviews, there is a clear need for medical games, and they can be used to help solve many problems. In other words, there are jobs-to-be-done for medical games. Perhaps the most obvious task for medical games is to aid in processes such as brain rehabilitation or physiotherapy, making health care more affordable. These processes involve repetitive exercises that are often tedious by nature. Games or game elements can make these exercises significantly more pleasant (e.g., GP3, GP13, & HP7). Furthermore, in addition to helping the patient himself or herself, medical games have the potential to help health care professionals, third parties such as payers, and also healthy people in general.

For the patient, medical games simply improve the recovery or rehabilitation process. Many interviewees highlighted that this is achieved by making different rehabilitation exercises more fun and engaging, even addicting, thus improving the motivation of patients to do them, resulting in quicker and more efficient recovery (e.g., GP11, HP2, & HP6). As GP12 put it, "*only a drug that is taken helps*," and bringing game elements to health care achieves just that: increasing patients' motivation to perform rehabilitation exercises, thus increasing their ability to help themselves. Additionally, GP11 pointed out that rehabilitation is made more pleasant for the patient by allowing the patient to monitor the progress and process of rehabilitation. As a whole, medical games engage the patient in the health care processes in a new way. This is portrayed in the quote by GP8 below:

> *Well, I think that the biggest value is very simple. The key is that you're mentally engaged in something while you're doing your rehab exercises. So it's bringing the mental state into a different level when you're doing something tedious.* (GP8)

Based on the experience of interviewees, medical games and similar applications have received almost exclusively positive feedback from patients who have tried them (e.g., GP3, GP13, & HP1). According to GP3, patients who tried their company's rehabilitation software described the experience as neither gaming nor rehabilitation but more like a middle ground between the two. According to GP13, when playing their hearing test game, patients were much more focused on the performance itself, allowing better concentration on the important things. As pointed out by GP10 and HP7, the games were able to provide a dopamine rush or "candy" to the patients, which in turn were able to increase their mood and make their progress more visible.

HP1 emphasized that medical games should act as precision weapons, designed to tackle a single, well-defined medical issue or process. However, GP3 pointed out that it is crucial for medical games' success that the products can be easily up-scaled to solve other problems as well. Furthermore, almost all interviewees emphasized that the usefulness and effectiveness of medical games has to be proven, not taken for granted. GP3 also added that in order to be accepted by health care professionals, the games should seek to improve and ease current processes, not re-engineer them completely. Similarly, GP13 said that their hearing test game was gladly welcomed by health care professionals partly because it did not alter the medical process itself at all and thus was easy to implement.

The interviewees seemed to consider that for hospitals and health care professionals, medical games offer two things above all: cost savings and service improvements. HP1 thought that cost savings were the prime reason for the implementation of new health care technologies, such as medical games. In the context of brain rehabilitation, HP3 among others pointed out that only a minority of patients receive proper rehabilitation care because there is just no funding for it. HP1 highlighted that medical games can ease health care professionals' burden by shifting the care toward patients' homes while still maintaining the presence of health care professionals in the process. Furthermore, various interviewees talked about how medical games can act as data collection and communication devices for health care professionals, improving their service and allowing them to decrease the amount of unnecessary routine work (e.g., GP5, HP1, & HP9).

> *And this allows us to have a tool that measures how well the patient has been following the rehabilitation program. The patient can track how well he or she is progressing. This same information is also delivered to the physiotherapist. When the patient visits the therapist next time, it is already known what the patient has been doing, and because of this, the focus can be directed onto deciding what's next.* (GP3)

HP9 said that medical games allow health care professionals to know their patients better, resulting in quicker and more accurate diagnoses or even constant remote monitoring. GP3 and GP11 pointed out that physiotherapists, for example, can track their patients' progress easily and give them web consultations. For public health care, this reduces costs, and for private health care service providers, this allows more clients, thus more business (GP3 & GP11). In addition, HP1 brought up that using new technologies increases the expertise of health care professionals. Furthermore, GP3 pointed out that when the patients' rehabilitation process is tracked, experts can find out what has worked and what has not in general.

For third parties, especially the payers, a quicker and more effective rehabilitation means less cost. HP9 highlighted that insurance companies could potentiallysee significant savings in their reimbursements. In addition, GP2 pointed out that medical games can allow the payers to observe how the rehabilitation is done and how committed the patient is. Similarly, GP3 noted that because of this possibility of tracking, insurance companies, for example, can find bottlenecks in the rehabilitation process.

GP5 pointed out that a further possibility of medical games is their use in disease prevention and detection, which should be more closely investigated. Similarly, HP1 emphasized that it is crucial to make health care more efficient and more affordable for everyone, and this is why developing new technologies such as medical games is so important. As an example, HP9 mentioned an application that can detect and warn about early signs of Alzheimer's disease or dementia, allowing the medication and rehabilitation process to start earlier. As a result, the patient stays healthy longer. This in turn reduces the cost of hospital treatment and allows the patient to stay at work longer, creating less cost and more taxes. The positive effects are thus manifold. GP10 and HP9 highlighted that this is a topical issue for many countries such as Finland and Japan, where the share of elderly citizens is climbing steadily all the time.

Medical games and their development have also the potential to benefit healthy consumers by offering proven and validated methods for self-improvement, such as brain training. There are already applications and methods for brain skill improvement in the consumer market. However, HP4 explained how some health care professionals and consumers look askance at these services, whose health benefits are often based only loosely on science, and similarly, GP10 noted that there is a significant amount of fluff on the market. As pointed out by many interviewees, medical games often have scientific rigor and verifiability as a built-in requirement, thus providing spin-off possibilities for brain-training products or partnerships by providing credibility. As a result, both industries could benefit from the cooperation.

4.2.2 Product or service features

The interviewees often discussed what features are essential to a good game. As the backgrounds of the interviewees varied significantly, the subject was processed from many perspectives. For example, game developers pointed out characteristics for successful games in general, whereas brain rehabilitation professionals emphasized requirements for a medical game tailored to a specific health care process. As result, a diverse outlook on the potential features for medical games was produced by conducting a systematic content analysis (following the guidelines of Tuomi & Sarajärvi 2002, 111). The different features that emerged from the discussions are listed in table 6.

However, it should be noted that table 6 does not serve as an exhaustive list. This is because mostly features mentioned directly and explicitly were taken into account. Implicit mentions about the features were not specifically analyzed. Nevertheless, the table provides an extensive overview on the potential medical game features and their respective significance. Most of the features are discussed below, with the most important features emphasized.

Table 6 Potential medical game features

Feature	Mentioned by	Feature	Mentioned by
Easy to learn	HP1, HP5, HP6, GP1, GP3, GP6, GP8, GP9, GP12	Provides feedback	HP1, HP2, HP4
Progression	HP1, GP3, GP4, GP5, GP6, GP11, GP12	Scalability	GP1, GP3
Proven effective	GP10, HP7, HP2, HP3, HP4, HP5	Rich content	GP3, GP5
Fun and entertaining	GP5, GP7, GP11, GP12, HP2	Takes all stakeholders into account	GP3, GP8
Addictive	GP4, GP6, GP9, GP12, HP7	Proven safe	GP10, HP4
Focused	GP8, HP1, HP2, HP4, HP5	Stable technically	HP1
Customizable	HP1, HP4, HP7, HP8	Long-lasting	GP12
Includes a story	HP1, GP5, GP9, GP12	Competition	GP12
Rewarding and encouraging	GP4, GP5, GP9, HP2	Applicable to real life	GP12
Motivating	GP2, GP3, GP5, GP10	Provides reminders	GP11
Reinforces communication	GP3, GP11, HP1	Deep motivation	GP9
Simple and clear	GP1, GP10, HP6	Provides alerts	GP3
Socia aspects	GP9, GP12, HP10	Good looking	GP6
Not annoying	GP3, GP6, HP3	Provides quick results	GP1
Easy to implement	GP3, GP6, GP8	Includes possibility to spend a lot	GP4
Not superimposed	GP2, GP6, GP13	Small sessions often	GP4

Based on this content analysis, medical games should be above all *easy to learn*. Many game experts highlighted that it should not take more than ten seconds to learn how to play a game (e.g., GP1, GP9, & GP12). As pointed out by HP5 and HP6, when the game is played by patients who may have impaired cognitive skills in the case of, for example, a brain injury, the need for ease of use is further accentuated.

However, although the games should be easy to learn, they should also be challenging, even difficult at times, according to many interviewees (e.g., GP6, HP1, & HP2). This is achieved by incorporating *progression* into the games. As stated by HP1 and HP5, the games should first be easy and then become more difficult as the player progresses. This goes hand in hand with the requirement that the games should be *customizable* so that they can be tailored to the needs of every player or patient. In addition, GP4 emphasized from his experience as a game developer that when playing the game, the player should feel like he or she is making progress during each session. This atmosphere of progress makes the player come back session after session.

It stands to reason that medical games should be *proven effective*, *fun*, and *motivating*, even *addictive*. Also, having an entertaining *story* in the game was seen as an important factor of fun by a few interviewees (e.g., GP9, GP12, & HP1). GP9 said that motivation can be achieved through superficial *reward* mechanisms, such as rewarding players with badges or trophies, works surprisingly well, but deeper motivation should, of course, have

more value. HP2 pointed out that motivation can be achieved simply by making the player feel successful after completing a difficult task. The role of *feedback*, which should be mostly positive, was also emphasized by health care professionals (e.g., HP1 & HP2). In addition, HP10 pointed out that as a patient, it would be nice if the game were played in a *social setting* or with other people; playing games alone can be burdensome and boring. Similarly, GP9 and GP12 pointed out that linking social features to the game can make it a lot more pleasant to use.

As a further factor to consider, the interviewees pointed out features that should not be included in the game. First of all, the game should *not be annoying*. For example, HP3 pointed out that some brain injury patients may be hypersensitive to sound and light, thus needing a limit to be set on the special effects of the games. In addition, according to GP13, the medical effects should not be superimposed on the game or vice versa, which can cause the game to seem fake or annoying. Furthermore, it should be proved that the game has no harmful side effects. HP4 used vitamin E as an example; it was believed to be healthy but was later proved to increase the mortality rate among people who took it excessively. Similarly, HP6 pointed out that if brain rehabilitation patients are exhausted when playing the game, the game can cause more harm than good. The issue is presented in the quote below:

> *There has be a certain amount of alertness when someone is trying to improve their memory or to learn something new. When the processor is damaged, the role of recovery and periodization of the exercises is crucial. Resting and shifting thoughts away from the rehabilitation at times is also very important. Everything is different when the brain is injured.* (HP7)

From the health care professionals' point of view, the game should be easy to implement with existing health care processes. GP13 highlighted that this is a crucial point for the acceptance of the games and a reason why their hearing test game was gladly welcomed. Furthermore, the game should *improve the communication* between the health care professional and the patient. GP3 and GP11, among others, considered this a key factor. In addition, many interviewees pointed out that the game should have a *clear and simple interface*. GP3 considered it important also that the game takes all stakeholders of the value chain into account. Furthermore, HP1 emphasized that in her experience, therapists highly appreciate it if the game does not have a large amount of *technical problems*.

From a business point of view, *scalability* is important. GP1 and GP3 emphasized that the game should be scalable to different markets and purposes. In addition, GP4 pointed out that in order to make a game highly profitable, it should be possible for the players to spend large amounts of money on the game when willing to do so.

As a further consideration, it should be evaluated whether to treat medical games as actual games at all. For example, GP3 and GP11 did not consider their company a game provider. Instead, they said they offer health care information systems that include game elements. According to them, some people, such as investors and customers, do not view anything related to games in very good light. Similarly, HP7 pointed out that games can have a bad reputation, at least for some people.

4.2.3 Bundling

Based on the interviews, bundling, as in pairing a product with another product or service, seems a very natural option, even a necessity, for medical games. A game alone does not work very well; it requires the presence of health care professionals, other health care services, physical products, or all of them in the same package.

First of all, medical games are almost always bundled with another health care service; they are used as a tool in, for example, brain rehabilitation or physical therapy, as pointed out by HP2 and GP3. Medical games were seen as a part of a larger service package by many interviewees (e.g., HP2 & GP1). This is rather self-evident, since it is very hard to imagine that games could replace the services of doctors completely. This is especially the case in brain rehabilitation because the process is very holistic by nature:

> *In rehabilitation of brain-injured patients, computer-based cognitive rehabilitation or games should be used as a part of holistic neuropsychological rehabilitation approach to be effective. Rehabilitation should address many facets of a brain-injured individual, treat him or her in a comprehensive frame of reference with appropriate techniques and strategies for cognitive but also for emotional and societal skills while increasing awareness and understanding of a new self.* (HP5)

As HP1 pointed out, health care professionals do not consider medical games a threat, because therapists are needed in running the game. Having a doctor in control of the game's use results in more appropriate care, as pointed out by GP10. Similarly, HP8 said that an important factor for motivation is human contact, and thus visiting health care professionals is crucial. However, medical games can be an interesting tool, in her opinion, to help the process. Furthermore, HP2 said that medical games can function as a feedback tool in, for example, rehabilitation care. In addition, HP1 highlighted that as a specialty of medical games, they offer an interesting option for home care purposes, thus allowing the nursing of larger amount of patients.

> *One important role to consider for technological rehabilitation solutions is their ability to reach dropouts, patients who cannot afford rehabilitation care. Applications that can be used from home are needed.* (HP1)

Secondly, medical games are also easily bundled with physical products, such as sensors or tablet computers, as pointed out by GP5 and GP10. For example, physiotherapy-based medical games work very well together with motion detection sensors like Kinect. GP3 highlighted that in this way, the game can detect whether the exercises are done correctly, and there is proof that they are conducted at all. In HP1's project, the games were bundled with sensors that allowed the patients to control the game by shifting their weight while sitting or standing. GP1 and GP10 noted that in medical games sold to hospitals and other health institutions, a physical product can play a rather large role. GP10 suggested that a medical game should perhaps be sold as a preinstalled service bundled with a tablet. As an interesting possibility, GP10 also pointed out that medical games could be bundled with pharmaceutical products. This way some drugs could be substituted with games, or the effect of the drugs could be enhanced by playing games.

In the context of health care information systems, single medical games can also play a rather small role. Health care technology provider GoodLife Technology has built a platform for its services that works as the base for other products and services, such as medical games if desired. The platform itself is a cloud computing system to which other end-user products can be attached. The platform comprises a service package that offers different services for the patients and health care professionals: game-based physiotherapy software for the patients and data-driven patient management tools for the therapists, for example (GP3). The case of GoodLife Technology further accentuates that a single medical game is just a small piece in a larger puzzle. In addition, GP5 suggested that the medical game itself should perhaps be free, and the profit would come from selling medical devices like EKG sensors bundled with the product. Thus, it can be concluded that a single medical game can be hard to make a profit on. Instead, it should be evaluated to what services or products the game can be bundled with.

4.2.4 Customization

Customization is seen as a crucial component of medical games because many medical conditions require focused cure or rehabilitation methods. Many interviewees emphasized that in brain rehabilitation, the need for customization is further highlighted because each brain injury patient is different (e.g., HP3, HP4, & HP6). As the injury can affect different parts of the brain, the symptoms can vary significantly. Because of this, brain injury

patients need many different exercises that target precisely the condition they have. As HP8 put it simply, "*there probably is not a single game that solves everything*." HP5 compared brain rehabilitation to a situation where a patient has a leg atrophied from injury: In this case, the patient is not told to do exercises and walking in general to strengthen the leg, but rather told to do leg extension exercises that target the specific weak muscle. In the same way, brain injury patients should not be ordered to play games in general; very focused and targetable exercises are eminently more effective (HP5). As an example of customization, HP5 said that their cognitive rehabilitation exercise software FORAMENRehab has around 100 separate exercises that all can be modified on many parameters to patients' needs.[10] Furthermore, HP7 noted that customization enables the health care professional to adjust the game on the go based on the performance of the patient.

In addition to the target area of the medical game, the difficulty also has to be customizable. HP1 and GP9 pointed out the simple fact that some patients are more skilled than others. Furthermore, HP7 suggested that the game should have an option to customize, for example, the sounds. This way patients could make the game more pleasant for them. This is linked to the issue pointed out by HP3 that some patients may be hypersensitive to certain sounds or visual effects, and with customization, these issues could be taken into account. Furthermore, as pointed out by HP2 and HP3, for example, some brain injury patients tire a lot quicker than others, so it would be important to take their condition into account as well.

However, customization can also have some downsides. According to GP11, customers in the public sector often do not like customization and want to have more standardized solutions. Furthermore, GP5 pointed out that if the game is tailored to the needs of a particular niche, it can be difficult to scale the game to other purposes. This can pose a problem, since scalability is important in order for the game to succeed economically, as pointed out by GP3. As a conclusion, it seems advisable to pursue developing a game that can easily be tailored to many purposes. This is especially needed in the case of brain injury patients as "*not all patients can be cast in the same mold. It does just not work that way*" (HP10). However, although the game should have the option to target a narrow focus area, scalability to other areas should not be forgotten.

[10] http://www.foramenrehab.info/

4.3 Customer dimension

4.3.1 Segments (B2B versus B2C)

Customer segments were discussed in the interviews from various viewpoints. At the most basic level, the segments can be roughly divided into B2C (business-to-consumer) and B2B (business-to-business) based on who directly pays for the game. As a further segmentation factor, the users of the game can be divided into many subcategories based on their types and interests. For example, GP8 noted there are at least four important customer segments for their medical game: insurance companies, hospital managers, clinicians, and patients. GP8 further accentuated that the game has to be well sold to all of these segments. These further segmentation factors are discussed separately in the next subchapter. In general, as pointed out by GP9, segmentation can be seen as an alternative to customization: if the game cannot be segmented or tailored to the skills and needs of the user, it should be offered to a more focused segment.

Based on the interviews, many interviewed serious-game providers do business in both B2C and B2B markets simultaneously (e.g., GP3, GP6, & GP9). For medical games, GP7 noted that there are two main options: either they are treated like traditional games and produced and distributed as such, or they are produced as medical services or products from the beginning. These two approaches differ significantly by nature. The former are games that are fun and addictive and result in secondary benefits, such as improvements in health. The latter are applications that have some game elements or mechanics but are treated more as medical tools or systems, thus following their regulation and certification processes. Roughly speaking, the former can be seen as targeting the B2C segment and the latter the B2B segment.

For medical games, especially brain rehabilitation games, the more prominent segment seems to be B2B. The main reason for this conclusion is that brain rehabilitation is almost always funded, at least in Finland, by either insurance companies or the social insurance institution, as pointed out by HP3 and HP7. According to HP7, rehabilitation is funded only rarely by wealthy patients themselves. Furthermore, brain rehabilitation itself is provided by health care organizations. From HP2's experience, the games should be sold to brain rehabilitation centers and be included in their service. However, the possibility of expanding the business to the B2C segment should not be overlooked; many interviews highlighted that the B2C segment has its own strengths, as discussed below.

According to the interviewees, the B2C and B2B segments both have their own strengths and weaknesses. GP11 made the comparison that B2B business is good for keeping a company running whereas B2C business offers the opportunity to generate huge profits as the potential volumes are significantly larger. Because of this, if a serious-

game company wants to grow remarkably, it has to figure out how to transform its business from the B2B to the B2C segment. Similarly, GP10 pointed out that B2C business is interesting because at best there is no upper limit to how much the company can sell. GP1 also said that the biggest business potential lies within the B2C markets.

> *Well, if you consider our case… if we have 25,000 physiotherapists in the United Kingdom using our services and then we sell a tablet to each of them with a price of 100 euros, now think if the therapists take care of 200 patients each year and we could sell our service directly to the patients for 10 euros a piece. There's a big difference; the volume is after all so much larger.* (GP11)

Furthermore, GP9 mentioned that their education game company first focused mainly on the B2C market because consumers can make purchasing decisions instantly. By contrast, in the public sector, the purchasing process can take years, and waiting that long would cause a start-up company to go bankrupt. However, the B2C market can be seen as more difficult as the competition is tougher (GP9). By contrast, another education game provider targeted the B2B market almost exclusively (GP6). The difference between these two serious-game providers is that the former (GP9) develops their product mainly in-house whereas the latter (GP6) aims to produces games in more bespoke way.

Additionally, GP10 stated that the public sector, which offers local health care in Finland, could be an approachable project partner and an easy way to start. This way, medical game companies could learn a lot business-wise, test their product, and gather experience. A further factor to consider, as pointed out by GP5, is that in the public sector, verified health benefits and cost savings are important buying-decision factors, whereas in B2C markets, things like the packaging and appearance of the product matter more.

4.3.2 Segments (further segmentation considerations)

Regardless of the direct payer, perhaps the prime customer of medical games is the patient as the game is above all used to help the patient's rehabilitation. However, one common characteristic of brain injury patients is that every patient is different, as pointed out by HP3, HP4, and HP6, for example. As HP7 mentioned, the brain functions as the core processor of the human body; everything is related to it. Thus, in brain injuries, the patients can have many different problems caused by the injury. Along the same lines, HP6 pointed out that the patients might need, for example, physical therapy, occupational therapy, or speech therapy. However, HP3 and HP6 said that neuropsychological rehabilitation can be seen as the most common form of therapy needed in brain injuries.

HP8 highlighted that there is a shortage of neuropsychological rehabilitation as there are not enough certified professionals. Thus, it can be argued that one main segment in brain rehabilitation games should be patients in neuropsychological rehabilitation. However, the need for different kinds of therapy provides other segmentation options as well.

All in all, HP5 said there is a substantial need for brain rehabilitation. In addition, based on the interviews, there is a large group of patients who either cannot afford brain rehabilitation or just do not call for it enough. Many interviewees emphasized that not all brain injury patients receive proper rehabilitation care (e.g., HP1, HP4, & HP5). Similarly, HP1 pointed out that technological innovations in the rehabilitation sector should seek to help the people who cannot afford proper rehabilitation care, and solutions that can be used at home are very much needed. Furthermore, HP3 pointed out that the largest group of brain injury patients is people who are discharged from the hospital early and are treated as outpatients. These mild brain injuries account for up to 90% of all brain injuries. Although mild brain injuries often cause disabling symptoms, most of the patients return to work, HP3 highlighted. Based on these notions, rehabilitation games should perhaps target outpatients or patients who receive inadequate care.

In addition to patients, therapists and other health care professionals are a key group in brain rehabilitation, and as they can benefit from medical games in many ways, they should be considered an important customer segment. For example, in addition to improving the patients' rehabilitation itself, the health care technology provider GoodLife Technology seeks to help physiotherapists create more business and serve more customers. Their platform provides a way for the patient and the therapist to interact and communicate better via, for example, the Internet if needed. The therapist can quickly see what the patient has done and act based on this information. Thus, time is not wasted on catching up, and the therapist's costs are significantly reduced (GP3, GP11). In the same way, GP9 pointed out that their education games make the job of the teacher easier by, for example, removing the need to go through homework. These examples highlight the importance of therapists, doctors, and other stakeholders as a customer segment. In the context of brain rehabilitation, HP7 considered it appealing that neuropsychologists could track their patients' progress interactively with a medical game of some sort. According to him, this would help both the patients' home treatment and the health care professionals' work.

> *It sounds interesting and tempting that the patient could do exercises at home with a game that has been proven effective, and the neuropsychologist could tailor the game to the needs of the patient. Or the game could dynamically change based on the performance of the patient. The neuropsychologist could also check how the patient is doing, and*

> *there would be more feedback about how the process is going. This would benefit the neuropsychologist as well.* (HP7)

Third parties, such as insurance providers, can be also considered customer segments. GP3 pointed out that insurance companies have shown notable interest in cooperation with GoodLife Technology, which would allow them to observe the rehabilitation process better. After all, insurance companies are usually the main payers in brain rehabilitation, as pointed out by HP3 and HP7. In agreement with this, HP9 highlighted that if a medical game could speed up rehabilitation or make it cheaper, the insurance companies would have an incentive to pay for it. According to GP8, insurance companies pay their company to conduct pilot studies. GP2 pointed out that in an extreme scenario, the insurance company could track whether the patient is doing the prescribed exercises, and if not, the payments could be frozen.

However, as a further consideration related to customer segments, HP1 emphasized that games are not suitable for all brain rehabilitation patients and it should be evaluated whether patients can effectively play these games. HP6 and HP10 said that some patients have a short temper. In addition, many interviewees highlighted that brain injuries often cause the patients to tire very quickly (e.g., HP2, HP3, & HP6) or have memory problems (HP2, HP3) or low motivation (HP2, HP3). Visual and motor skills can also be impaired, as pointed out by HP3. Problems like these should be taken into account when designing medical games and considering customer segments. HP2 has treated people with severe game addictions, and to these, people rehabilitation games are obviously a bad option. In contrast to old game addicts, a further factor to consider is that not everyone likes games. As a (former) patient, HP10 said that he just was not very interested in brain rehabilitation exercises. Furthermore, he pointed out that there is not one solution for everyone, and not everyone likes games.

When considering the customers in terms of age and technology orientation, older people compose a segment that is both promising and challenging. According to HP7 and GP10, older people are a very large potential patient group, and they are not always very experienced with technology. HP6 also pointed out that some patients do not own any type of computer and are not willing to use one. Furthermore, some patients just dislike the idea of playing games, as highlighted by HP8. However, even though older people are not used to new technologies, it does not mean they do not like them. HP1 stated that in their medical game project, non-technology-oriented patients have also given mostly positive feedback on rehabilitation games. GP11 also pointed out that older people can learn how to use new technology as long as they are motivated to do so. In addition, even though older people of today are not very familiar with video games, the gamer generation is getting older. Regardless of their familiarity with games, older people represent an

important segment for medical games as their share is growing all the time and they are underserviced as a segment (GP10).

> *Older people play games as well. You just have to wrap the game up in a meaningful way. Just like many elder people are solving crosswords, Sudoku, or something, and it's accepted and seen as a healthy thing to do for the brain. It's pretty much all about packaging.* (GP10)

A further factor to consider is that patients are not the only customer segment who can view games or new technological solutions in bad light: HP1 highlighted that some therapists prefer "old-school" methods and do not like to work with the newest technological innovations. Furthermore, although not especially related to their age, doctors have a reputation of being very cautious when trying anything new, as pointed out by GP10. On the other hand, HP3 and HP7 pointed out that doctors and health care professionals often gladly try new things, as long as they are proven to be efficient and safe. Additionally, HP7 pointed out that with some patients, pen-and-paper solutions just work better.

The interviewees oftentimes pointed out that people can have very different game preferences (GP3, HP1, & HP8). For example, in HP1's project, where rehabilitation games were tested, some adult gamers disliked the games because they were too childish: "*Grown men are not very interested in lifting bunnies around*." Because of varying tastes, entertainment game developers have often clear segments of different players. For example, GP4 said that there are "mommy games" and "daddy games." In addition, GP12 emphasized that people differ notably in their willingness to compete; some people highly value competition whereas some people want to avoid it. HP1 and GP3 stated that because different player groups can be clearly identified, it should be considered whether to design different games for different patients. However, GP3 also pointed out that making an extensive game library is expensive, and thus it should be considered whether to make games at all instead of, for example, simpler applications with some game elements.

When considering the B2C market, a further possible segment is formed by people who are not actual patients but want to improve their health or increase their brain-related skills. In the interviews it was discussed whether it is possible to make a consumer version of a brain rehabilitation game that could, for example, improve memory or other cognitive skills. HP3 pointed out that if a game could verifiably improve memory, as it should in brain rehabilitation, healthy people might be interested in it as well. HP4 also said there would be a very large and profitable market for such games if their health effects could be scientifically proven and the games well designed.

> *I think that memory is something that… nowadays people often have so many things to remember. A game with certified results in improving memory could be quite a hit. - - If you develop a game that can increase intelligence and you back it up with scientific evidence, you have a guaranteed market.* (HP3)

In B2C markets, there are already brain-training games available to everyone. HP5 said there is significant general interest in brain training among people. As an example, the company BRIIM, founded by GP12, offers brain-training services and products to both B2C and B2B markets. GP12 mentioned that their main customer segment consists of people who have children, busy jobs, and many things to take care of. When people have too many things to concentrate on, their focus is shattered. Brain training can be an appealing value proposition to these people. In addition, GP5 and HP5 also pointed out that games have significant potential in disease prevention purposes. All in all, there are some potential B2C customers for medical game companies as well.

However, there are some challenges related to consumer-oriented markets. GP12 pointed out that people have significantly lower motivation to prevent diseases or health problems compared to treating an actual problem. Similarly, GP7 and GP4 highlighted that consumers download games mostly because of their entertainment value instead of their health benefits. GP10 pointed out that a further factor to consider for this segment is whether the B2C versions of medical games are so diluted that they offer no significant result compared to their B2B versions, where a medical professional is guiding the process. GP1 said that offering a brain rehabilitation game to consumers is not a good idea. Instead, conversely, it should be evaluated whether a health game developed for healthy people could work for brain injury patients as well, according to GP1.

Regardless of whether B2B or B2C is chosen as the main market, the segments can also be geographically divided. In many interviews, the importance of internationalization was brought up (e.g., GP1 & GP7). The Finnish market is rather small, and developing a medical game is thus costly. For this reason, GP1 suggested the game should seek larger markets. Furthermore, GP7 highlighted that it can be significantly hard to receive funding if the game is targeted only to the small Finnish market. In addition, Finland has a large bureaucracy, and this hindrance is not as present in many other countries, as noted by HP9. On the other hand, GP2 pointed out that in some Asian countries, government regulations are even stricter, and GP8 highlighted that each country has its own regulatory bodies that can vary. If a company decides to target international markets, it should keep in mind that there are cultural differences in game customers. GP9 mentioned that in the United States, people are more willing to pay more, whereas in Europe free games are more popular. However, Europeans often dislike in-app purchasing and in-app advertising and are willing to pay to remove them, according to GP9.

4.3.3 Channels and customer relationships

Channels and customer relationships were extensively discussed during the interviews. One of the biggest differences between the B2B and B2C segments is how the product or service is marketed, sold, and distributed and how customer relationships are taken care of. In this chapter the different options for channels and relationship management are presented for both the B2B and B2C segments. In addition, the importance of good distribution channels and the challenges related to channels were also discussed. In general, based on the interviews, it can be stated that the success of a serious or medical game company is sometimes even highly dependent on its ability to develop proper customer channels and customer relationships, as highlighted by GP3, GP6, and HP5, among others.

As implied in the previous chapter, the B2B market seems more prominent for medical games in general. Based on the interviews, there seems to be roughly two ways to sell medical games in the B2B markets: The first one is direct selling and marketing. This option is an arduous task that usually involves fieldwork, like contacting people, acquiring contacts, and conducting selling visits, as emphasized by GP8 and GP13. The second one is partnerships, as presented by GP3 and GP11, among others. In this option, the medical game provider cooperates with another organization that already has a distribution network in place by, for example, bundling their products together.

Direct selling seems to be the natural way serious games are sold to B2B customers. As an example from the education game field, GP6 said that their company NordicEdu mostly acquires customers by "doing legwork," such as attending events and gatherings. He also highlighted the important role of customer references. Along the same lines, GP1 and GP4 suggested that medical games should be sold like pharmaceuticals and medical devices—by meeting health care professionals, discussing and demonstrating the benefits, and winning them over with a sales pitch. GP8 also said that this is the way their company sells their products:

> *I mean, when you're doing any type of entrepreneurial project, one of the prerequisites is to be able to be very, very driven in reaching out and being aggressive and speaking with a lot of people, calling, using contacts that work, and anyone who knows, anyone who's remotely involved in the field, we bring them into the office. We show them a product. We go to clinics. We do presentations. It's a major, major effort to get clinicians, an endless stream of new clinicians, in the door and their new offices to show the product to and get feedback. I mean it's the only—there's no secret sauce for that. It's just you really have to be aggressive in going out there and connecting.* (GP8)

In addition to being burdensome, GP13 pointed out that selling to hospitals can be extremely difficult. According to his experiences, large incumbent pharmaceutical companies have made it hard for small new firms to enter the market. The traditional way pharmaceuticals are sold is by offering lunches to doctors and talking about new products. There is no place for small start-up firms in this process, according to GP13. By contrast, GP10 said that health care professionals are very good at and interested in purchasing physical goods, such as medical instruments. For this reason, GP10 suggested that medical games should be sold in the same way by bundling them with tablets, for example, and using the traditional medical wholesalers as a channel.

GoodLife Technology provides an example of how distribution is organized by having a partnership. Its cooperation with the exercise prescription software provider PhysioTools has allowed it to have a very large network of physiotherapists as its possible clients. The products and services of GoodLife Technology are bundled with the content provided by PhysioTools. According to GP3, GoodLife Technology provides the technology and PhysioTools provides the content and distribution channels. As a result of this partnership, GoodLife Technology can reach around 90% of Great Britain's physiotherapists and around 250,000 physiotherapists globally in 80 countries, according to GP11. In addition, GP3 pointed out that therapists can be considered marketers and salespersons as they can recommend GoodLife Technology's products to their patients, further increasing the extent of the distribution channel. GP3 and GP11 both pointed out that this partnership produces a strong competitive advantage for their company.

> *Our big competitive advantage is the partnership with the industry leader. For us, it opens the distribution channels so that we can reach 250,000 physiotherapists in 80 different countries. If you would take off with a different strategy, a heavy organization with lots of sales force and marketing power would be needed. In our case we can run with a small organization, and the costs are rather low. We can expand to other countries, and it's not a necessity for us to physically be there.* (GP3)

GP13, the cocreator of the hearing test game Herring, also highlighted the need for distribution partnerships, especially in the context of international business. In Herring's case, it was too expensive to sell its product to countries outside Finland because travel costs would use up a large amount of potential revenues. According to GP13, a distribution network acquired through a partnership could solve the problem. Similarly, HP5 pointed out that the lack of proper channels and marketing has also hindered the distribution of their cognitive rehabilitation software FORAMENRehab. For this reason,

she pointed out that health care professionals should cooperate with professionals who have expertise related to channels and marketing.

For medical games, there are many potential stakeholders in the distribution and selling process. HP2 brought up that doctors have the freedom to try new tools if they believe they have benefits and no risks. HP2 also accentuated that it is important to convince the senior rehabilitation physician about the product as he or she can often take the matter to important meetings. GP10 also highlighted that doctors' recommendations are an important factor in selling medical games. Giving a slightly contrasting opinion, HP3 suggested that brain rehabilitation game–selling efforts should target not doctors but rather neuropsychologists and patient associations, since they work more closely with patients. In agreement with this, HP7 said that like doctors, neuropsychologists tend to have the freedom to choose the methods and tools they use in the rehabilitation process. Additionally, HP4 and HP5 pointed out that international congresses and scientific seminars are crucial for the distribution of new ideas related to health care tools and methods. HP5 considered it important to write about the new products in health care publications. Furthermore, GP3 brought up the role of the patients in product distribution and marketing: Today people are willing to influence their provider and the form of their care and rehabilitation. There should be more options for health care delivery as devices such as smartphones and tablets have become common. GP3 said that if consumers demand better service and new tools, the health care sector, even the public one, will have to react. As a further thing to consider, GP8 mentioned that it can be important to reach out to the patient's family, children, or caregivers as well.

The customer channels for the B2C market seem rather straightforward: Digital distribution–based application stores like Google Play and App Store were almost exclusively presented as the main option (e.g., GP5, GP9, & GP12). Platforms like Steam for PC were also mentioned by GP2 for games that are not mobile-based. However, GP6 pointed out that even though digital distribution is a lot easier for consumers, some people still prefer to buy games in a physical package from a local store, perhaps because they are used to it. As a middle option, GP12's company has chosen to sell their brain-training CDs in a web store. However, they are moving toward digital distribution as well.

> *Guys who have been developing games see it like the distribution channels are already there, since we have the App Store in place. Yeah, that's right, but that doesn't get you anywhere.* (GP11)

As shown above, GP11 highlighted that even though digital distribution platforms like App Store are easy for the company to implement, it does not mean that customers are easily reached. GP13 talked about the same issue but also pointed out that having a certain niche helps. As an example, he mentioned that an application offered to diabetes patients

targets a smaller segment of people that have a connective community around them. As a potential alternative to traditional digital distribution platforms, GP10 suggests that there could be a mutual portal for valid and certified medical games where customers could buy them from one place.

Some interviewees pointed out that if a medical game is bundled with a product, such as a heartbeat sensor or a medical device, then the distribution process is slightly different. GP5 pointed out that a simple way is to let the customer buy the physical product from a local store or a web store and allow the app to be downloaded from a digital distribution platform for free. In addition, GP10 talked about the possibility that medical games could be sold in pharmacies in the same way medical devices are sold.

Furthermore, after the service has been sold, it is important to take care of customer relationships. GP3 talked about the importance of providing training to customers, further pointing out the benefits of the product and reinforcing the buying decision. In addition, GP11 pointed out that companies in the game industry know their customers better than any other companies. This is a result of mobile devices producing large amounts of data about the user. By analyzing this data, GP11 highlighted, companies can know their customers well and develop an understanding on them. When customers are well known, it is easier to create lasting relationships with them.

All in all, many interviewees accentuated that distribution channels are crucial to the success of medical games in both B2C and B2B markets (e.g., GP3, GP6, & HP5). GP6 pointed out that many customers do not have enough experience to distinguish good serious games from bad serious games, thus giving an edge to companies who can best reach customers. However, GP2 pointed out that when considering the different distribution channels for medical games, it should be kept in mind that probably there is no single solution for every company. The business decision makers should consider all the best channel options, taking the circumstances of the business into account.

4.4 Internal capabilities dimension

4.4.1 Key processes

Based on the interviews, there are a few key processes above others that are crucial to medical games: game development itself, research and validation, market research, and marketing or commercialization. These processes stem from the fact that in the field of medical games, according to GP5 and GP7, two completely different industries meet: On the one side is the game industry, where companies do “what they want” and everything is very practical, agile, and market driven. On the other side is the medical industry, which

is the complete opposite, swamped with regulations, bureaucracy, reservations, and very long product development cycles. GP8 brought this up as well:

> *There's always a challenge and a tension between making the game fun, enjoyable, engaging in the long term and also making sure that at every step of the game, it adheres to the clinical objective.* (GP8)

Similarly, GP13 pointed out that serious games such as medical games are challenging to produce, since the developer has to take two objectives into account. However, on the other hand, GP10 pointed out that when the game has benefits other than just providing fun, it does not have to be as great as entertainment games usually are.

A self-evident key process for medical game companies is the production and development of the game. GP4 emphasized that games should be properly planned; making one great game is more important than effectively making several mediocre games. Similarly, GP6 said it was important to properly design the game on paper before starting the real production and programming of the game. If the game is programmed without a clear plan or design, it can be costly and time consuming to correct the code afterward. As further consideration, GP7 pointed out that game production cycles are very rapid, whereas development projects can take up to 20 years in the medical companies. GP7 noted that if medical games are to be treated as games, then the production cycles have to be quick.

Nearly all interviewees emphasized that it in order to succeed, medical games have to have scientific evidence behind them. If a medical game claims that it has health benefits, the benefits have to be proven, as pointed out by GP9, HP3, and HP7, among others. HP6 pointed out that a game will not claim to be a part of the rehabilitation process if there is no evidence. Similarly, GP3 and HP3 emphasized that it is very hard to sell anything to health care professionals if the product is not proven effective and safe, and also profitable business-wise. In order to generate this evidence, medical game companies have to conduct thorough and rigorous research and testing. This often requires lots of time, money, and perseverance, and at worst can be very challenging, as noted by GP2, GP10, and GP11. Many interviewees see the research and validation procedure as a key challenge for medical games (e.g., GP1, GP5, & HP5). GP10 even pointed out that the exhaustive process of certification and research was one of the main reasons why their neurogaming project was frozen:

> *It would've required lots of money to carry on with the project. We were losing faith, both we and our investors. Firstly, certifications and scientific research were needed, and after that, you'd need to commercialize the*

> *game and take it to the health care sector. None of us was willing to continue chewing on that piece of work.* (GP10)

From the health care professionals' point of view, medical games should be thoroughly studied in scientific medical settings, as emphasized by HP2. In addition, according to HP2, one promising study is not enough; it just points out that the subject is worthy of more studies. Several studies are needed for adequate evidence. A further challenge is presented by brain injury patients, said HP4, because they differ from each other significantly, and for studies, dozens of similar patients are needed. Furthermore, HP3 and HP5 highlighted that conducting these studies can be very difficult and time consuming. For example, the development process of FORAMENRehab took around 10 years, according to HP5. As another example, GP2 said that in their project, they were forced to run usability tests with young people instead of elders because the Japanese safety regulations and checklists for elders were too strict for their time schedule. Similarly, as GP10 said above, their neurogaming project was frozen because gathering enough scientific evidence was too expensive and burdensome.

On the other hand, GP3 said that it is not always needed to conduct exhaustive medical studies that require enormous amounts of time and money. For some products or services, just pointing out and proving that the new method saves money, improves results, or simplifies existing processes can go a long way. At least this is the case in their main field of work, physiotherapy. Furthermore, GP5 pointed out that it matters significantly who has created the game; if the game is developed by neuroscientists, it has more credibility than if it were created by traditional game developers.

However, as a significant upside to rigorous research, the game can achieve the status of a verified medical practice. According to HP2 and HP8, this in turn opens many doors; the medical game can become a standard practice and be entitled to public reimbursements and such. HP4 said that in this case, the game would gain a large amount of customers internationally in a short period of time. As a further factor, solid scientific proof can protect the company from risks. As a warning example, GP10 mentioned the case of the Finnish earlight product developer, Valkee. On its webpage, Valkee claims that its product can, for example, improve mood and banish winter depression. Unfortunately, the company has recently received significant criticism and bad publicity due to deficiencies in its scientific proof. Thus, the importance of solid scientific proof is further accentuated.

According to GP10, a further important factor is whether the usability testing and building of the scientific base is built into the production of the game from the start. As GP10 said, "*When you have already finished the game, it's a bit late to try to promote it with some scientific studies*." In addition, GP11 emphasized that the research can be done in partnerships with, for example, universities. This can make the process a lot easier and

cheaper, and some start-ups can even be born from these university projects (GP1). Additionally, HP1 highlighted that validated, high-quality, and evidence-based results could help the whole industry. According to her, if there was a standardized classification for medical games, health professionals could easily recommend games, and different games for different problems could be easily found.

Based on the interviews, market research can be seen as one key process for medical game companies. In GP8's experience, their biggest challenge was to integrate their service as a part of clinicians' practice and get them to engage in using it. The process was rather laborious:

> *It took years of iteration, rapid iteration, constantly watching people use it, taking notes, understanding what clinician needs are, and understanding what their constraints are.* (GP8).

GP3 also emphasized that it is crucial to clearly understand the processes and requirements of the customers, especially when selling to health care professionals. Their goal was to develop their service so that it did not radically alter the daily work of the physiotherapist. In order to achieve that, GoodLife Technology cooperated with different physiotherapists, tested the technical and functional feasibility with them, and listened to their needs:

> *They told us what features they need and what are useful. Then we developed those and didn't try to guess by ourselves what the customers want.* (GP3)

Similarly, GP13 also highlighted that understanding the health care process in question and designing the product to fit the existing process is a key success factor for new technological innovations for health care: "*Processes in health care are often rather standardized. There is a reason why each pinprick is done in a certain way*." Based on GP13's experience, if a company wants to alter these processes, some change resistance is to be expected. According to GP3, the whole value chain has to be considered and understood from start to finish. In addition, HP9 emphasized that there is a large network of different information systems in the health care sector, and a new system, such as a medical game, has to fit in and be validated. This also requires the medical game developer to understand the market very well.

The role of marketing can also be significant. If the segment is B2C, then advertising costs will be huge. GP4 and GP9 pointed out that marketing efforts are crucial if a game aims to succeed in the consumer markets. In GP4's experience, large game companies spend more money on marketing than game development itself. If the segment is B2B,

the direct selling and channel management costs will be substantial; GP11 pointed out that in addition to marketing the game to end users, the game has to be marketed to health care professionals as well when targeting the B2B segment. As GP11 said, "*In the entertainment game business, it is enough that the end user is using the product*," whereas in the medical game sector, there are more customers to convince. By contrast, GP8 said that they have a lightweight approach to marketing and focus only on the groups they are working with at the moment. In GP8's experience, at the early stage, a huge scale is not needed, and when a large-scale marketing push is done, all the assets needed should be ready, the target customers known, and the marketing message clear.

4.4.2 Key resources

The resources can be almost directly derived from the key processes. If the key processes are game development, research and validation, market research, and marketing, then the main resource is the expertise related to these processes. However, the interviewees pointed out some interesting issues related to the key resources.

For medical games, the importance of human capital was often emphasized. Many interviewees (e.g., GP7 & HP9) pointed this out by saying that when developing a game or building a start-up, it is important to have a great team. Additionally, based on the interviews, medical game companies need a wide array of expertise. Business expertise was many times pointed out as crucial but often overlooked (e.g., GP9, GP10, & HP9). According to GP9, if the game is developed mostly by researchers, it will be rather difficult to commercialize later. Because of this, he said that business expertise should be integrated into the game developed from the start. Similarly, GP3 said that an engineer-driven approach does not get a company very far, since products do not sell themselves, and thus various areas of expertise are needed. Based on her experience with cognitive exercise software development, HP5 also highlighted the need for marketing and customer channel expertise. Furthermore, GP7 and GP10 emphasized that business expertise is needed especially from the field of health care. According to them, knowing the business models and traditions of the health care industry is crucial. All in all, the lack of business skills poses a major challenge to medical games: in GP5's experience, international events and conferences are filled with medical games with great research results but no actual business success.

As research and validation is one of the key processes in the production of medical games, medical expertise is needed in both designing the game and researching it later on. HP2 said that medical games should be developed in close collaboration with health care professionals in order to make them credible. Similarly, GP2 pointed out that health care experts can better consider the needs of the customers, and thus they should be

included on the development team. On the other hand, GP11 said that medical expertise is not needed in-house and should not be taken "too close." However, GP2 pointed out that conducting research has its own rules and norms, and thus experienced researchers are an important asset. As a further point to consider, GP8 said that having user experience design professionals is crucial. The importance of great user experience can be seen in the statement below by GP8:

> *We actually hired someone full-time to be involved solely on the user experience side and to bridge the psychological, where people come from, from the psychological perspective to the technical perspective, to ergonomics, to human factors, and really being able to bridge all these things together. I think that that's the secret. That's probably that most important thing that would make a product that's a health care–oriented product come alive. That's what you really need.* (GP8)

Furthermore, game development involves a significant amount of programming by nature. Programming can be outsourced to some extent, according to GP9, but many interviewees suggested it should be kept in-house. HP9 even said that having programmers on the payroll is not enough; they need to be committed and embedded in the ownership structure. As a simplifying factor, GP11 said, medical game companies do not need as much graphic expertise as traditional game companies do. However, GP9 emphasized that an art director or a lead designer is essential to the success of the game. According to him, the game should look, feel, and seem good from the customer's perspective, and this is not something that can be superimposed later.

In addition, as medical games target a field full of regulations and bureaucracy, juridical expertise should be considered as well. Based on GP8's experience, "*fundamentally important is being supported by the regulatory authorities*." However, GP11 said that you should not learn everything by yourself and instead use partners in other countries that understand the regulations thoroughly. Similarly, GP8's company, used a legal consultant, but GP8 also pointed out that this approach can be costly.

The different areas of expertise, such as programming, research, and marketing, can all be outsourced somewhat in theory. Based on the interviews, there is no single right way to do this. For example, SkillPixels (GP9) has decided to keep nearly everything (e.g., development, research, and business) in-house, whereas GoodLife Technology (GP3 & GP11), by contrast, has mostly outsourced health care expertise and acquired distribution channels through a partnership. Similarly, education game provider NordicEdu has no particular pedagogical expertise inside the company. According to GP6, this is not an issue; the expertise can be outsourced, and the company finds it effective to focus solely on its core competences.

Attitudes, attributes, and values can also be considered key resources. HP9 emphasized that honesty, openness, and transparency are extremely important in the start-up phase, in particular when a firm is seeking funding. Furthermore, GP12 pointed out as a challenge that Finnish companies do not make moves quickly enough, and they tend to be too humble without a reason. In his experience, medical game companies need to be brave, confident, and agile. According to him, especially in the digital world, products have to be launched quickly and developed based on customer feedback. Similarly, GP9 highlighted the need for the ability to reassess and change the product and constantly see it from the customer's perspective. This is something that separates commercial successes from research prototypes.

Furthermore, funding itself was also often emphasized as a key resource. However, fundraising was depicted as difficult by many interviewees, including GP3 and GP9. GP11 mentioned the collection of large funding especially as a challenge:

> *In Finland you can gather 100,000 euros pretty easily, but in turn getting 5,000,000 is damn hard.* (GP11)

HP9 said that in order to raise funds, the company has to have a credible cash flow statement, answers to the difficult questions posed by investors, and proof that the team can get things done. The importance of a good fundraising team was also often mentioned (e.g., GP4 & GP7). As a further important factor, GP4 pointed out that investors should never be cold called. This means that some other company should first recommend the company seeking funding to the investors. From GP4's experience, this approach has a significant impact on the result.

4.4.3 Data as a key resource

Based on the interviews, it can be noted that there are substantial possibilities but also potential threats posed by the data generated by medical games. On the one hand, data can lead to significant service improvements in the health care sector, but on the other hand, collecting data can be complicated and can hurt people. From the business point of view, valuable data can become a steady source of revenues, but it can also be hard to harness it as merchandise, as pointed out by GP9, GP11, and HP9, among others. A quote by GP13 summarizes the situation well:

> *The most interesting business models are related to data, but they are also the business models that no one has yet been able to crack.* (GP13)

In general, medical game data has many potential uses. HP9 pointed out that by analyzing data, the patient can be observed and measured from a distance. Because of this, patients can be invited to the hospital for further inspection when needed, or they can receive alerts that they should contact a doctor. HP9 highlighted that for elderly people, this is an efficient way to allow them to stay safely at home for longer. Additionally, the doctors can use the data as a tool in diagnosing, or even produce direct diagnoses based on the data. As a further factor presented by HP7, data has one significant strength: it is objective. GP3 said that health care professionals can benefit from data, which can describe how the medical process has gone, and they can use it as a decision support tool. In addition, HP5 pointed out that data generated by the games can form a base to be used in the scientific research related to the game.

In addition to being useful, data generated by a game has the potential to be used as a source of revenues by the company producing the game. However, this can take time and be difficult. GP11 compared data to Uncle Scrooge's money bin, which has to be filled first before it becomes valuable. According to GP11, GoodLife Technology is planning to develop a premium interface for physiotherapists that provides valuable information about patients and saves time by, for example, diagnosing the patient's problem based on the previously generated data. In addition, GP3 brought up that data can provide precious statistics for physiotherapists on what exercises work best for each injury, and allow the therapists to observe how the patient follows the prescribed exercise routine. Furthermore, as pointed out previously by GP2 and GP3, insurance companies are potential data customers, but it would be unethical to give raw customer data to them. GP3 proposes that instead, for example, information related to rehabilitation bottlenecks in general can be valuable to insurance companies without sacrificing patients' privacy.

For the B2C market, large amounts of data are generated by smartphones and devices already, as noted by many interviewees. GP5 said that this data could and should be taken advantage of and used with new applications. Similarly, GP1 said there was potential in wearable technology devices being linked together, thus possibly providing meaningful data. Along the same lines, GP5 said that consumers could benefit from large national health accounts that collect personal health data in one place. The same data could be used in health care processes as source of information. As an example of excellent data utilization, GP13 talked about a company that produces asthma inhalers; every time an inhaler is used, GPS-based location data about the place of use is gathered. This way the company can warn its users about locations where the quality of air is likely to be poorer. GP3 pointed out that as the data is anonymous, no one's rights are violated, and the company can still produce valuable information.

> *If you consider an elderly person living alone… and there is a device that is tracking how the person is moving around, and can even detect if the*

> *person has fallen down, or the person is required to perform a test that measures cognitive state, for example, there's a huge amount of potential, but also terrible threats related to it.* (HP9)

Many interviewees (e.g., GP11 & GP13) pointed out that collecting data can be very difficult, mostly because of legislative barriers. As an example, GP3 and GP11 said that in Germany, the partner software of GoodLife Technology, PhysioTools, cannot be online in any way. Furthermore, HP9 emphasized that collecting data can violate individual rights and cause harm to people, and GP9 and GP13 highlighted that there are many ethical considerations related to data collection in general. On the other hand, HP9 and GP11 pointed out that many people are still willing to hand over all the data about them almost for free. As GP11 noted, younger generations are used to the idea that almost all information about everyone is publicly available. As a solution, the interviewees (e.g., GP9, GP11, & HP9) agreed that the data should be collected anonymously, and HP4 and HP5 also emphasized that the permission of the patient has to be always secured.

As further challenges, HP1 emphasized that information security issues are the biggest problem related to data and medical games, and they need to be taken care of carefully. In addition, in her experience, technical feasibility and compatibility with other information systems has to be considered as well. Furthermore, GP1 accentuated that the data has to be linked with certain variables, or else it is rather meaningless. For example, no one is interested in what heart rates the users of a product have if this is not paired with other information, such as weight and gender of the user. Similarly, HP9 pointed out that data can produce both nice-to-know and need-to-know information and that these two need to be distinguished as no one is willing to pay anything for nice-to-know.

4.5 Profit formula dimension

4.5.1 Revenue model and pricing

Based on the interviews, one of the biggest challenges of medical games is related to their pricing and revenue models (e.g., GP2, GP3, & HP9). The problem is twofold: firstly, who pays for the game, and secondly, what the price and the pricing mechanism are. These difficulties stem partly from the fact that in Finland, health care is often provided for free, and thus people have become accustomed to the idea that they do not have to pay for anything health care–related, as pointed out by GP5.

Brain rehabilitation in Finland is funded almost exclusively by either insurance companies or the Social Insurance Institution, as noted by HP2, HP6, and HP7, among

others. Selling the game directly to payers is not a valid option is this case, but according to HP2, the game should rather be included in the rehabilitation service provided by hospitals and rehabilitation institutions. The game could offer improved rehabilitation service to these institutions, and thus they would have an incentive to pay. In addition, GP1 emphasized that if the benefits are validated, the price can be rather high compared to a normal game. Furthermore, GP10, GP13, and HP7 pointed out the importance of cost savings as a selling argument for health care professionals. The revenues can thus be seen as a product of someone else's cost savings. As a pricing method, GP10 and GP13 pointed out that the price of a medical game should be linked with the cost savings by making calculations that prove the economical effectiveness of the game.

Based on the interviews, the most prominent revenue model for B2B markets is an annual license or a subscription-based fee. The medical game Herring used one-time payment as the revenue model, and according to GP3, this was not an ideal choice. The game has been in use for seven years now, and even a modest usage-based fee or monthly payment would had generated significantly more revenue from the game than the one-time payment. However, GP13 said that they have been able to charge for maintenance services as an additional source of revenues. HP5 said that FORAMENRehab is sold using both one-time payment and, alternatively, an annual license fee. In addition, HP5 pointed out that they have separate licenses for personal and business use; for individual patients the price is significantly more affordable. Similarly, GP8 said that they use mostly licensing fees and monthly subscriptions service, also accentuating the modularity of the service:

> *For most of the groups that we work with, it is a licensing fee. It depends on if you're in the clinic or at home. Like basically, this product is like more of the modular. So if you're a patient, you get only a specific piece of a product. If you're a clinician, you get another piece of the product. So the pricing is different depending on all those. So it is a monthly subscription that we look at.* (GP8)

Bundling the game with physical products is one potential revenue model when targeting health care companies. As GP10 pointed out, health care professionals are used to purchasing tools and devices, so bundling would be a natural option when selling to B2B markets. In addition, HP1 pointed out that when talking about certified medical devices, the prices go up significantly, up to tens of thousands of euros. Because of this, if the game is thoroughly researched and validated, resulting in proper certificates, it can possibly be sold for rather high prices when bundled with a product.

As a further option, the revenue model can be also based on the data generated by the game. For example, GoodLife Technology offers premium analytics services to health

care professionals for an annual license fee. GP3 and GP11 pointed out that this service allows physiotherapists to access a global knowledge bank and improve their decision making.

Furthermore, HP6 said that if medical games can make the patient's rehabilitation process more effective, insurance companies have an incentive to pay for the games. In agreement with this, GP8 reported that insurance companies pay their company for conducting pilot studies.

If the game is sold in B2C markets directly to patients, there seems to be two revenue models that the interviewees highlighted. The first option is to bundle the game with a physical product, such as an activity bracelet. GP5 highlighted that this way, the game itself can be given away for free because the revenues come from selling the devices. The second option is to charge for the game itself. However, GP4 accentuated that mobile games are today almost exclusively based on the free-to-play revenue model, where the game is given away free and the revenues come from other sources, such as in-app transactions. As an example, GP3 and GP11 said that this is the revenue model that GoodLife Technology uses with its physical therapy application for patients. The application itself is free, but the patients can purchase additional content, such as training programs to be used outside of rehabilitation, for an extra charge.

However, although free-to-play is the dominant revenue model for mobile games, some interviewees consider it rather unfit for medical games (e.g., GP9, HP9). For example, GP9 noted that in-app purchases make the game feel like the player is cashed in on something all the time. In the context of medical games or education games, where the customer is often a patient or a child, a more ethical option is to sell the game for a one-time payment, according to his experience. GP1 further argues for premium pricing as direct competition for a medical game is close to nonexistent, thus allowing the company to put a price tag on the game. Another option is to charge based on usage, as discussed by GP10 and HP9. However, HP9 noted that it might not be the right thing to do to make the patients who need help the most pay the most. By contrast, GP10 pointed out that this is exactly how courses of drugs are sold, and thus it would be a natural way to sell medical games as well. Also, the possibility of a monthly subscription fee should be evaluated as it would provide a steady source of revenue, as pointed out by GP6 and GP7.

All in all, making money with medical games can be rather difficult at first, but this issue is likely to be solved in the future; as GP6 pointed out, very few serious-game companies in Finland are profitable. This is mostly because the business model of traditional games is not very suitable for medical games. However, GP6 also pointed out that although there are no "quick wins" in the serious-game business, it does not mean that profitable business is not achievable with persevering work.

4.5.2 Cost structure

Based on the interviews, medical game companies' cost structure consists mostly of three cost items: game production, research, and marketing. These three cost items are in line with the key processes and resources needed for a medical game.

Many interviewees (e.g., GP9, GP12) emphasized that human capital in general is the largest source of costs for serious-game companies. As GP9 stated about their cost structure, *"Sometimes it's labor costs, sometimes it's marketing costs. But it's mostly these two.*" Along the same lines, GP6 pointed out that the tools that games are made with are rather cheap, but hiring programmers requires money. GP4 and GP11 estimated that producing a proper game or an information system employs around five people for a year, resulting in some hundreds of thousands euros in costs. Moreover, GP4 pointed out that often a single game is not enough and several games are needed in order to succeed, so the cost has to be multiplied. In addition, many companies require a value network around them, and GP12 pointed out that managing this network is rather costly, at least in terms of time.

However, what makes medical games expensive is not their production. GP10 pointed out that producing the game itself is rather cheap; it can be done for some tens of thousands of euros in theory. However, adding the medical aspect to games creates a substantial amount of additional costs in the form of research, certification, and marketing:

> *It's going to be a long road to get the product sitting on the wholesaler's shelves.* (GP10).

In addition, GP2 pointed out that the amount of users is going to be smaller than what normal games tend to have. Because of this and the increased costs from research and marketing activities, he stated, medical games will have rather high costs per game.

One factor behind the expensiveness of research is that in order to conduct credible and thorough studies, a large amount of patients is often needed and the process is arduous. As an example, HP3 said that for a proper study, you need 5,000 patients who play the game for two months, and also 5,000 patients who do not play the game. Similarly, GP7 and GP10 pointed out that when the subject of research is human health, the research cycles are long and the expenses high. In addition, in order to follow regulations and receive certificates, legal expertise is needed, and this can create lots of costs, as pointed out by GP8.

A further point to consider, provided by GP1, is that although game development and research activities create a large amount of fixed costs, the game can afterward be sold to numerous customers without significant variable costs. Of course, if the game is online

based, the company has to buy more servers when the number of customers increases. However, after the game is ready, it creates mostly marketing expenses. GP4 pointed out that because of this, the largest amount of costs for big game companies comes from marketing expenses. Nevertheless, game companies can calculate how much an average customer produces revenue and how much acquiring a customer costs. As a result, with each new customer, the company makes a profit. Similarly, GP11 said that marketing is very likely to be the largest source of costs, especially when the company is targeting larger markets. This is true for GoodLife Technology despite having a partner that provides an extensive distribution network. GP11 estimates that without the partner, building the distribution network would be an arduous task and take three years.

4.6 Value network dimension

4.6.1 Key partners and suppliers

Based on the interviews, the value network of medical games is quite accurately presented in figure 14 (p. 51), which was designed based on the first few interviews and preliminary knowledge. The most relevant key partners for medical games are closely related to the key processes of the company: Firstly, partners are useful when the game is designed and produced. Then, in the research and validation process, partners can provide significant help. Later on, partners are important when the game is marketed, sold, and distributed.

In the design and production phase, universities and health care professionals can offer valuable insight, as pointed out by GP11, HP1, and HP9, among others. GP8 and GP13 emphasized that collaborative development is the only way to build products that are useful. For example, HP1 emphasized that cooperation with universities allowed their project to have diverse expertise, and a multidisciplinary team of health care professionals provided help in designing the content of the applications. Similarly, GP1 and GP2 pointed out that educational organizations are needed and beneficial as intermediaries between game companies and health care organizations. As some interviewees (e.g., GP9, GP10, & HP3) have pointed out, conducting scientific research can be expensive, but this issue can be partly circumvented by having a university as a research partner. As an example, GP11 said that many universities internationally have offered to cooperate with their company. Furthermore, the possible customer company of the game, such as a rehabilitation provider or the patient, should be taken into close partnership when developing and improving the game, according to various interviewees (e.g., GP8, GP13, & HP2). In agreement with this, GP10 noted that game companies should mingle more

with different medical companies. Similarly, GP5 said that many medical companies are often interested in co-developing new innovations.

Many interviewees also pointed out that funding agencies, such as Tekes (the Finnish Funding Agency for Technology and Innovation), are important partners as they can offer both financing and consultation. For example, GP3 emphasized that Tekes has provided their company with significant help in refining their business plan and their revenue model logic. The same goes for other national organizations, such the Finnish Social Insurance Institution, that can, for example, partake in the research process and possibly fund the project, as pointed out by HP8. Similarly, GP2 emphasized that the Finnish government and the EU can have an influence on how much medical game affairs are researched.

Many different partners are helpful in marketing and distributing the game. As the case of GoodLife Technology and PhysioTools has shown, a partner can solve the problem of building an extensive distribution network. Similarly, GP13 and GP7 pointed out that if the game is bundled with a separate product, a strong partnership should be achieved with the product manufacturer.

> *The right partner for us would've been the product development department of the device manufacturer that we've integrated our product with. It would've been crucial. These companies have existing sales organizations, and that allows small companies to dodge the difficulties of selling abroad.* (GP13)

Furthermore, HP9 said that it is important to have investors in the company who have strong existing networks and who can thus open doors. In addition, the role of health care professionals as marketers should not be underestimated. For example, HP5 and HP6 emphasized that very often, the initiative to experiment with new technologies originates from enthusiastic health care professionals. HP3 and HP9 also pointed out that patient associations can have a strong influence over patients, and thus they should be used as marketing partners as well. Many interviewees (e.g., GP4 & GP9) emphasized that it is important to have good partnerships with distribution platforms like App Store.

Furthermore, as the majority of health care is provided by the public sector in Finland, medical game companies should seek to establish relationships or even partnerships with public health institutions. However, HP9 said that some start-ups have canceled their information system projects because it is rather difficult to sell to the public sector due to bureaucracy, slow decision making, and the complexity of existing information systems. On the other hand, GP10 noted that public organizations are rather easy to contact and eager to cooperate in promising projects.

All in all, the interviewees emphasized the importance of an extensive value network as partners are often needed in all key processes. GP12 and HP9 emphasized that start-up firms in particular should seek to build and maintain networks, which provide valuable help for small companies. Many experts (e.g., GP7 & HP9) also pointed out that small companies should network with each other and provide help to each other. However, the game industry in Finland is already rather networked by nature, and game companies often discuss their issues together, as highlighted by GP4 and GP7.

4.6.2 Value network position

Based on the interview examples, serious-game companies in general can assume many different value network positions. Four slightly different options are presented by discussing the cases of four serious game–related companies. Although neither of the case companies can be completely considered to be medical game companies, the examples still provide insight on different value network positions suitable for a medical game firm.

The business of GoodLife Technology is based largely on partnerships; the company conducts research in cooperation with universities and develops products with the help of a partner, and its distribution is for the most part organized by its partner. The core capability of the company is to provide cloud computing software that acts as a platform for different health care applications. GP11 describes their value network role as a dealer or a moderator that communicates with the different stakeholders and connects them. GP3 highlighted that the company seeks to develop expertise related to managing the whole service package, so taking all the sides of the value chain into account is important.

NordicEdu has chosen to act as an education game producer that tailor-makes games based on the needs and requirements of the customer. As pointed out by GP6, NordicEdu's expertise is above all related to game design and production, and pedagogy-related talent, for example, comes often from the customer. This approach allows the company to flexibly produce education games as made-to-order products that match the customers' requirements. However, its value network position requires that the customer have expertise related to the product, and thus the customers tend to be public organizations and companies that order the product, as GP6 discussed.

On the other hand, GP9 said that SkillPixels has decided to keep the required expertise in-house in order to develop education games from start to finish. This approach enables the company to design and produce games independently. As SkillPixels targets mostly B2C markets, the expertise to carry out the whole process is needed. However, the company still cooperates with some quarters, such as application stores and other distribution partners, as GP9 mentioned. As a result of the centralized approach, the company can produce more harmonious product families, but the costs tend to be higher.

By taking a value network position that reinforces strong collaboration and partnerships, a small company can leverage itself significantly. As an example, GP12 said that their brain-training company BRIIM has around four employees, but still over 30 people are involved in the development of its products. When different small companies help each other, a wide array of experts is involved in the development and marketing processes for the companies. BRIIM has many partnerships with other companies that allow them to cross sell each other's products. GP12 said that, for example, in the company's brain-training center it sells and promotes their partner's coffee, whereas the same partner recommends BRIIM's service in its coffee shops. However, as a downside, managing the network can take a significant amount of time and thus be costly, as GP12 mentioned.

4.7 Strategic factors dimension

4.7.1 Competitors

According to the interviewees (e.g., GP4, GP7, & HP9), the entertainment game market is filled with rivalry, and it is extremely difficult to stand out. This phenomenon is also present in the serious-game market. GP9 mentioned that a further problem is that there are many serious games that claim to have benefits without proper scientific evidence. Because the amount of games is so vast, it is difficult for consumers to separate the wheat from the chaff. Even worse, GP13 mentioned, lousy serious games can ruin the reputation of the whole industry if they gain attention for some reason.

By contrast, direct competition in the field of medical games is rather low at the moment. According to GP11, only a handful of companies offer products almost similar to those of GoodLife Technology. However, GP3 said that in his experience at international exhibitions, while almost every physiotherapy tool provider has crammed some sort of games into their devices, the quality of these games is often very poor:

> *Let's put it like this…. Last summer we were in a physiotherapy exhibition in London, and almost every company that offered some kind of device had attached something game-ish or a game into the products. But to me it felt that the gap between the software and the hardware was huge; you had really expensive devices that cost like £200,000, but the game included in the product looked like an elementary school kid would've done it with PowerPoint. The contradiction is really big.* (GP3)

Additionally, GP5 and GP7 pointed out that there are numerous health or medical games on display in different conferences, but almost all of them lack commercial success. Furthermore, GP10 and GP9 said that medical games could greatly benefit from an umbrella organization that would set certain standards and rules for the games and thus give certifications for games that met these requirements, resulting in better reputation.

However, other health care methods and tools can be seen as competitors as well. GP11 said that their company is, in a way, competing against the fact that the whole physiotherapy industry is stuck in the old ways. In addition, HP6 mentioned that dancing as a rehabilitation form has been used, and HP4 has studied musical rehabilitation therapy. New methods and innovative methods like these can also be seen as competitors to medical games. Furthermore, many interviewees (e.g., GP9, GP13) pointed out that medical games compete with traditional pharmaceuticals because games have the potential to either substitute or enhance the use of drugs. GP10 highlighted that because of this, pharmaceutical companies have vested interest in medical games. Similarly, GP5 pointed out that in his experience, the pharmaceutical industry has shown significant interest in medical games.

In the B2C segment, serious games are often seen as competing against traditional games. However, medical games in particular are often used for mainly benefit instead of fun. Nevertheless, if medical game spin-offs are sold as brain-training games, for example, then entertainment games can be seen as competitors. In addition, GP13 pointed out that games in general can be seen as competing against other methods of entertainment, such as circus shows and Netflix. As a further competition force, GP2 and GP13 pointed out that large incumbent companies like Apple and Google may end up dominating the health game market because they have the resources to gather and store enormous amounts of data.

4.7.2 Strategy, differentiation, and brands

Strategy itself is a component that is specific to individual companies. Because of this, industry-wide generalizations regarding the subject are difficult to make. In this chapter, strategy-related issues are discussed in the context of two brief examples of two serious-game providers. Additionally, some further issues pointed out by the interviewees related to strategic factors are presented.

GP3 mentioned that the strategy of GoodLife Technology is based on taking incremental steps and not attempting to conquer the market overnight. According to him, a big reason behind this strategy is the fact that physiotherapists are not ready to change their methods instantly. Furthermore, GP3 and GP11 both emphasized that GoodLife Technology has built itself a significant strategic advantage by partnering up with

PhysioTools. This advantage stems from PhysioTools having an extensive distribution network, and also its strong, 20-year-old brand. Because of this partnership, GoodLife Technology can dodge a large share of marketing work and instead use its partner's existing resources to the advantage of both companies. In addition, as the company structure does not require a heavy sales unit, the company can stay smaller and more agile.

The strategic factors are rather different when doing business in the B2C market. According to GP9, building a strong brand is crucial. This requires the refinement of superficial abilities, such as graphics and the overall feel of the game. In addition, the importance of a distinguishable icon was pointed out by GP9:

> *In the application stores, one simple way to differentiate from others is to have an icon that separates the game from the rest.* (GP9)

In addition, GP9 emphasized marketing efforts should strive to acquire a front-page spot for the game. However, superficial assets such as graphics and the icon guarantee only that many players try the game. He also added that if the company wants to build long-lasting relationships with customers, durable and high-quality content, such as a great story and rewarding game experience, is crucial. Furthermore, according to GP9, if customers give the game bad reviews, the company has to react and fix the issues quickly if is possible.

Many interviewees (e.g., GP6, HP3, & HP4) said that medical games can build a strong brand and differentiate themselves from the competition by backing the game up with rigorous and credible research results. Furthermore, GP6 pointed out that if the game is published by a well-known game publisher in the field of education games, such as Fingerprint Digital, customers can better be assured of the quality of the game. Another important factor to consider is the question of whether medical games should be presented as games or as something else: GP3 and GP11 pointed out that their company is not a medical game developer but rather a health care technology provider. Similarly, GP8 emphasized that their product is more than just a game:

> *I think that we haven't focused too much on the games for health. We focused a lot on physical therapy technology, health care technologies, but not as much on games. Because the game is one aspect of our system, the very important aspect, but we got more than games. We've got assessments. We've got exercises. We have telerehab components. We have a clinician management control. We've got outcome measures. So all these aspects are all part of what our product is. We don't consider*

ourselves like just purely games for heath. It's not definitely overlapped. It's more of a full-on health care technology. (GP8)

4.8 Summarization of the key findings

The key findings from the interview are summarized in table 7 below.

Table 7 The key findings per each business model dimension

Dimension	Key research findings
Value proposition	Medical games have substantial potential to improve health care. In addition to improving the recovery or rehabilitation process of the patient, medical games can be useful tools for health care professionals by allowing them to closely monitor their patients, improving communication and making the process more effective. As a result, cost savings and service improvements can be achieved. However, medical games should have certain features; most notably they should be easy to learn, proven safe and effective, and fun and motivating and also have progression built in. Furthermore, customization is crucial for medical games; patients can differ significantly from each other, and often the care has to be focused to target a narrow condition. In addition, bundling medical games with health care services or physical products appears important, even necessary. The games should be integrated into the health care ecosystem instead of being sold separately.
Customer	Medical games should target primarily B2B markets but consider the option to transfer the business to B2C markets as well. In addition to patients, health care professionals and institutions are important segments for medical games. Payers, such as insurance providers and the public sector, can be considered segments also as the game can benefit them by making health care more effective. Furthermore, the games should be either highly customizable or, alternatively, offered to a more focused segment, as patients can have various needs and tastes. As a further factor, customer channels are essential

	to the success of medical games, and acquiring them through a partnership should be considered.
Internal capabilities	Game development, research and validation, market research, and marketing can be seen as the key processes related to medical games. The key resources are human capital and expertise related to the key processes, in addition to funding, which can be hard to raise. Based on the interviews, the research and validation process appears to be potentially the most arduous and expensive process and can take years. Business expertise was also seen as crucial but often overlooked for medical games. Furthermore, data generated by medical games can potentially be utilized and thus used as a source of revenues, but harnessing it can be difficult.
Value network	The value network can be seen as a continuation of internal capabilities; the key processes can be divided into separate functions and these functions carried out by different actors in the value network. Because of this modularity of the key processes, medical game–related companies can assume various value network positions within the ecosystem. In the lightweight version, the company manages only one key process, such as medical game production. On the other hand, one company can control the whole medical game value chain, but this option requires significant capital and a large amount of expertise.
Profit formula	The pricing and revenue models are a noteworthy challenge for medical games. In countries like Finland, where health care is often provided for free, patients are not used to paying for their care. However, although patients and health care professionals benefit from medical games substantially, they should not always act as the payers in the B2B model. Instead, health care institutions and health care payers also have an incentive to pay for medical games because games can make the health care processes more effective and thus reduce costs, even improving service. Data as the source of revenues should be considered also as it can create value for various customer segments. When considering the cost structure, the largest amount of costs is likely to stem from research and validation activities, but marketing can also create significant costs when trade volumes increase. Additionally, game development and

	market research create costs, but their role in the cost structure is rather low.
Strategic factors	There is no considerable direct competition in the medical game market at the moment. However, medical games compete against traditional health care methods and pharmaceuticals, and also against new innovative health care methods, such as musical therapy or dance as rehabilitation. Three considerations for strategy can be highlighted: Firstly, the medical game company should consider forming a partnership with an established medical company, which can solve the issue related to distribution channels and selling. Secondly, building a strong brand with the use of rigorous scientific proof is recommended. The role of branding is further accentuated in the B2C market, where superficial features, such as the application icon, matter more. Thirdly, it should be evaluated whether to brand the product as a medical game at all or approach it as a more comprehensive health care technology package.

5 DISCUSSION

5.1 Discussion of the key findings

In this section, the key findings from the interviews are discussed and linked with the existing literature. However, it should be noted that as the main motivation behind this research is the fact that business models for medical games are rather untouched as a subject, comparison with literature is difficult. The specific aim of this thesis is to develop a conceptual business model framework and empirically use it in explorative medical game business model research. The research questions are, (1) what are the key components of business models for medical games, and (2) what are the most notable challenges related to business models for medical games and how can they be overcome? The results are next discussed with the research aim and questions in mind.

The value proposition can be seen as the centerpiece of a business model, and it is closely related with *customer segments*. Magretta (2002, 87) emphasized in her business model definition that "a good business model answers Peter Drucker's age old questions: Who is the customer? And what does the customer value?" Similarly Osterwalder and Pigneur (2010, 20–22) point out that customers are the heart of any business model and the value proposition is the reason the customer chooses one company over the other. Given the importance of a good value proposition offered to a certain customer segment, several important issues need to be highlighted based on the results.

In the literature, the medical benefits of health games have been often pointed out (e.g., Stach and Schlindwein 2012; Anguera et al. 2013; Brown-Johnson et al. 2015). This research further reinforces the argument that medical games can offer substantial benefits to the patient especially by increasing fun and engagement in tedious, repetitive processes. This in turn increases the patient's motivation to do the beneficial but often boring exercises, hence possibly hastening the process and improving the rate of recovery. This was something that all the interviewees agreed on and some interviewees had also experienced in practice. Thus, it can be concluded that medical games can offer a compelling value proposition to the patient in two primary ways: by providing the patient with beneficial medical effects and improved recovery results and by increasing the user experience of the patient related to health care processes through increased fun, engagement, and motivation.

However, the results of this research also highlight that medical games can be a significant source of value for other stakeholder groups as well. The same issue has also been discussed in the literature: Kaleva et al. (2013, 26) pointed out that the games should seek to improve the health care professionals' customer relationship management and lessen their administrative burden. Stach and Schlindwein (2012) and Brown-Johnson et

al. (2015) also concluded that doctors can benefit from health games through improved patient-doctor communication. Based on the results of this research, medical games clearly benefit individual health care professionals by providing them with a monitoring and communication platform. As a result, patients can be known better, and time-consuming routine work can be avoided. Additionally, over time games can produce valuable data that in turn can help health care professionals in, for example, diagnosis and decision making. Furthermore, many health care professionals pointed out that medical games can also greatly improve the treatment of outpatients and allow a higher number of patients to be taken care of. In the case of brain rehabilitation, this is especially useful as the number of patients is substantial relative to treatment available.

Another important customer segment is composed of health care institutions, private clinicians, and hospital owners. For this segment, the value proposition of medical games is related primarily to more-effective health care processes. For the public sector, this translates to reduced costs, whereas for private health care providers, the potential to increase customers and thus revenues can be a more important factor. In addition, medical games can increase the quality of health care service, thus allowing the health care provider to increase customer and employee satisfaction. In the literature, Hwang and Christensen (2008, 1335) pointed out that fixing health care is often approached by cutting costs. The results of this research are similar in showing that cost savings are essential in health care, but differ by pointing out that for private health care providers, service improvements and increased revenues can be also important.

Furthermore, the results highlight that medical games can offer a value proposition to health care payers as well. This is related primarily to the potential that medical games have in terms of cost effectiveness. In addition, medical games can possibly make the health care process more transparent to payers, thus allowing them to more effectively monitor and research possible bottlenecks and problems. As often noted in the literature (e.g., Christensen 2009 et al.; Kaplan & Porter 2011), health care is in a cost crisis, and affordable health care solutions are crucially needed. Thus, it can be argued that if medical games can make health care more cost effective, a compelling value proposition is presented to health care payers. However, Zott and Amit (2007; 2008) highlighted that business models seeking only to improve economic efficiency are often less successful than business models seeking novel transactions. In addition, Herzlinger (2006, 7) pointed out that sometimes increasing the effectiveness of health care can pose problems for hospitals, whose funding is dependent on the amount of sick people. Thus, the aim of medical games perhaps should not be only to decrease health care costs.

Regarding value propositions and customer segments, it can be concluded that there are four key customer segments for medical games: (1) patients, (2) health care professionals, (3) health care service providers, and (4) payers. All potential customer segments should be carefully examined and identified when designing a medical game,

and a compelling value proposition should be formulated for each customer segment. The multifaceted nature of medical game customer segments and value propositions can be considered as a key component of business models for medical games.

Regarding customer segments on a larger scale, the B2B customer segment appears more prominent for medical games, as also previously suggested by Kaleva et al. (2013, 25). Based on the results, this is due to several reasons: First of all, medical games can offer appealing value propositions to several consumer segments in the B2B market. This means that more value is created, so there is potential for more value to be captured—that is, more revenues. Secondly, health care professionals are almost always needed as supervisors in medical processes, and thus the game should be included in their service. Furthermore, in the case of brain rehabilitation, the payer is almost always the public sector or an insurance company. Based on the results, the medical game can be easily included in the health care services paid for by these two parties, which requires a B2B approach, whereas asking them to pay for the game separately can be difficult. However, the B2C market should not be completely overlooked; many interviewees emphasized that the largest volumes and best possibilities for substantial growth are there. In conclusion, medical game companies should target primarily the B2B market but consider the B2C market as a possible, attractive option.

Based on the results, some *product features* for medical game need to be highlighted as they can be of valuable help in designing the game. Firstly, the interviewees emphasized several key features that are recommended for medical games. Secondly, bundling and customization are listed as individual essential components of the value proposition based on the literature review. These two components proved crucial for medical games also, and thus they are discussed with particular care.

From the patient's point of view, valuable features for a medical game are linked mostly with the game's ability to increase user motivation and improve user experience in health care processes by, for example, making progress visible, rewarding the patient, and including a good story. However, the most emphasized feature was ease of use. Professionals from both a health care and a game background emphasized that the game should primarily be easy to learn, although for slightly different reasons: game professionals said that if the game is not very easy to learn, the player abandons the game and finds something else. On the other hand, health care professionals pointed out that especially in the case of brain rehabilitation, patients can have impaired cognitive skills, and thus simplicity is crucial. Simplicity is further recommended as the results highlighted that the game has to be easily implemented into the daily practices of health care professionals and take all stakeholders into account. This is linked to the existing literature, in which the complexity of health care information systems and the need for easily integrated solutions are often noted (Hwang & Christensen 2008, 1334–1335; Herzlinger 2006, 7).

In addition to the other product feature recommendations, *customization* is crucial for medical games. The need for customization was particularly emphasized by the health care professionals interviewed. For example, in brain rehabilitation, the patients can differ significantly, and each patient requires focused care that has to be tailored to his or her situation and needs. By contrast, some business-oriented interviewees highlighted that the game should not be developed to meet the requirements only of a small niche. The same issue has been emphasized by Kaleva et al. (2013, 26). The game has to be scalable; that is to say, the game should be easily transferred to solve the problems of other customer segments also. However, tailorability and scalability do not necessarily rule each other out; Osterwalder and Pigneur (2010, 23) pointed out that customization allows for tailored products and services while still allowing a company to benefit from economies of scale. In addition, Amit and Zott (2001, 504) emphasize that customization is a substantial potential source of value creation because it increases customer lock-in. As a conclusion, customization is a key component to medical games and should take into account both the ability to focus on narrow health issues and the transferability to larger context.

A further key finding concerns *bundling*, or pairing a product with another product or service. Amit and Zott (2011, 504) highlight that complementary products can be an important source of value creation. Bundling in the case of medical games mostly refers to integrating the game into the health care ecosystem, and it can be considered as a key component for business models for medical games. Owing to the nature of health care, a stand-alone medical game seems difficult to produce; the medical process is almost always supervised by a health care professional, and thus the medical game should be integrated into the health care service package. From the patient's perspective, what he or she receives is not a separate medical game but rather a comprehensive health care service in which the game is used as a tool and managed by the health care professionals. Furthermore, it should be evaluated whether to bundle the game with a physical product, such as a medical device or a tablet computer. This might be useful because, as many interviewees pointed out, institutions and companies in the health care sector are used to purchasing physical goods. In addition, the results complemented the notion by Kaleva et al. (2013, 24) that for medical games, partnering up with an established medical product vendor can create significant value for both parties.

The most important findings regarding internal capabilities are related to the content of key processes and key resources. For medical game companies, the key processes can be divided into four categories: game development, market research, marketing and distribution, and scientific research and validation. Game development refers to the design and production of the actual game, and the key resources needed in this process are programming expertise and a skilled art director that ensures the game's attractiveness. Market research refers to the process by which the potential customers of the game are closely studied and their needs identified. The need for thorough market

research stems from the fact that medical games have potentially many users, such as patients and therapists, and the game has to fit both the needs of the users and the process seamlessly. Since medical games need to be integrated into the network of health care information systems, market research should also cover the inspection of technical feasibility. The key resources for the market research process are related mostly to business, technical, and user experience expertise. It should also be noted that based on the results, the process can be expected to take a significant amount of time, even years of constant iteration.

Of the four key processes, the two most challenging seem to be marketing and distribution, and research and validation. If medical games are located at the intersection of two very different industries, the game industry and the medical industry, then these two processes tend to follow the rules of the latter. The difference between these two industries was accentuated in the results: When talking about game development, the game professionals pointed out that production cycles have to be very short and agile. By making constant, quick-release iterations, the game can constantly be improved based on customer feedback and instantly distributed via application stores. By contrast, health care professionals emphasized the importance of rigorous and careful scientific research, which can take years and cost millions of euros. Also, distribution in the medical industry is rather different from in the game industry; direct selling and existing partnerships or networks were emphasized. Potentially the most significant challenges for business models for medical games are crystallized in this contradiction between the two industries: For rather small game companies, the burdensome clinical trials can be the main challenge when entering the market (as also noted by Kaleva et al. 2013, 26) and the health care regulations might feel overwhelming (as also pointed out by Hwang & Christensen 2008, 1334–1335). The distribution process can pose a big challenge as well.

However, these challenges can be effectively overcome by constructing a solid value network. As emphasized in the business model literature, value networks are often the cornerstones of good business models and crucial in value creation (e.g., Morris et al. 2005, 728; Zott & Amit 2007, 195; Sánchez & Ricart 2010). Based on the results of this research, the key processes related to medical games can be divided into separate modules and shared between different companies in a value network. The modularity and the notable role of value networks is definitely a key component of business models for medical games. Due to this modularity, companies can assume many possible value network positions ranging from agile and lightweight subcontractors (controlling one key process) to powerful and centralized industrial giants (controlling the whole value chain). For example, a small game company can produce a medical game while a university or an established medical company manages the research and validation. The different possible value network positions allow the companies to share the risks of burdensome and expensive clinical trials, but as a requirement, the profits have to be shared as well.

Chesbrough's (2007) theory of open business models is very helpful in the case of medical games. Chesbrough suggests that companies should open their business models, or seek to leverage ideas developed by outside companies and also, in turn, sell their own technologies or ideas that are hard to commercialize in-house. As a result, research and innovation activities become more profitable, and fewer innovations are left "sitting on the shelf" (Chesbrough 2007, 22–23). Based on the results of this research, open business models can be a solution to the key challenge of capital-intensive, risky, and burdensome clinical trials. Open business models further allow the sharing of risks related to clinical trials and make it possible for one partner in the network to collect a profit by conducting clinical medical game research. Similarly, as Kaleva et al. (2013, 26) suggested, the clinical trials should perhaps be targeted at standardized platforms instead of individual games. This would in time enable the quick production of different medical games, as long as the games were built using a standardized technology, method, or platform that has been scientifically researched and certified.

The key challenge related to marketing and distribution channels is caused mostly by two factors related to the health care industry: Firstly, based on the interviews, comprehensive and broad markets for health care products and services do not exist the same way they do in, for example, the game industry, where application stores can practically reach everyone instantly. This finding is in line with the findings of Hwang and Christensen (2008, 1334). Similarly, Kaleva et al. (2013, 11) noted that markets for medical games are close to nonexistent. As a result, it is very hard to reach customers, and marketing can require significant amounts of effort and money. Secondly, medical games have several potential simultaneous customer segments. However, the flip side of this is that the game has to be marketed and sold to every segment. The results of this research highlighted that health care professionals have a significant role in decision making related to new health care investments, but Kaleva et al. (2013, 27) argued that one of the main challenges of medical games is the fact that many health care professionals view the game industry in a bad light. However, by contrast, the health care professionals interviewed emphasized that they and their colleagues look very kindly on new innovations that can improve the state of health care, and games are not an exception.

Despite the challenges related to marketing and distribution, they are key components in business models for medical games. Based on the results, a medical game company's ability to develop proper customer channels and relationships is what determines the company's commercial success. As a solution to this dilemma, the best option seems to be a partnership with, for example, a medical company that has an existing network of customers and a powerful sales organization. As a result, both parties can create value: the medical company can increase its service quality or offering, and the medical game company can acquire the much-needed customer channels. Partnerships like these further emphasize the need to bundle the medical game with another product or a service.

In light of results, the profit formula dimension also appears rather challenging. A key challenge is related to the fact that in many countries, such as Finland, health care is for the most part funded from taxes, produced by the public sector, and provided free to patient. As a result, people are used to free health care services, so perhaps medical games also have to be funded by other parties. Insurance companies and the public sector have an incentive to pay for medical games because they can make health care more cost effective. However, as a requirement for this to happen, the benefits of the game have to be proven. This in turn requires expensive clinical trials and development cycles. As pointed out, medical games can potentially create significant value for several customer segments, and there are several potential sources of value capture as well. However, Shafer et al. (2005, 205–206) discuss how a common problem of business models is that even if a large amount of value is created, a company will not capture much value if it fails to develop proper value capturing mechanisms.

The interviewees did not have strong opinions on the best revenue or pricing models, apart from the notion that one-time payment seems like a bad option in the long run. Subscription models, annual licenses, and usage-based fees were pointed out as possible options. Furthermore, the results highlighted that the possibility of giving the game away for free and using either data and analytics or a physical product as the source of revenues should be considered. In the business model literature, data-driven business models have been presented as promising options (see, for example, Hartmann et al. 2014). The interviewees also considered data-driven business models to have potential but pointed out that that there are many challenges related to them. Based on the results, the most notable challenges are related to the sensitive nature of medical data, and regulations. Similarly, Kaleva et al. (2013, 26) also point out the same issues. In conclusion, data can be considered a key component of business models for medical games but also a significant challenge that is not easily solved.

As a further consideration, the scientifically validated health benefits that are required for medical games can potentially be utilized outside the medical context. Many interviewees, especially health care professionals, believed that wellness games or brain-training applications with scientifically validated results could offer a compelling value proposition to the mass market. This consideration is also related to the open business model concept (Chesbrough 2007); in this way, the technology developed in medical game clinical trials could be sold and harnessed for other purposes simultaneously. This would further reduce the economic burden and risk related to the research and validation process and, in addition, could greatly benefit companies in the wellness game industry or allow the medical game company to target the B2C market effectively as well.

Regarding the strategic factors of business models for medical games, the findings were rather scarce. However, based on the results, and the findings of Kaleva et al. (2013, 13), it can be concluded that medical games face very little direct competition. On the

other hand, the results highlighted that medical games compete against traditional health care methods, pharmaceuticals, and innovative health care methods. As a result of the low direct competition, the interviewees pointed out, medical games can more easily get away with less fun and entertaining game elements, as long as the clinical effectiveness has been proven. By contrast, Kaleva et al. (2013, 16) emphasized that even medical games have to be "good games." However, the interviewees also highlighted that the competition is likely to intensify in the near future, and then the game portion of medical games will have to be of high quality. As further factor to consider, some interviewees emphasized that medical games should perhaps be labeled not as games but instead as comprehensive health care technologies or information systems. A key component of medical games thus might be the fact that they should not be considered games at all.

5.2 The key components and challenges of business models for medical games

For this study, two research questions were postulated. The first research question is, what are the key components of business models for medical games? In order to answer this question comprehensively, an illustrative figure depicting the key components of business models for medical games was created. These key components are primarily derived from the results of this research. As various business model authors have emphasized (e.g., Osterwalder & Pigneur 2010; Morris et al. 2005), different business model components are highly interconnected, and it is important to understand the relationships between different components (Casadesus-Masanell & Ricart 2010, 197). Similarly, the results of this research support the high interconnectedness of medical game business model key components, and thus presenting the key components in a single, unitary illustration is reasonable. This study was motivated by the fact that if medical game companies cannot create and capture value properly, the games are left unused despite their potential benefits. By summarizing the key components in a comprehensive representation, the potential solutions for value creation and capture in medical game environment can be illustrated. The six different business model dimensions are indirectly present in the illustration and they form the underlying structure of the key components. The illustration is depicted in figure 17 on the next page.

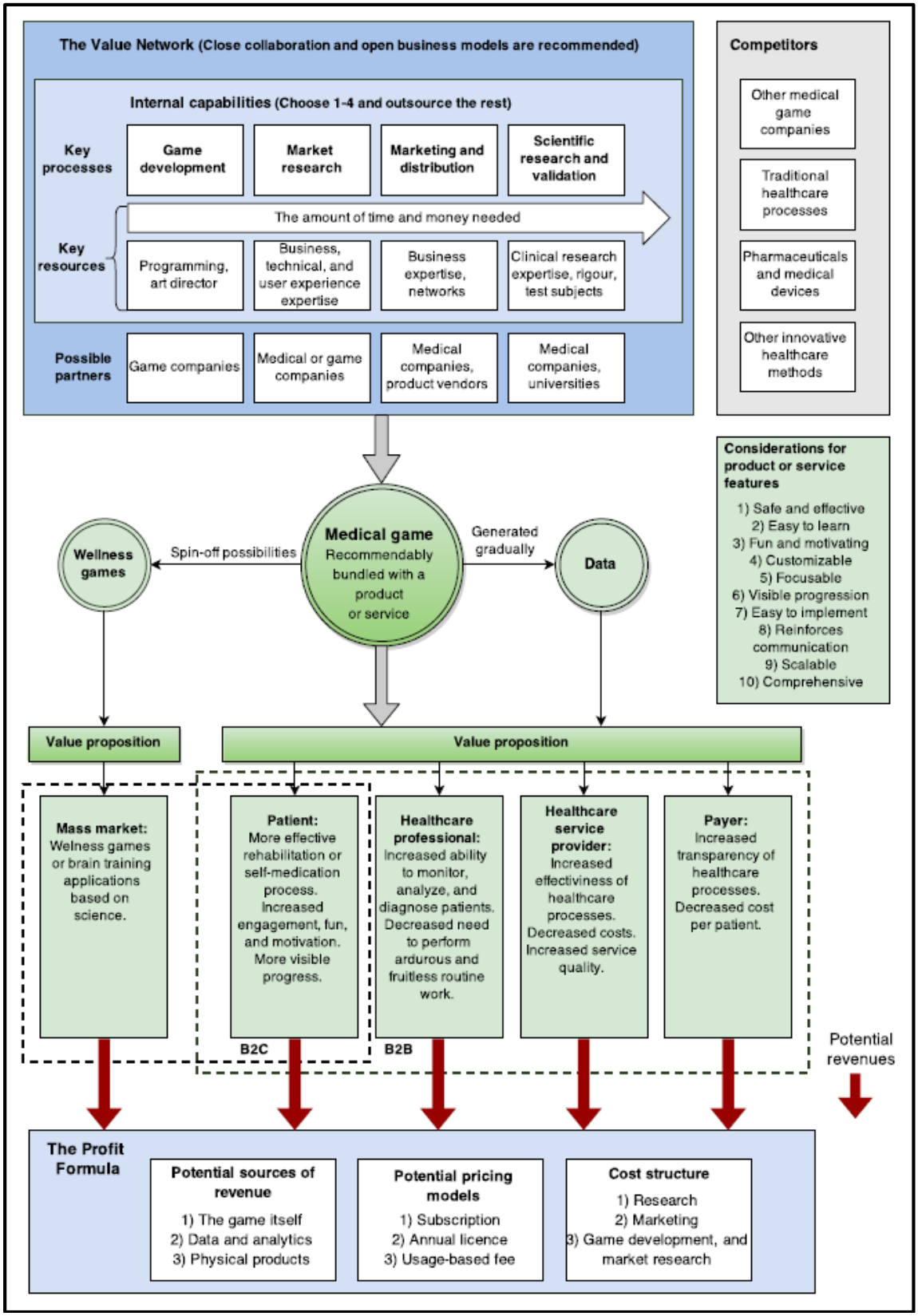

Figure 17 The key components of business models for medical games

The second research question considered the key challenges of business models for medical games and how they can be overcome. Five significant challenges can be highlighted based on the results of this research. In order to emphasize these challenges and possible solutions related to them, they are listed and summarized in the table below.

Table 8 The most notable business model challenges of medical games

Challenge	**Possible solution**
Clinical trials are compulsory for medical games, and they require a substantial amount of money, time, and expertise.	Partnerships with medical companies and universities should be considered. Open business models and industry standards can further alleviate the issue.
Especially for the B2B medical game market, marketing and distribution are burdensome and costly.	Piggybacking the customer channels of existing medical companies is suggested. Bundling the game with an established health care product or service can create value for both parties.
Making money with medical games can be difficult. The question of who should pay is often hard to answer.	Value propositions for different customer segments should be clearly designed and articulated. Additional sources of revenue, such as data or physical products, should be considered as an option.
Medical game–generated data holds significant potential for value creation and capture, but harnessing its value is challenging.	The sensitive nature of medical data and regulations should be taken into account. Resourceful ways to provide analytics services to different customer segments should be developed.
The B2C segment appears to have potential due to larger possible volumes, but entering the B2C market appears challenging for medical games.	Medical game companies should consider first entering the B2B market. They should then seek to expand their existing business to the B2C market. Furthermore, the clinical evidence can potentially be reused in wellness games.

In sum, this study sought to explore the business model characteristics and issues related to the business environment of medical games. By answering the two research questions concerning the key components and key challenges of business models for medical games, this study has painted a preliminary picture of how medical games can be commercialized and what issues underlie in the industry. The key components act as important building blocks of business models for medical games, whereas the challenges further highlight several important issues related to the business model components.

6 CONCLUSIONS

6.1 Theoretical implications

The primary theoretical contributions of this research are twofold: Firstly, this research provides pioneering information on the academically untouched subject of business models for medical games. Secondly, the business model framework developed in this research provides a conceptual contribution to the existing business model literature. The two areas of contribution are discussed next.

This research was motivated by the finding that there was no academic literature on health games from a business perspective, and contributing to this research gap was arguably important: the health care sector is in crisis due to increasing costs (e.g., Christensen 2009; Kaplan & Porter 2011), and new health care technologies combined with innovative business models can potentially alleviate the issue (e.g., Herzlinger 2006; Hwang & Christensen 2008). Medical games have been found beneficial for health care processes in the literature (e.g., Stach & Schlindwein 2012; Brown-Johnson et al. 2015), but their business models have not been examined; the only study related to the topic was a practitioner-oriented report that preliminarily discussed the topic and further pointed out the ambiguity concerning the business models of medical games (Kaleva et al. 2013). This research seeks to address this particular research gap.

This research looked at medical games from a business model perspective, which is a novel way to examine the subject. The specific aim of this thesis was to develop a conceptual business model framework and empirically use it in explorative medical game business model research. This framework was used as an instrument in data collection and data analysis including 22 semistructured interviews. The results of this study extend the understanding of health games by providing a completely new view of the subject through the business model concept. Thus, the prime theoretical contribution of this thesis is the extension of perspective concerning the health game literature.

Furthermore, the benefits of medical games from a health care professional's perspective is a theme that has been briefly mentioned in the literature (e.g., Stach & Schlindwein 2012; Kaleva et al. 2013) but not explicitly discussed. The findings of this research explicitly emphasize that medical games should not be designed only from the patient's point of view as there are several potential customer segments to medical games, namely (1) patients, (2) health care professionals, (3) health care service providers, and (4) payers. All of these segments can benefit significantly from medical games and thus should be taken into account when designing the game.

Moreover, the previous literature has focused primarily on pointing out design recommendations for specific health games (e.g., Poole et al. 2013; Brown-Johnson et al.

2015). The recommendations in the literature have often been derived from clinical test involving patients and health care professionals. This research provides considerations for medical game features that can complement the existing literature for two reasons: Firstly, the design recommendations are linked not to a specific game but rather to medical games in general; what is lost in specificity is gained in the increase in scope. Secondly, the suggested features are derived from the experiences of a wide array of game, business, and health care professionals. Hence, the recommendations presented in this research can also extend the literature through variation in perspectives.

The second prime contribution of this thesis is related to the business model literature. This research contributes to the business model research field by providing a conceptual business model framework that can be used in business model innovation and design. The framework was created by conducting a content analysis on nine existing business model frameworks. The framework seeks to synthesize existing literature into a more comprehensive and unified form. The motivation behind the framework was based on the ambiguity of and lack of consensus on the business model concept, which has often been pointed out in the recent literature (e.g., Al-Debei & Avison 2010; Zott et al. 2011; Lambert & Davidson 2013). The specific objective of the framework is to provide an instrument that is useful in considering the key components of a certain business model in a larger scope.

The usefulness of the business model framework was tested in practice: the framework was an instrument assisting in and giving structure to the data collection and analysis. Based on the results of the study, the framework provided significant help in the research process and facilitated the systematic discussion of a complex and ambiguous subject. As a further note, the wide array of potential business model components proved to be a useful feature, allowing detection of various components. As Morris et al. (2005, 727) pointed out, “progress in the field has been hindered by lack of consensus over the key components of a model.” The framework developed in this research contributes to the resolution of this issue by helping the identification process of key components. In conclusion, the framework can be a beneficial tool in both scientific research and practical business model design by providing a clear structure and further considerations for the key components.

Furthermore, this research responds to the suggestion concerning future work by Al-Debei and Avison (2010, 374). They pointed out the need to examine the degree of importance of each business model dimension in different industries. According to the results of this research, the role the value network is accentuated in the medical game industry; it can be seen as a continuation of the focal company’s internal capabilities and as a crucial element of value creation. In addition, the multifaceted nature of value propositions and customer segments can be highlighted as well. The results of this research concerning the profit formula of medical games are rather limited, which implies

that the challenges related to this particular dimension are out an important area of future work.

Moreover, this study reinforces the findings related to the importance of the value network of Palo and Tähtinen (2013). Palo and Tähtinen discussed business models from a strategic network perspective, emphasizing that strategic networks play a notable role in market and value creation of technology-based services. The findings of this research further accentuate the importance of value networks in the commercialization of new technological innovations. As a further consideration, the ideas presented in this study concerning the modularity of value networks can potentially be applied in other industries where capital-intensive research and development processes hinder the market entrance of smaller companies. In addition, the open business model concept presented by Chesbrough (2007) was found to be a compelling solution to the issues related to the research-intensive nature of the medical game industry, thus reinforcing the existence of the concept and providing an interesting area of future work.

6.2 Practical implications

A large number of medical game–related professionals from both game and health care backgrounds were interviewed for this research. As a result, this research provides medical game–related practitioners with a roadmap of the business model for medical games. The illustration of the business model key components for medical games can act as a guiding framework for new business design or assist in benchmarking an existing business model. Moreover, the five highlighted challenges of business models for medical games can offer valuable suggestions to companies wrestling with the same issues. In addition, for the major stakeholder groups in the value network related to medical games, several implications are highlighted.

Firstly, for patients, this research further accentuates that medical games can offer an entertaining, engaging, and motivating way to improve the effectiveness of health care processes, such as rehabilitation. In practice, many patients can have an influence on the treatment they are given. For this reason, patients, especially those under rehabilitation, are recommended to ask their doctors about the possibility of medical game–based treatment. As pointed out in the results of this research, changes in health care are often initiated by patients who demand improved service and new ways of treatment.

Secondly, for health care professionals, this study highlights that medical games have the potential to be useful tools in different health care processes. Medical games can, for example, allow better monitoring of patients and support the decision-making and diagnosis processes with data-based evidence. Because of this, health care professionals are encouraged to consider medical games a potential tool to add to their toolbox. This is

an important point to consider as the role of enthusiastic health care professionals in the diffusion of new technologies was also emphasized in this research.

Thirdly, for health care service providers, it should be pointed out that according to the results of this research, medical games potentially offer an appealing way to improve the effectiveness of health care processes and allow for a larger number of patients to be taken care of. As a result, medical games can provide an attractive return on investment. Thus, they should be taken into account by those considering investments in new health care technologies.

Fourthly, for the payers of health care, such as insurance companies and the public sector, this research points out that medical games can offer an effective way to decrease the costs of health care processes. For this reason, it is suggested that payers seek out opportunities to cooperate with medical game companies for mutual benefit. There is a notable amount of potential in medical games, but this potential cannot be harnessed if the often small medical game companies do not receive adequate funding.

Fifthly, for companies willing to develop and sell medical games, three important points to consider are highlighted: Firstly, doing everything alone can be very difficult, arduous, risky, and expensive. Partnerships can provide significant synergies in, for example, clinical trials, marketing, and distribution, and thus they should be actively considered. Secondly, it should be taken into consideration that the patient is usually not the only potential customer of the game. However, the plurality of potential customers also requires that the needs of the different customers be known in order for the game to be fluently integrated into the health care ecosystem. And finally, making money with medical games can be difficult, but this issue can potentially be alleviated by harnessing other sources of revenue; bundling the game with a physical product can produce synergies for both the game and product, and it can make the whole package easier to sell. Data and analytics services have also the potential to be the main revenue-generating mechanism for medical game companies. Hence, the role of data should not be underestimated.

6.3 Limitations

The first limitation of this research stems from the nature of the business model approach. An important strength of the business model concept is its ability to simplify complex issues and allow the examination of the big picture from a business perspective (e.g., Zott et al. 2011, 1036–1037). However, the high-level scope also results in significant simplification of the subject, which can mean that some details that appear minor but in reality are essential fall outside the scope of examination. This is a crucial point to consider because, as Shafer et al. (2005, 204–206) discussed, rather small flawed

assumptions and misunderstandings in the logic and details of a business model can be detrimental for a company. Furthermore, as Chesbrough (2010, 356), among others, pointed out, "business model innovation is not a matter of superior foresight *ex ante*—rather, it requires significant trial and error, and quite a bit of adaptation *ex post*." Although this research provides medical game companies with comprehensive ex ante foresight, the process of business model innovation is a completely different animal.

The second set of limitations is related to the scope of the study. Firstly, due to the brain rehabilitation focus of the research, there was a strong emphasis on the B2B market as brain rehabilitation is rarely a self-medication process and thus requires the presence of health care professionals. As a result, the B2C market perspective was possibly overlooked to some degree, and thus the results might be skewed in favor of the B2B market. However, although this might be a limitation, it might also be fruitful for future research. Furthermore, due to the geographically focused scope of this study, the results cannot be reliably generalized to other contexts.

The third limitation is related to research methods. As the research uses interviews as the primary source of data, the results are based mostly on subjective interpretations. Because the interviewee first presented his or her interpretation of the issues in question, and then the researcher interpreted the interviewee's message, the effects of interpretation are multiplied. However, in order to avoid distorting the interviewees' opinions, the research results were proofread by the interviewees before the conclusions were made. Nevertheless, the results represent the subjective views of Finnish game and health care professionals and thus might be biased. As emphasized in the business model literature, flawed assumptions related to the underlying core logic and the value network can impair a business model. Furthermore, it should be considered a limitation that this study and the only remotely related study (Kaleva et al. 2013) both used the same data collection methods: expert interviews. This partly sets the pace for future work; method triangulation should be considered when next conducting a study about this topic.

6.4 Future work

Several implications for future work can be pointed out. Furthermore, the limitations of this research should be considered opportunities for future research. A few potential areas of future work are presented here.

Firstly, future work concerning business models for medical games should focus especially on a single business model dimension. The business model overview provided by this study can effectively be complemented by examining the business model dimensions separately but with more accuracy and rigor. As previously highlighted, the profit formula dimension is surrounded by a significant amount of ambiguity, and looking

at it more closely might provide substantial contributions for both research and practice. Based on the results and literature, a common problem of business models is their ability to create value but fail in capturing it. Because of this, research related to the profit formula dimension would be beneficial for business models in general as well.

Furthermore, the value network plays a substantial role in business models for medical games, implying its importance as a target of future work. The need for networked business model research has also been pointed out by Palo and Tähtinen (2013). In addition, the open business model concept of Chesbrough (2007) offers an interesting perspective that should be further examined in the context of health games. Moreover, instead of using expert interviews like this study, the value network of health games should perhaps be investigated using a different research design. For example, a case study approach to the nature of medical game–related partnerships would be fruitful avenue of study, since it could examine individual cases more intensively.

In addition, based on the results, data-driven business models in health game context is a topic linked with significant potential but also notable challenges, hence making it a compelling area of research. In the context of health games, approaching the business models particularly from the perspective of data as a key resource (e.g., Hartmann et al. 2014) might lead to substantial advancements in issues related to value creation and capture.

Secondly, in the context of medical games, an appealing subject for future work is critical research on whether medical games should be considered games at all. Based on the results of this study, branding medical games as games can sometimes raise customer suspicion, and it can even be contemplated whether the “game” label directs the company’s attention too much toward secondary issues. Instead, approaching medical games from traditional information system development perspectives has potential, hence encouraging the information systems science researchers to look at the subject from another angle.

Thirdly, the conceptual business model framework developed in this research can aid both researchers and practitioners in business model design– and innovation-related studies. For this reason, further developments concerning the framework are warmly encouraged. Although the components of the business model are derived from the literature, they are not set in stone. This is an interesting area of research; the existence of each component could be questioned and empirically tested. As another potential area for future work, the importance of different business model dimensions in relation to different industries appears promising. The same direction was earlier pointed out by Al-Debei and Avison (2010) also. Examining what makes certain industries flourish from a business model perspective can advance the state of business and management research as a whole, thus providing an appealing area of future work.

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APPENDICES

Appendix 1 The most cited articles, and articles from IS publications

The selected articles from the top 20 most cited articles			Citations (ranking) as of 3.12.2014	
Authors	**Year**	**Title**	**Scopus**	**WoS**
Chesbrough & Rosenbloom	2002	The role of the business model in capturing value from innovation: Evidence from Xerox Corporation's technology spin-off companies	641 (1)	398 (1)
Magretta	2002	Why business models matter	414 (2)	214 (3)
Teece	2010	Business models, business strategy and innovation	376 (3)	235 (2)
Morris, Schindehutte & Allen	2005	The entrepreneur's business model: Toward a unified perspective	309 (4)	185 (4)
Mahadevan	2000	Business models for Internet-based e-commerce: An anatomy	277 (5)	152 (5)
Shafer, Smith & Linder	2005	The power of business models	218 (6)	na
Gordijn & Akkermans	2001	Designing and evaluating E-business models	218 (7)	127 (8)
Chesbrough	2010	Business model innovation: Opportunities and barriers	213 (8)	137 (7)
Johnson, Christensen & Kagermann	2008	Reinventing your business model	212 (9)	73 (19)
Zott, Amit & Massa	2010	The business model: Recent developments and future research	192 (10)	105 (10)
Amit & Zott	2008	The fit between product market strategy and business model: Implications for firm performance	184 (12)	146 (6)
Amit & Zott	2007	Business model design and the performance of entrepreneurial firms	134 (18)	111 (9)
Hedman & Kalling	2003	The business model concept: Theoretical underpinnings and empirical illustrations	190 (11)	97 (12)
Amit & Zott	2010	Business model design: An activity system perspective	167 (13)	102 (11)
Chesbrough	2007	Why Companies Should Have Open Business Models	151 (16)	86 (13)
Casadeus-Masanell & Ricart	2010	From strategy to business models and onto tactics	142 (17)	82 (15)

The disqualified articles from the top 20 most cited articles				
Authors	**Year**	**Title**	**Scopus**	**WoS**
Rappa	2004	The utility business model and the future of computing services	156 (14)	81 (16)
Bonaccorsi et al.	2005	Entry strategies under competing standards: Hybrid business models in the open source software industry	121 (20)	86 (13)
Dai & Kauffman	2002	Business models for internet-based B2B electronic markets	151 (15)	75 (18)
Seelos & Mair	2005	Social entrepreneurship: Creating new business models to serve the poor	122 (19)	
Seelos & Mair	2007	Profitable business models and market creation in the context of deep poverty: A strategic view		79 (17)
Dehnert & Van Der Aalst	2004	Bridging the gap between business models and workflow specifications		71 (20

Relevant Senior Scholars' Basket of eight articles				
Authors	**Year**	**Title**	**Journal**	
Hedman & Kalling	2003	The business model concept: Theoretical underpinnings and empicical illustrations	EJIS	
Al-debei & Avison	2010	Developing a unified framework of the business model concept	EJIS	
Osterwalder & Pigneur	2013	Designing Business Models and Similar Strategic Objects: The Contribution of IS	Journal of AIS	

Appendix 2 The unification factors of different business model components

Component class		Abstracted from components
Internal capabilities	100.00%	Internal capabilities, Capabilities/competencies, Create value or any of the subterms below
Key resources	100.00%	Key resources, Complementary assets needed, Resources/assets, Resources
Key processes	100.00%	Key processes, Processes, Processes/Activities, Key activities, Activities and organisation, Stucture of the value chain
Human capital	33.33%	Human capital, People
Cash and financing	33.33%	Cash, Financing, Financial aspects
Data and Information	22.22%	Data, Information
Technology	22.22%	Technology
Equipment	22.22%	Equipment
Facilities	11.11%	Facilities
Marketing	11.11%	Marketing
Innovation process	11.11%	Innovation process
Rules and metrics	11.11%	Rules and metrics
Norms	11.11%	Norms
Customer	88.89%	Any of the subterms below
Segment	88.89%	Market segment, Target customer, Customer (Target market, scope), Customer segment(s), Customers
Customer relationship	44.44%	Customer relationship(s)
Channels	33.33%	Channels, Distribution
Customer information	11.11%	Customer information
Value proposition	88.89%	Value proposition(s), Customer value proposition, Offering or any of the subterms below
Offering	44.44%	Output (offering), Offering, Products
Job-to-be-done	11.11%	Job to be done
Bundling	11.11%	Bundling
Customization	11.11%	Level of customization
Profit formula	77.78%	Profit formula, Economic factors, Capture value, Profit potential or any of the subterms below
Revenue model	66.67%	Revenue (generating) mechanism, Revenue model, Revenue streams, Revenue/pricing
Cost structure	66.67%	Cost structure, Costs
Margins	33.33%	Margins, Margin model
Resource velocity	22.22%	Resource velocity, Velocity
Volumes	11.11%	Volumes
Profit	11.11%	Profit
Operating leverage	11.11%	Operating leverage
Value network	77.78%	Value network, any of the subterms below
Key partners	33.33%	Key partners, Key partnerships, Partnerships/alliances
Suppliers	22.22%	Suppliers
Value network position	11.11%	Value network position
Information flows	11.11%	Information flows
Product / service flows	11.11%	Product/service flows
Strategic factors	66.67%	Strategic choices, Strategy, any of the subterms below
Brand	44.44%	Brand(s), Branding
Competitive strategy	33.33%	Competitive strategy, Strategy
Competitors and complementaries	33.33%	Competitors, Competitors & Complementaries
Differentiation	22.22%	Differentiation
Growth plans	11.11%	Personal/investor factors (growth plans)
Mission	11.11%	Mission
Longitudinal process component	11.11%	Left out - Reason: too complicated

Appendix 3 The interview themes

Interview themes

HEALTHCARE RELATED THEMES

Brain rehabilitation process

The objective was to understand the brain rehabilitation process from start to finish. Possible questions: What are the key challenges / success factors / decision making actors? Is there a need for new rehabilitation methods or tools? How new healthcare methods are implemented? Who is the payer? What costs are associated with brain rehabilitation?

The value network of brain rehabilitation

The objective was to develop an understanding on the key partners in the brain rehabilitation network. Possible guiding questions: Who are the payers? Which actors have the greatest influence on the selection of rehabilitation methods? What is the role of insurance companies and the public sector? What is the role of the patient?

Medical games as a part of rehabilitation or other healthcare processes

The objective was to examine how the interviewees view medical games and their potential. Possible guiding questions: What requirements there are for medical games? What are the general attitudes towards medical games? Does the interviewee have experience on medical games? Can medical games be beneficial? Or harmful? Should medical games always be clinically validated?

(MEDICAL) GAME RELATED THEMES

The development process of (medical) games

The objective was to understand how (medical) games are designed and produced. Possible questions: What are the key resources / processes / challenges / success factors in the process?

The commercialization of (medical) games

The objective was to understand how (medical) games can be commercialized. Possible questions: What are the biggest challenges related to commercialization? How customers can be segmented? How can the B2C and B2B markets be compared? What are potential pricing mechanisms and revenue sources? What are the biggest costs?

Health and medical game markets

The objective was to discuss health games from a market perspective. Possible questions: How the future of health / medical games is seen? What are the most notable possibilities / trends / threats?

(Medical) game value networks

The objective was to understand what actors are essential in medical game business. Possible questions: What are the key partners and suppliers? What is the role of different actors? What is the role of universities / insurance companies / the public sector? How is the value network managed?