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Abstract

The healthcare sector is currently in the verge of a reform and thus, the medical game research provide an interesting area of research. The aim of this study is to explore the critical elements underpinning the emergence of the medical game ecosystem with three sub-objectives: (1) to seek who are the key actors involved in the medical game ecosystem and identify their needs, (2) to scrutinise what types of resources are required in medical game development and what types of relationships are needed to secure those resources, and (3) to identify the existing institutions ('the rules of the game') affecting the emergence of the medical game ecosystem.

The theoretical background consists of service ecosystems literature. The empirical study conducted is based on the semi-structured theme interviews of 25 experts in three relevant fields: games and technology, health and funding. The data was analysed through a theoretical framework that was designed based upon service ecosystems literature. The study proposes that the key actors are divided into five groups: medical game companies, customers, funders, regulatory parties and complementors. Their needs are linked to improving patient motivation and enhancing the healthcare processes resulting in lower costs. Several types of resources, especially skills and knowledge, are required to create a medical game. To gain access to those resources, medical game companies need to build complex networks of relationships. Proficiency in managing those value networks is crucial. In addition, the company should take into account the underlying institutions in the healthcare sector affecting the medical game ecosystem. Three crucial institutions were identified: validation, lack of innovation supporting structures in healthcare and the rising consumerisation.

Based on the findings, medical games cannot be made in isolation. A developmental trajectory model of the emerging medical game ecosystem was created based on the empirical data. The relevancy of relationships and resources is dependent on the trajectory that the medical game company at that time resides. Furthermore, creating an official and documented database for clinically validated medical games was proposed to establish the medical game market and ensure an adequate status for the effective medical games. Finally, ecosystems approach provides interesting future opportunities for research on medical game ecosystems.

Keywords	Medical games, health games, health technology, service ecosystems approach
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Tiivistelmä

Terveydenhoitoala on reformaation partaalla tehden lääkepelitutkimuksesta ajankohtaisen ja kiinnostavan tutkimuskohteen. Tämä tutkimus käsittelee lääkepeliekosysteemin syntymiseen vaikuttavia kriittisiä elementtejä kolmen osakysymyksen avulla: (1) ketkä ovat lääkepeliekosysteemin avaintoimijat ja minkälaisia tarpeita heillä on, (2) millaisia resursseja lääkepelien kehittämiseen tarvitaan ja millaisia suhteita tulee luoda päästäkseen käsiksi kyseisiin resursseihin sekä (3) millaiset instituutiot (ns. pelisäännöt) vaikuttavat lääkepeliekosysteemin syntyyn. Tutkielma keskittyy erityisesti lääkepelien käyttöön aivovammakuntoutuksessa Suomen markkinoilla.

Tutkielman teoreettinen tausta koostuu palveluekosysteemikirjallisuudesta. Empiirinen osuus muodostui 25 semi-strukturoidusta teemahaastattelusta. Haastateltavat valittiin kolmen keskeisen asiantuntijuuden perusteella: pelit ja teknologia, terveys ja rahoitus. Aineisto analysoitiin palveluekosysteemikirjallisuuden pohjalta luodun teoreettisen mallin avulla. Tutkielmassa avaintoimijat jaettiin viiteen ryhmään: lääkepelirytykset, asiakkaat, rahoittajat, regulatiiviset toimijat ja täydentävät toimijat. Heidän tarpeensa olivat vahvasti sidoksissa potilaiden motivaation ja sitä kautta terveydenhuollon prosessien tehostamiseen. Tämä puolestaan laskee terveydenhuollon kustannuksia. Lääkepelien kehittäminen vaatii useita resursseja, erityisesti dynaamisia ja aineettomia resursseja, kuten taitoja ja tietoa. Päästäkseen käsiksi näihin kriittisiin resursseihin lääkepelirytyksen tulee kyetä luomaan ja hallitsemaan monimutkaisia suhdeverkostoja. Verkostojen taidokas johtaminen on vahvasti kytköksissä yrityksen menestykseen. Lisäksi yrityksen tulee tunnistaa lääkepeliekosysteemin taustalla vaikuttavat instituutiot ja niiden vaikutukset lääkepeliekosysteemiin. Tutkielmassa käsitellään kolmea kriittistä terveydenhuollon instituutiota: validointikäytäntöjä, terveydenhuollon innovaatorakenteiden puutosta sekä nousevaa kuluttajistumista.

Tulosten perusteella lääkepelejä ei voi kehittää eristyksissä yrityksen suhdeverkostosta. Empiirian pohjalta luotu malli lääkepeliekosysteemin kehityskaaresta korostaa, että vaadittavat resurssit ja suhteet ovat riippuvaisia siitä, missä vaiheessa ekosysteemin kehitystä lääkepelirytyks kulloinkin on. Vahvistaakseen lääkepelimarkkinoita ja taatakseen peleille vaadittavan statuksen, tulisi kehittää virallinen dokumentoitu validointijärjestelmä lääkepeleille. Lisäksi palveluekosysteeminäkökulma tarjoaa kiinnostavia jatkotutkimusmahdollisuuksia lääkepelitutkimukselle.

Asiasanat	Lääkepelit, terveysteknologiat, palveluekosysteemi
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Turun yliopisto
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CRITICAL ELEMENTS UNDERPINNING THE EMERGENCE OF THE MEDICAL GAME ECOSYSTEM

Gamifying traumatic brain injury rehabilitation in Finland

Master's Thesis in Marketing

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1 INTRODUCTION

1.1 Ecosystems approach in medical game context

As the population is aging and healthcare costs are constantly rising there is a global need for delivering, higher quality, more accessible and cost-efficient ways to improve the current healthcare system (Kaleva, Hiltunen & Latva 2013, 8; Kalapanidas et al. 2009). The emerging healthcare crisis combined with the consumers' increasing craving for game design in various non-game scenarios in order to increase motivation provides a fertile ground for the emerging *medical game* ecosystem (e.g. McGonigal). Consequently, the potential economic and social benefits of medical games could be substantial making it an important research topic. Furthermore, rising *consumerisation* is likely to affect the healthcare sector's service provisions leading to the increased utilisation e.g. of health technologies and thus, also medical games (Laing & Hogg 2002). Hence, the shift in focus of the healthcare sector is increasingly towards patient empowerment and participation. In addition, recently, instead of seen as merely a source of aggressions and addictions, there have been various studies proving the potential of using games in order to *develop various skills* (e.g. Granic, Lobel & Engels 2014; Prensky 2012; McGonigal 2011).

Simultaneously, in today's increasingly complex and interconnected world, it is becoming clear that 'no business is an island' (Håkansson & Snehota 1989). Thus, successful companies have to evolve rapidly and effectively and thus, draw into several types of resources, investments, partners, and customers to create cooperative value networks (Moore 1993). Consequently, the performance of a company can often be explained by its ability to continuously develop relationships with others making it one of the most valuable resources of the company (Håkansson & Snehota 1995). In *service-dominant logic's service ecosystems approach*, the concept *ecosystem* is used to describe the dynamic value networks that are connected by shared *institutional logics* (Vargo & Akaka 2012, 207).

Furthermore, the nature of global markets has changed due to e.g. increasing importance of knowledge, technological complexity, availability of digital technologies and competition turning more and more global. This all has led to a fundamental shift in the way economic *value* is created. Individual companies cannot master all their value activities on their own, nor would it be economically beneficial for them to try. In consequence, firms and other social actors are creating increasingly complex networks (Möller, Rajala & Svahn 2005; Möller & Rajala 2007.) Accordingly, *service-dominant logic*, a service centred mind-set, highlights that value is not created within a company but rather it is made in co-operation with several actors involved (Vargo & Lusch

2004). Additionally, those resource integration practices with other actors are strongly influenced by their context, *institutions*, which can be defined as the ‘rules of the game’ (Williamson 2000). Respectively those resource integration practices between actors affect the underlying institution creating a constantly changing concept of markets (Chandler & Vargo 2011).

Thus, combining service-dominant logic’s *ecosystems approach* to medical games research was seen practical for least three reasons. (1) Firstly, the actors involved in the medical game ecosystem are various due to the different kinds of expertise that are required in order to develop, distribute and market a medical game. In addition, (2) the healthcare sector is strictly regulated, thus, there are strong existing *institutions* i.e. ‘rules of the game’ (Williamson 2000) affecting the nature of the market. Moreover, (3) actors in the field are mainly start-ups with very limited resources. Thus, the importance of the resource-integration practices with other actors is emphasised more. Additionally, due to the lack of empirical evidence, service-dominant logic cannot be categorised as a theory, but rather a perspective that is, a fruit of intense conceptual development. To gain more support for the perspective, there is a general need for empirical research.

Moreover, prior research on medical games has been mainly focused on the potential of separate medical games in their context i.e. conducting clinical tests to prove the effectiveness of a specific health game. There are some articles and publications discussing the state and potential of health games in the Finnish market (Kaleva et al. 2013) as well as globally (Arnab, Dunwell & Debattista 2013; Alvarez, Alvarez, Djaouti & Michaud 2010; Susi, Johannesson & Backlund 2007; Stewart & Misuraca 2012; Ma, Jain & Anderson 2014) and a few academic articles discussing taxonomies in terms of serious games (e.g. Gekker 2011, Wattanasoontorn, Boada, García & Sbert 2013). However, there is a general need for more comprehensive understanding of the *medical game ecosystem* and its functions.

1.2 Objective and structure of the study

The purpose of this study is *to explore the critical elements underpinning the emergence of the medical game ecosystem*. The research objective is divided into three sub-objectives, which are as follows:

1. What kind of key actors are involved in the medical game ecosystem and what are their needs?
2. What types of resources are required to make successful medical games and what types of relationships are needed to secure those resources?
3. How the existing institutions (‘rules of the game’) are affecting the emergence of the medical game ecosystem?

In chapter two, relationships, resources and value creation are discussed in the light of service-dominant logic's *ecosystems approach*. Service-dominant logic was chosen as a theoretical framework due to its flexibility in terms of discussing a multifaceted phenomenon such as the emergence of the medical games ecosystem. Chosen concepts, such as resource integration, service ecosystems and institutions, enable the focal phenomenon to be discussed in multiple levels. Chapter 2 ends with a framework that provides a basis for the study on the emergence of the medical game ecosystem.

Chapter 3 discusses the methodological framework of the study. Due to the explorative and open-ended nature of the study, a qualitative approach was chosen to gain in-depth understanding of the phenomenon. In the research design chapter 24 semi-structured theme interviews were conducted using purposive sampling. Interviewees were chosen based on their expertise including e.g. Finland's leading professionals in traumatic brain injury rehabilitation, potential medical game funders, game industry experts, and health technology experts.

Chapter 4 focuses on describing the medical game context and traumatic brain injury rehabilitation context of the empirical case. This provides a solid basic to understanding the context and thus, enables better comprehending of the case study results. Chapter 5 provides the results of the empirical study and leans on the framework designed in section 2.4. First, it presents the key actors in the medical game ecosystem and their needs. Next, value propositions to all the key actors, are discussed. This is followed by presenting the valuable resources and the beneficial relationships that help securing those resources. Furthermore, the important institutions brought up in the empirical evidence are discussed. In the end of chapter 5, the alternation of the resources and relationships needed in different phases is discussed and the main challenges of the emergence brought up in the interviews are presented.

Finally, chapter 6 discusses the main findings of the study. The critical elements in the emergence of the medical game ecosystem are presented and discussed. Furthermore, a model of developmental trajectories of the emerging ecosystem is illustrated. Lastly, future research directions are outlined.

1.3 The complexity of traumatic brain injuries

Traumatic brain injury (TBI) can be defined as “an alteration in brain function or other evidence of brain pathology caused by an external force” (Tuominen, Joelsson & Tenovuo, 2012, 1697). Common causes of TBIs are traffic accidents and falls (Current Care Guidelines for TBIs). Instead of brain damage being isolated to one specific area in the brain, TBI is often *diffuse* i.e., wide spread (Traumatic Brain Injury - Fact Sheet; Ylinen 2012, 7).

TBI is a disorder of major public health concern due to its high incidence, prevalence, and economic consequences (Sarajuuri, Kaipio, Koskinen, Niemelä, Servo & Vilkki 2005, 2296; Current Care Guidelines for TBIs). It affects people of all ages and is the leading cause of long-term disability among children and young adults (Koskinen & Alaranta 2008, 205). Most brain injuries occur during the years when people are aiming for vocational goals and acquiring the skills and values needed to achieve vocational success (Sarajuuri et al. 2005, 2296). Indirect costs of TBI injuries far exceed those of direct costs of TBI patients. To put the economic loss into perspective, median production losses due to early retirement, were estimated to be €1.19 million per TBI patient according to a research conducted. (Tuominen et al. 2012, 1699.) However, brain injuries should not be viewed only as an economic and social detriment. Each TBI incident is a tremendous tragedy in an individual's life as well as those around them. When a person gets a brain injury, a major challenge is, how they can adapt to the situation and find their strength after the injury. (Lindstam & Ylinen 2012, 5.)

What makes brain injuries particularly demanding is the fact that the brain is where the essential mechanisms also for adaption and learning are located, which complicates the rehabilitation process. The symptoms of the patient depend largely on the location and the extent of the injury. (Ylinen 2012, 6–7.) TBI patients may suffer from a wide range of short- or long-term deficits affecting (1) motor functioning (e.g., extremity weakness, impaired coordination, and balance), (2) cognitive function (e.g., attention and memory), (3) sensation (e.g., hearing, vision, impaired perception, and touch), and (4) emotion (e.g., depression, anxiety, aggression, impulse control, and personality changes) (Pietrzak, Pullman & McGuire 2014, 202). These deficits may cause patients difficulties in working, doing household tasks or other daily activities, establishing relationships and returning to productive life (Pietrzak et al. 2014, 202; Sarajuuri et al., 2005, 2296).

TBI is a heterogeneous disorder i.e. every injury is different and thus, every case must be evaluated individually. Different forms of rehabilitation are needed for different subgroups of patients and at different phases over the course of recovery to optimise the effect of the rehabilitation for every individual. (Sarajuuri et al. 2005.) The whole process of brain injury rehabilitation is based on the plasticity of the brain i.e. other parts of the brain taking over the tasks of the injured parts (Ylinen 2012, 7). There is increasing evidence that a neurologically impaired brain has the potential for remodelling if rehabilitation training is challenging, repetitive, task-specific, motivating, salient, and intensive (Pietrzak et al. 2014, 203).

Rehabilitation often takes place in several phases: initially in a hospital and eventually home-based programmes allow the patients to develop their skills in their home environment (Burke, McNeill, Charles, Morrow, Crosbie, McDonough, 2009).

Effective rehabilitation must be early, intensive and repetitive and patient's boredom often has a negative impact on their motivation and engagement to the treatment. The usage of the design of video games, often associated with good user engagement, may offer insights into how more effective methods for traumatic brain injury rehabilitation can be developed with good results. (Burke et al. 2009; Wattanasoontorn, García Hernández & Sbert 2014). At present, the evidence that the use of video games in rehabilitation of TBI patients improves motor or cognitive functionality is very limited, primarily because the current studies consist of case studies and small RCTs. Moreover, medical games have the potential to offer more affordable and available rehabilitation therapy for traumatic brain injury patients e.g. by increasing the accessibility of rehabilitation (Pietrzak et al. 2014.)

2 SERVICE ECOSYSTEMS APPROACH

2.1 Value co-creation with multiple actors

Vargo and Lusch recognised and introduced a new dominant logic that seemed to be emerging in business (2004). *Service-dominant logic* (S-D logic) is a service-centred mind-set that provides a unified understanding of the purpose and nature of organisations, markets, economic exchange and value creation (Vargo & Akaka 2009, 32; Service Dominant Logic). The mind-set stands in sharp contrast to the traditional economics worldview – what Vargo and Lusch call *goods-dominant logic* (G-D logic) (e.g. Vargo & Lusch 2004, 2008). In contrast to the product-centred G-D logic where the emphasis is in the competitive advantage *within* the firm, S-D logic emphasises *the exchange of service* as a fundamental basis of exchange stating that all firms are essentially service firms. Furthermore, S-D logic focuses on *value co-creation processes* in the complex and dynamic ecosystem of actors (Service Dominant Logic).

According to S-D logic the traditional marketing has long been biased by G-D logic, which is strongly centred on the goods, or more specifically, on products that consist of both tangible (goods) and intangible (services) units of output (Maglio, Vargo, Caswell & Spohrer 2009, 398). In G-D logic producer creates a product that contains some value and consumer “destroys the value” and this process is repeated. In G-D logic, production is seen as the value driver, value creation happens in isolation from the customer and physical resources (i.e. *operand resources*) are emphasised (Chandler & Vargo 2011, 37). However, as the current marketing trend is shifting away from exchange of tangible goods and toward the exchange of *intangibles*, e.g. specialised skills and knowledge, and processes, a new dominant logic is starting to emerge (Vargo & Lusch 2004, 1–2).

According to S-D logic the definition of service originates from wrong premises. From the 1980s onwards, the acceptance of the so-called IHIP characteristics (intangibility, heterogeneity, inseparability, perishability) was widely observable. This definition, which is characteristic for G-D logic, sees services similar to goods but with additional inconvenient qualities – thus, not very desirable. G-D logic views services as something that is inferior to goods, e.g., “intangible goods” or “add-ons”, the primary focus of which is to enhance the value of goods. Changes in general market conditions, especially technological development, have contributed to the growing criticism towards the IHIP paradigm. (Vargo, lecture 25.3.2015; Moeller 2010, 359.) Consequently, S-D logic, considers *service* as the fundamental basis of all exchange. (Vargo & Lusch 2008b; Vargo & Akaka 2009).

According to S-D logic, service is defined as “the application of specialized competences (knowledge and skills), through deeds, processes, and performances for the benefit of another entity or the entity itself” (Lusch & Vargo 2006, 283). Instead of the plural “services”, S-D logic chooses to use the singular form “service”, which indicates that the meaning and the connotation are both substantially different: reflecting the process of doing something *for* and *with* another party (the beneficiary of the service) whereas “services” is traditionally used to describe intangible units of output (Lusch, Vargo & Tanniru 2010). S-D logic is of the opinion that goods are *not* the primary reason why we buy goods; instead we buy them because of the service i.e. the benefits they offer, or because of intangibles e.g. the brand images, how they affect our self-image, or to gain social connectedness. The perspective of *service logic*'s (Grönroos 2006) differs slightly from the one of S-D logic's, since they do not perceive goods as services but rather “transmitters of service, as distribution mechanism for customers achieving value-in-use”. In other words, goods do not render services as such, they merely are one type of resources functioning in a service-like process, and the process is seen as the service that customers consume (Grönroos 2006). In healthcare context, a customer does not consume the health application itself as a service, but the whole process starting from using the knowledge about the app and information needed to use it to track one's lifestyle and thus, improve it, is the service.

However, the shift to S-D logic is much more than a mere transition from goods to service(s) – S-D logic is changing the whole purpose of the company in the process of *value creation* (Vargo & Lusch 2008a) embracing the finding that value is always co-created with multiple actors involved and not just within a firm. Understanding the dynamics of value creation is essential for both academics and practitioners (Gummesson & Mele 2010, 182). It is a question of how to combine the value activities of multiple actors to form value-creating services that benefit all the actors involved in the value network (Möller et al. 2005). Additional insights can be found in the approach of e.g. Nordic School of service marketing, especially in Gummesson's many-to-many marketing (2005), and IMP group's network approach (Chandler & Vargo 2011, 36). One can break free from G-D logic by removing labels such as “producer” and “consumers” and recognizing that all parties involved in economic exchange are resource-integrating service-exchanging actors that have the mutual aim of value co-creation (Vargo & Akaka 2012, 209; Vargo & Lusch 2011) Thus, S-D logic proposes that it is all fundamentally A2A (actor-to-actor); that is, all actors are basically doing the same things i.e. “co-creating value through resource integration and service provision” (Vargo & Lusch 2010).

Table 1 G-D logic compared to S-D logic on value creation (Akaka & Vargo 2013, 5)

	G-D logic	S-D logic
Process of value creation	Value-added activities	Value co-creation
Central view of value	Value-in-exchange	Value-in-context
Participants in value creation	Firm	Multiple stakeholders
Central resources	Operand resources	Operant resources
Driver of value creation	Production	Resource integration
Context of value creation	Firms	Service ecosystems

Customers and firms are seen as partners co-creating the value since it is always the service beneficiaries who ‘uniquely and phenomenologically’ determine the value of a company’s offering through use i.e. *value-in-use* (Vargo & Lusch 2008a, 258; Vargo & Akaka 2012, 210; Gummesson 2005, 146). Goods derive their value through use i.e. the service they provide to the customer (Vargo & Lusch 2008b, 7). Firms can only offer value propositions, but cannot create or deliver value independently. Thus, the consumer will eventually determine the value and choose to participate in the value creation process. (Vargo & Lusch 2008b, 7; Vargo & Lusch 2004, 11).

S-D logic supports marketing practitioners by affecting the fundamental way of perceiving firm’s activities; the focus is shifted from making something for someone else to consume to assisting customers in their own value-creation processes (Chandler & Vargo 2011, 35). “The focus is not on products, but on the customers’ value-creating processes, where value emerges for consumers, and is perceived by them” Grönroos (2006) states, and emphasises the importance of value *creation* process instead of value *distribution*. Nowadays, the customer is not the end of the chain, nor has it ever really been (Gummesson 2005, 145). The more customised and knowledge-intensive the service is, the more dependent it generally is on the participation and input of the customer participation (Maglio & Spohrer 2008, 18).

More recently, the concept of “value-in-context” have been established to capture the notion that value has to be understood in terms of the specific context of the beneficiary (Chandler & Vargo 2011). In other words, value of any given resource can be determined differently by different actors, or by the same actors in different contexts e.g. at different time (Chandler & Vargo 2011). Context is a key phenomenon in value creation (Gummesson & Mele 2010, 189).

Chandler and Lusch define value proposition as “invitations from actors to one another to engage in service” (2015, 8). In other words, value proposition development can be seen as a step in the value co-creation process aiming at inviting actors to serve one another in order to gain e.g. economic, financial, or social value (Chandler & Lusch

2015, 8). An important notion is that value propositions are not always successful e.g. due to the abundance of value propositions. In addition, different actors may evaluate same value proposition in a different way resulting that the intensity of the value proposition may vary from high to low. The *intensity* refers to the how strongly a value proposition from one actor to another draws them to engage in service i.e. a high level of intensity bespeak of high relevance to an actor. High intensity value proposition may invite engagement from all relevant stakeholders. (Chandler & Lusch 2015, 8.)

Furthermore, the dynamic lens of service-dominant logic, provides a broader and more comprehensive view for studying value creation, and thus, innovation (Akaka & Vargo 2013, 4). Innovation is not seen as something that happens within a firm, but rather it is something that is co-created within a continuously evolving service ecosystem (Akaka et al. 2013, 17). Innovation is not defined by what firms produce as output i.e. making better and more attractive outputs, but how firms can better *serve* customers (Vargo & Lusch 2008b, 4–5; Vargo, lecture 25.3.2015).

2.2 Resource integration for value co-creation

S-D logic centres on dynamic interactions among multiple actors suggesting that the ultimate reason why various actors interact with each other is to exchange *resources* with the aim of creating value for themselves and for other parties (Vargo & Akaka 2012, 210). Thus, the base of S-D logic is that all parties involved in economic exchange are resource integrating and service-providing actors that have the mutual aim of *value co-creation* (Wieland, Polese, Vargo & Lusch 2012, 16). Service exchange process enables different parties not only to access other resources for their own benefits but also to create new, better resources through the process of resource integration (Wieland et al. 2012, 14). Through A2A relationships knowledge and other resources are transferred, and learning takes place (Gummesson & Mele 2010, 191). Moreover, it is necessary to place interaction and resource integration practices in the broader context of relationships and networks (Gummesson & Mele 2010, 182).

The literature regarding S-D logic recognizes two broad classifications of resources: (1) *operand resources* (e.g., natural resources), which are, in most cases, tangible and static resources that require action taken upon them in order to make them valuable, and (2) *operant resources* (e.g., human skills and knowledge), which are dynamic and intangible resources capable of acting on other resources to create value (Wieland et al. 2012, 14; Vargo & Akaka 2009, 35; Akaka & Vargo 2013, 6.) S-D logic emphasised operant resources over operand resources in the process of value co-creation (Vargo & Akaka, 2013, 6). Thus, operand resources do often contribute to the co-creation of value, but they only become something of value when operant resources, such as skills

and knowledge, are applied to them (Vargo & Lusch 2004; Vargo & Lusch 2008c, 31). S-D logic puts the intangible resources of the company in the centre making them the fundamental source of competitive advantage and economic growth (Vargo & Lusch 2008a, 258; Wieland et al. 2012, 14; Vargo & Akaka 2009, 35). Also in network perspective the operant resources of the firm's value net are emphasised; the competences (e.g. skills and knowledge) of a firm do not only reflect those of its own personnel but also other parties' competences that belong to firm's value network, and the competences strongly connected to the performance of the company (Håkansson & Snehota 1995, 14–15). Relationships also provide indirect benefits in terms of granting access to e.g., other relations, organisation, resources and competences (Håkansson & Snehota 1995).

Akaka and Vargo (2013, 2) state that technology can be seen as one of the central constructs in the study of service science and value co-creation. Orlikowski (1992) suggests in her structurational model that technology can be considered both a medium (*operant resource*) and an outcome (*operand resource*) of human action. In addition technology influences and is influenced by institutions (“rules of the game”) as well as the human action. S-D logic, however, provides a broader perspective to technology suggesting emphasising that it is more than mere output of human action, but rather “a collection of practices and processes, as well as symbols, that are drawn upon to serve a human purpose”, (Akaka & Vargo 2013, 2). Moreover, the concept of value-in-context suggest that the value of a technology is dependent on the context within which it is applied, and thus, the same technology can emerge as a resource in one context and as a resistance i.e. not considered as a resource (Zimmerman 1951) in another. Thus, variety of contextual factors e.g. service beneficiary, time, place or cultural influences affects to how a particular technology is perceived. (Akaka & Vargo 2013, 2.) From S-D logic point of view, technology can be seen as a value proposition when developed for a specific purpose to solve a particular problem, often in unique context (Akaka & Vargo 2013, 13).

Dynamic environments result in companies having to constantly innovate to be able to adapt their value propositions and services. As for innovations, they are based upon a collection of competence, which the company continuously renews, integrates, creates, and transforms. Thus, S-D logic suggests that sustaining competitive advantage requires *collaborative competence*. Collaborative competence further on helps a firm to develop two additional competences that are needed in the complex and dynamic business environments: (1) *absorptive competence* and (2) *adaptive competence*. Absorptive competence refers to a firm's ability to understand the important trends and know-how in the external environment, and thus, utilising them in the firm's own value-creating processes. Adaptive competence refers to firm's ability to adjust itself according to changing circumstances. Collaborative competence helps developing both of these

crucial competences, and thus, enables the firm to better use its partners and their resources to improve its own viability. This all may result in lowering firm's relative resource costs as well as enhance its relative value propositions. (Lusch, Vargo & O'Brien 2007, 9.) Thus, competitive competence can be a solution to how companies can adapt to continual waves of innovation and change (Moore 1993, 75).

The fundamental basis of resource integration is that the value-creating resources are not limited to the company: customers, suppliers, and other parties constitute operant resources and contribute to value creation (Vargo & Akaka 2009, 36; Gummesson, 2005, 226). According to S-D logic, the only true source of competitive advantage is knowledge (Lusch et al. 2007). Knowledge development is seen as a process with several parties involved and where the company has to connect and integrate these fragments of knowledge (1995, 14–15). In other words, relevant knowledge is scattered among different actors, only some of which are accessible for a company whereas others are not (Håkansson & Snehota 1995, 27). It is in relationships that the existing knowledge is confronted with other parties' knowledge and new knowledge is created (Håkansson & Snehota 1995, 14). Resources are *heterogeneous* and their form and usefulness is dependent on how and with which other resources they are combined (Håkansson & Snehota 1995).

Service science is the study of service systems, which are dynamic value co-creation configurations of resources (people, technology, organisations, and shared information) (e.g. Maglio & Spohrer 2008, 18). Maglio and Spohrer see service systems as the basic theoretical constructs of service science (2008). They are open systems capable of increasing the viability of other systems through sharing or applying their resources as well as capable of improving their own viability by acquiring external resources (Maglio et al. 2009, 403). Providing any complex service requires incorporating people, technology, value proposition and shared information to match each opportunity (Maglio & Spohrer 2008, 19).

Maglio and Spohrer define service systems as “value co-creation configurations of people, technology, value propositions connecting internal and external service systems, and shared information (e.g., language, laws, measures, and methods)” (2008, 18), where the smallest service system is seen as an individual interacting with others whereas the largest service system is the global economy (Maglio & Spohrer 2008, 18). The function of service systems is to connect people, technology and information through value propositions with the aim of co-creating value for the service systems participating in the exchange of resources within and across systems. (Vargo & Akaka 2009, 33.) Furthermore, individuals, groups, organizations, firms, and governments can be considered to be service systems if they are able to take action, apply resources, and work with other parties in reciprocally beneficial ways (Akaka & Vargo 2013, 7).

2.3 Institutions and dynamic context affecting the ecosystem

More recently Vargo and Lusch extended the framework of S-D logic to a more systemic view by introducing the concept of *service ecosystem*, which draws upon a dynamic systems approach to study the interactions among various actors (Akaka et al. 2013, 6). The *service ecosystem approach* aims at understanding the complexity of context, which influences and is influenced by social and economic exchange (Chandler & Vargo, 2011). In other words, the service ecosystem approach is focused on analysing the complex and dynamic nature of the social systems through which service is provided, resources are integrated, and value is co-created. S-D logic provides an alternative framework to understand the role of context as a complex phenomenon. Key cornerstones are the concepts of service exchange, integration of resources (primarily operant), value co-creation and value-in-context. (Akaka, Vargo & Lusch 2013, 6)

Context influences value co-creation and market through its influence on resources and service (Chandler & Vargo 2011, 39). Resources “becoming” resources depend largely on the context in which they are embedded i.e. resources can be more valuable in one context than in others (Chandler & Vargo 2011, 39). Moreover, when different actors connect with one another, they are simultaneously joining their networks together constituting a context that has been studied in e.g. network approach (e.g. Håkansson & Snehota 1995) and “the embeddedness of markets” (e.g. Granovetter 1985). These joint networks enable a larger pool of resources to be used for service-for-service exchanges (Chandler & Vargo 2011, 40). A service ecosystems view suggests that service systems are not fixed or made up of static connections. A service system’s mixture of resources is almost never completely closed. Thus, service exchange happens not only within a service system but also among service systems leading to a multitude of service systems interwoven together and forming a larger ecosystem. Thus, service ecosystems are best studied by observing various levels of interaction: micro, meso, and macro. (Chandler and Vargo 2011.)

Vargo and Lusch define service ecosystems as “relatively self-contained self-adjusting systems of resource-integrating actors connected by shared institutional logics and mutual value creation through service exchange” (Vargo & Lusch 2011 in Wieland et al. 2012). Ecosystems are largely overlapping, interconnected and actors can belong to several of them simultaneously. On Lusch et al. (2010, 20) a service ecosystem (also referred to a *value network*) is defined as a “spontaneously sensing and responding spatial and temporal structure of *largely loosely coupled* value proposing social and economic actors interacting through institutions and technology, to: (1) co-produce service offerings, (2) exchange service offerings, and (3) co-create value”. Business ecosystems, like their biological counterparts, are gradually moving from a random collection of elements towards a more structured community (Moore 1993, 76)

The aim of service ecosystems approach is to extend the focus from dyadic relationships to triads i.e. systems of more than two actors. Economic exchange cannot be thought without triads. The whole idea of a dyad is too simplified and ignores the complexities of ecosystems e.g., does not take into account indirect interaction. (Vargo, lecture 25.3.2015) What happens in a relationship between two parties does not depend exclusively on the two involved actors but on what is going on in a number of other relationships i.e. the broader network picture always affects to how a pair of actors develop their relationship (Håkansson & Snehota 1995, 20). When taking into account the process of actors influencing other actors through other parties in the value network, much richer picture of the reality is accomplished (Vargo, lecture 25.3.2015). Service ecosystems approach is striving after living down the dyadic examination as well as taking into account the underlying institutions.

What further distinguished ecosystems approach is that it also emphasises how social context i.e. *institutions* influence and are influenced by value co-creation processes within and between service ecosystems (Vargo & Akaka 2012, 210). In this connection, institutions do not refer to organisations, but rather to socially created rules, norms, and regulations (Vargo, lecture 25.3.2015). In other words, service ecosystems can be seen as networks governed by institutions – institutions referring to ‘the rules of the game’ (Williamson 2000). Thus, value co-creation within service ecosystems is driven by shared institutions (Vargo & Akaka 2012, 211). In a similar way Gummesson points out that markets are essentially guided by three factors: competition, co-operation and rules defined by institution. Furthermore, markets are dynamic, in a continuous change, yet striving to keep the balance between these three forces. (2005, 218.) Institutions, too, are composed of human actions and interactions (Giddens 1984). Institutions effect the co-creation of value in several ways. They offer guidelines that affect which resources are regarded as valuable in a specific place and time. In addition, they guide how those resources can be accessed, adapted and integrated in a specific context (Akaka et al. 2013). Thus, S-D logic’s ecosystems approach is specifically accentuating the significance of the interaction within and between service systems, the social context that frames value co-creation practices, and the recombination of resources to create innovations (Akaka & Vargo 2013, 5).

Each actor in the ecosystem brings a unique quality to the context that not only affects other actors in the context but also the context as a whole (Chandler & Vargo 2011, 38). Thus, nothing happens in isolation (Gummesson 2005, 144). Because each actor in the context is continuously integrating and exchanging resources with other actors in the ecosystem, there is an endless change in the context. (Chandler & Vargo 2011, 38) Service ecosystem approach aims to understand the underlying mechanisms that drive multiple levels of interaction of resource integration and service-for-service exchange (Akaka et al. 2013, 6). Each of these becomes the context where the others

take place. If you really want to know what is happening in one level you have to look at it from another level. (Vargo, lecture 25.3.2015.)

S-D logic emphasises that “value is always uniquely and “phenomenologically determined by the beneficiary” referring to any actor in the service phenomenon in specific context (Vargo & Lusch 2008b, 7). In essence, the purpose of exchange is to access resources that have potential benefit to actors in their own particular context (Chandler & Vargo 2011, 35). S-D logic proposes three levels of contexts: micro, meso and macro that “coincide with fundamental processes of value co-creation” (Chandler & Vargo 2011, 36). Interactions in ecosystems can occur at micro levels (e.g., dyadic exchange encounter), meso levels (e.g., organisations or industries), and macro levels (e.g., national or global institutions) (Akaka et al. 2013). To understand the development of innovations in service systems it is essential to be able to oscillate among these micro- meso- and macro-level perspectives (Chandler & Vargo 2011). The ecosystems approach suggests that direct service-for-service exchange is masked by indirect interactions, at multiple levels, not only in the networks of relationships but also in the institutions that guide the actions and interactions in multiple levels (Vargo & Lusch 2011). In other words, the perspective makes explicit the way micro, meso and macro levels are in continuous interplay; small scale interaction becomes translated into large-scaled pattern whereas these, in turn, feed back into small groups (Chandler & Vargo 2011; Granovetter 1973). The micro-level actions and structures compose meso- and macro-level interactions and structures, as well as meso- and macro-level structures guide the actions and interactions at the micro-level (Akaka & Vargo 2013, 7).

The ecosystem approach also points out that all social and economic contexts are naturally complex because of how actors, dyads, and triads create synergy among various coinciding direct and indirect service-for-service exchange (Akaka et al. 2013, 2, Chandler & Vargo 2011, 44). By gaining deep understanding of systems of service exchange rather than focusing on challenges or superficial difficulties of particular contexts (e.g., global differences amongst countries), researchers and practitioners can better understand and deal with the complexities of dynamic systems (Glouberman & Zimmerman 2002). The service ecosystem approach is possibly able to provide a more solid foundation for developing marketing theories and studying the creation of value, also within complex global contexts (Akaka et al. 2013, 2). The ecosystems approach argues that the underlying source of complexity in a global context is not ultimately based on differences or distances, but rather the increased embeddedness of social networks and the multiplicity of institutions within a service ecosystem as well as the diversity of resource-integrating practices that reproduce both (Akaka et al. 2013, 2). The aim of the service ecosystems approach is to understand the essential drivers and dynamics of complex social and economic systems that influence and are influenced by exchange (Akaka et al. 2013).

The highly embedded context of international marketing makes it an interesting application for ecosystems approach thinking. Moreover, in the global context, multiple levels of networks and institutions are emphasised. Thus, service ecosystems approach offers a broader scope for international marketing. The traditional decision-making process concerning e.g. market entry strategies becomes a study of institutions and networks of actors that are not limited by the country borders, and that can be analysed in micro, meso and macro levels. This changes the perspective in which risks are regarded i.e. the focus shifts to e.g. challenges of engaging in exchange within embedded cultural contexts and multifaceted networks, or intellectual property risks as well as risks in brand equity. (Akaka et al. 2013, 16.)

Service ecosystem view emphasises the strength of “largely loosely coupled” relationships or what Granovetter calls “weak ties” (1973) in the co-creation of value as well as the reformation of service systems. (Vargo & Akaka 2012, 211) In essence, Granovetter describes a situation where actors belong to close-knit networks of business friends between whom the ties are strong. But the problem with these relationships is that they are limited in size; you can only be close to so many people. However, members of a strong network have weak ties to a large number of acquaintances; thus, much of the value networks actually consist of weak ties and they provide bridges to a variety of other networks, which makes them especially valuable. (Granovetter 1973; Lusch et al. 2010, 20.) Thus, the largely loosely coupled relationships enable ‘seemingly unrelated networks to form a larger macro-structure which can be more fluid, agile, and adaptable’ (Lusch et al. 2010, 20)

All the unique service provision efforts conducted by actors, dyads, triads, complex networks and service ecosystems eventually create the markets. Moreover, context frames these processes. (Chandler & Vargo 2011, 45.) Thus, “markets emerge from simultaneous continuous processes at different levels and layers of context” (Chandler & Vargo 2011, 45).

2.4 Summary of the theoretical framework

Service-dominant logic and its ecosystems approach offers the right perspective, vocabulary and assumptions that assist in analysing the current challenges the medical games ecosystem is facing as well as helps recognising the current opportunities. Furthermore, service ecosystems approach enables the medical game ecosystem to be observed in multiple levels. The framework of analysis in Figure 1 is constructed to answer the three sub-objectives of the research objective stated in section 1.2. The figure below represents the medical game ecosystem and brings the key concepts of the theoretical background together. It consists of six key elements: (1) actors, (2) value

propositions, (3) resources, (4) relationships, and (5) institutions. Additionally, the circular arrows on the background portray how the dynamic nature of the five elements continuously interacting creates the (6) emergence of the ecosystem.

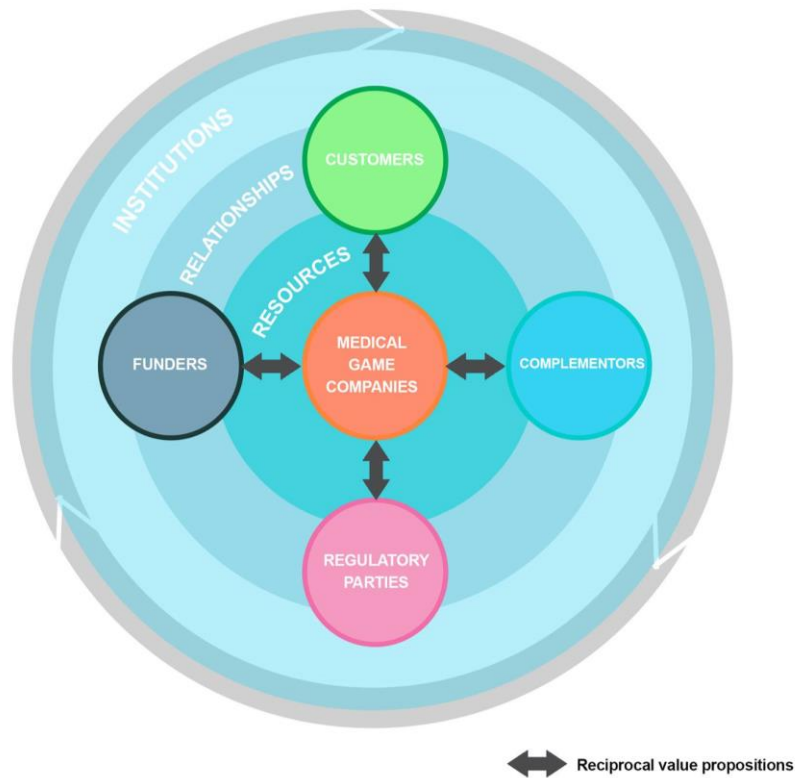


Figure 1 Theoretical framework of the emergence of the medical game ecosystem

Firstly, the *key actors* are divided into five major groups: (1) medical game companies, (2) customers, (3) funders, (4) regulatory parties, and (5) complementors i.e. other relevant parties involved in the ecosystem. Each actor in the ecosystem brings a unique quality to the context that affects the other actors and the ecosystem as a whole (Chandler & Vargo 2011). The two-way block arrows represent the reciprocal *value propositions* i.e. the expected improvement in actors' viability through other actor's service. Medical game companies are aiming at offering competitively compelling value propositions to all key actors, and respectively, those actors are offering value propositions to medical game companies. The inner layer in the diagram represents the *resources* that are being integrated in reciprocal service exchange between the actors. The focus is especially on the intangible and dynamic resources (i.e. operant resources) e.g., skills, knowledge, know-how, expertise, and experience. A variety of resources are required to create a successful medical game.

The middle layer represents the relationships amongst all the key actors. The medical game companies have relationships with the other key actors who, too, have relationships with one another that affect their relationships with the medical game company as well as the ecosystem as whole. In other words, value is co-created through interaction and collaboration within this network of actors, rather than within the medical game company itself. The outer layer represents the underlying *institutions* (i.e. social norms) and emphasises the importance of the context throughout which value is created and evaluated uniquely by the service beneficiary. Everything that happens in the ecosystem affects the underlying institutions and respectively, the institutions affect the ecosystem as whole. Thus, institutions coordinate the value co-creation practices within the ecosystem. Finally, all these elements are constantly affecting each other, thus, the circular arrows represent the dynamic emergence of the medical game ecosystem over time.

3 RESEARCH DESIGN

3.1 Research approach

This study aims at exploring a real-life phenomenon, that is, *the critical elements underpinning the emergence of the medical game ecosystem*, by identifying beneficial relationships, resources and value propositions in the ecosystem as well as making the affecting institutions explicit. Although there is a general need for both qualitative and quantitative research on this field, due to the multifaceted and complex nature as well as the novelty of the focal phenomenon, qualitative case study was found more suitable. Due to the open-ended starting point, making hypotheses would not have been practical nor had it been possible, supporting the choice of qualitative method. Qualitative method is often preferred when exploring a new area (Miles & Huberman 1994, 10). Since the study aims at in-depth understanding of the critical elements affecting the emergence of the medical game ecosystem, holistic approach and an attempt to gather data in natural settings were seen suitable.

The strengths of qualitative data lie particularly in its richness and holism and its strong potential to reveal complexity (Miles & Huberman 1994, 10). The aim was towards in-depth and detailed examination of the phenomenon (Hirsjärvi, Remes & Sajavaara 2004, 152). Traumatic brain injury rehabilitation in itself is a complicated process involving several kinds of resources and expertise. The complexity of the healthcare context as well as the initial state of the medical game industry both demanded an open and dialogic approach. Qualitative research pursues to describe certain phenomena, understand specific actions and to give theoretically meaningful interpretations to these phenomena (Eskola & Suoranta 1998, 61). The aim was to gain deeper understanding of the structures surrounding the studied area e.g., gaining understanding in the healthcare processes, what kind of challenges are faced, especially in terms of TBI rehabilitation, and what kind of relevant actors, resources, and institutions are involved. Despite the marketing approach, the knowledge about the overall phenomena discussed was vital in terms of understanding the bigger picture, e.g. the nature of traumatic brain injuries and their treatment, understanding the processes in the insurance companies as well as understanding the entertainment game industry and its revenue logics.

This study has features of *an exploratory case study*. A *case study* is an empirical study where a contemporary phenomenon is studied in a real-life context. (Yin 2003, 1) It is recommended especially when the boundaries between the phenomenon under scrutiny and its context are difficult to detach from one another (Yin 2003, 13). Furthermore, a case study is preferred when *how* and *why* questions are being posed

(Yin 2003, 1). Moreover, as the objective of this study was to explore a new phenomenon and no clear set of outcomes could be expected, a case study was seen appropriate to enlighten the situation (Yin 2003, 15). This case study can be seen as *exploratory* due to the novelty of the focal topic. The purpose of exploratory studies is to seek to explore what is happening and is conducted typically by talking to experts on the field as in this study (Gray 2009, 35). Iteration was strongly present throughout the whole process. The general aim was to keep an open mind for all the possible results even if it would result in admitting that the medical game ecosystem does not show potential. Thus, there was a lack of hypotheses (Eskola & Suoranta 1998, 19).

3.2 Case selection and data collection

This study is a *single-case study* where the focal phenomenon is the emergence of a medical game ecosystem in Finland, and more specifically, in the *traumatic brain injury (TBI) rehabilitation* context. This study was commissioned by *Play for Reward*, a multidisciplinary research project working under *Up Your Game*¹ network. The aim of the project was to study rewarding gaming experience and how to reform traditional brain injury rehabilitation services by implementing effective game-based solutions. Thus, this study focused on using medical games in TBI rehabilitation. To be precise, the focus was more on the neuropsychological rehabilitation than the motoric. Furthermore, medical games for neuropsychological TBI rehabilitation differ significantly from medical games that are being used to e.g. train shoulder pain. In addition, the *Play for Reward* project focused on investigating the emerging medical game ecosystem, that is, the part this study contributed to. There were five enterprise partners in the project. Three of them were providing the practical health and game business know-how (an entertainment game company Tribeflame, a health technology company GoodLife Technology, a healthcare information system provider BCB Medical) whereas two of them were providing the scientific knowledge on the focal topic (rehabilitation centres Orton Ltd. and Validia Rehabilitation).

Matters such as accessibility affected the case selection. *Play for Reward* research project offered an optimal multidisciplinary environment as well as access to valuable

¹ *Up Your Game* is an interdisciplinary game research network founded in February 2014 by the University of Turku in Finland. There are around 70 university professionals involved, including 15 professors from six different faculties and several experts from other universities, gaming companies and developmental organisations. The aim of *Up Your Game* is to initiate new game research projects that answer to the needs of science and society.

company partners, which further on enabled being absorbed in the focal phenomenon. Medical games, or more precisely, medical games in TBI rehabilitation, were a natural selection as the focal subject of study due to the company partners, which included Validia Rehabilitation and Orton Ltd. both rehabilitating TBI patients and thus, offering their professional expertise and experience in use.

Finland provides an apt setting for a study of medical game ecosystem. Even if the emergence of the medical game ecosystem is only in its initial state in Finland as well as globally, Finland is a pioneer in health technologies and eHealth solutions. There is a large number of health technology professionals and additionally, health technology is now the largest and most significant high-tech segment in the Finnish industry (*Industry overview: Finland is a small giant --*). Furthermore, being a European hot spot in entertainment game industry, the future prospects of the medical ecosystem were seen intriguing.

Qualitative interviews were chosen as the main data collection method of the study due to the open-ended and exploratory nature of the study (Gray 2009, 370). They are an efficient method when it is expected that the research problem will have multiple and complex answers (Hirsjärvi et al. 2004). The great advantage comparing to other data collecting methods is that qualitative non-standardised interviews give the flexibility to monitor and adapt to the situation. In addition, interviewers can ask clarifying questions and otherwise have a conversation with the interviewee to build up deeper understanding of the focal topic. The goal was to get the interviewees to tell narratives and explanatory portrayals instead of merely agreeing or disagreeing with the interviewer (Stake, 1995, 65). A case study enables placing the data in a broader context and getting clarifying explanations (Creswell 2014, 14). Qualitative interviewing aims at in-depth information and rich understanding of the focal phenomenon (Hirsjärvi et al. 2004, 194). Despite its benefits, interview as a data collection method has its disadvantages. In-person interviewing is time-consuming, requires a lot of planning and can include misconceptions and inaccuracies from both sides – the interviewer and interviewees (Hirsjärvi et al. 2004, 195). Especially the analysis of open-ended interviews is time-consuming (Hirsjärvi et al. 2004). In addition, unstructured interviews result in a lot of irrelevant data relative to the research question that has to be processed anyway (Hirsjärvi & Hurme 2008, 36). Taken the disadvantages into account, qualitative interviews were still seen as the most suitable to collect data in this context.

A total of 24 interviews were conducted with altogether 25 interviewees between November 2014 and April 2015. Three interviews were conducted over a telephone and three over Skype due to large geographical distances and limited timeframe of the

study; the rest were done in face-to-face meetings. With the exception of one interview², all interviews were recorded for reliable recall during data analysis. Investigator triangulation, i.e. two interviewers, was used in several interviews to gain broader understanding on the focal phenomenon. Despite one exception, where two interviewees from the same organisation were interviewed together, the interviewees were interviewed individually. Some of the interviews were conducted by a colleague researcher from the same project team (indicated in Table 2). In those situations, the themes were discussed in advance. In addition, in the case of an ambiguity related to the interview data, the issues were discussed. One of the interviews was conducted in English and the other 23 in Finnish.

The interviewing method chosen was *a semi-structured theme interview*. Hirsjärvi and Hurme (2008) call this method a ‘theme interview’ but the term has not yet been established in other languages than Finnish. The term refers to the most essential feature of the interviewing method; instead of detailed questions, the proceeding of the interview relies on certain main themes. The method moves the emphasis from the interviewer towards the interviewee, better bringing out their voice. (Hirsjärvi & Hurme 2008, 48.) In this study, the themes were decided *a priori* (see Appendix A for the outline of interview themes) but the exact form and order of the questions varied according to each situation (Eskola & Suoranta 1998, 87). The set themes made sure that more or less the same topics were discussed with all the interviewees. However, the interviews were conducted in a flexible way. Depending on the interviewee’s role including expertise and knowledge on the topic, the questions were adjusted. Additionally, the informants could bring out relevant topics of their own, which was a strong asset in an open-ended study such as this.

The interview themes were divided into two: healthcare related themes and (medical) game related themes. They included questions linked to e.g. important relationships, main challenges encountered in the development and commercialisation of medical games, and the implementation process of new rehabilitation methods. To keep the reactions spontaneous, the interviewees were not provided with the questions beforehand except in one of the interviews where the questions were specifically requested.

In qualitative interview it is important to choose informants that have experience in the focal phenomenon or have other relevant knowledge concerning the topics of interest (Tuomi & Sarajärvi 2009). *Purposive sampling* was used in this study to obtain as broad as possible overall picture of the studied phenomenon (Hirsjärvi et al. 2004, 155). Choosing the interviewees was a result of careful planning together with the *Play*

² Due to technical difficulties. Nonetheless, thorough notes were made.

for *Reward* research team. A list of interviewees is located in Table 2. A preliminary ecosystem diagram was drawn in co-operation with the team members. An ecosystem diagram was sketched based on five first interviews and network pictures method was used i.e. the interviewees were asked to draw a picture of their value network. Thus, the relevant actors in the value process of traumatic brain injury rehabilitation as well as medical game development were identified. In addition, some of the initial interviews led to others, allowing the responses of the interviewees to lead to new data, this is *conceptually-driven sequential sampling* (Miles & Huberman 1994, 27). All interviewees agreed on using their real names and professional titles in the study.

Setting *boundaries* – e.g., defining the aspects of your case that you can study within the limits of your timeframe and resources – is a vital part of purposive sampling (Miles & Huberman 1994, 27). Setting boundaries is based on the theoretical attractiveness of the data in terms of the research question chosen (Eskola & Suoranta 1998, 65). Thus, in this study, the main issue in terms of the sampling was to get to interview at least one member of each relevant actor group of medical games ecosystem identified in the preliminary ecosystem diagram. In addition, the study was focused mainly on the Finnish market due to the accessibility of the interviewees and the limited timeframe of the study.

The amount of the interviewees was not fixed beforehand, but it was considered throughout the interviewing process. During the study attention was paid towards *saturation*: a situation when the data starts repeating itself and the new interviews do not bring essential information in terms of the research question (Tuomi & Sarajärvi 2009, 87; Eskola & Suoranta 1998, 63). After interviewing the experts in the same area of expertise, certain patterns started to repeat themselves bringing less and less new information relevant to the research question.

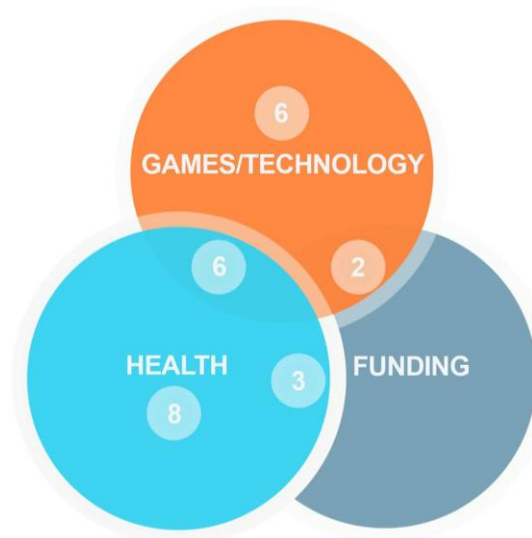


Figure 2 The three main domains of expertise of the interviewees

The expertise of the interviewees (see Figure 2) can be roughly divided into three main areas that are relevant to implementing medical games into TBI rehabilitation: (1) games and technology, (2) health and (3) funding. Some of the interviewees can be seen as expert in more than one of the three domains as presented in Figure 2. The amount of health professionals (8) was justifiable since the domain of traumatic brain injury rehabilitation was relatively unknown to the researcher prior to this study. In addition, to understand the potential of games in TBI rehabilitation, it was important to gain as good understanding of the context as possible. Also a TBI patient was interviewed to gain more in-depth understanding of the real issues in the TBI rehabilitation process from a patient's viewpoint. Other serious³ games companies (education game companies) were chosen since the amount of the health game companies in the Finnish market is yet limited and they are struggling with similar kind of issues than health game companies. Moreover, an entertainment game company was chosen to understand the nature of the traditional game market and its challenges. Altogether, six games and technology experts were interviewed amongst which was also a representative of an academic institution. In addition, six interviewees with health technology or health game expertise were interviewed. The experts in the domain of funding were chosen keeping the health aspect and the game aspect in mind. Social Insurance Institution and insurance companies are both relevant funders of the TBI rehabilitation. Additionally, a business angel with a special interest in med tech and ICT was chosen to represent the private sector funding. Furthermore, two of the funding experts had a strong experience in the game industry.

In addition to conducting interviews, the researcher participated in the Games for Health Europe conference held in Utrecht (26–28.10.2014), a technology and health themed seminar, Synergia IT (7.4.2015) and Turku Game Day meets Game Research Day (23.4.2015). Furthermore, during the empirical research process, the Internet pages of each interviewee's organisation provided valuable information about each organisation and their services provided supporting the conducting of the interviews. This study was an open-end study *per se*. The research questions and the research plan evolved together with the data collected i.e. the plans changed flexibly according to the circumstances and current state of knowledge (Hirsjärvi et al. 2004, 155).

³ Serious games are “computerised games whose chief mission is not entertainment, including entertainment games, which can be reapplied to a different mission other than entertainment” (Sawyer 2007).

Table 2 Interviewees, their organisations and positions at the time of the interview.⁴

Date	Name	Organization	Position	Alias
24.11.2014	Heli Vehkala	Neuron	Project Manager	H1
27.11.2014	Jyrki Korkeila	University of Turku	Professor of Psychiatry	H2
28.11.2014	Olli Tenovuo	Turku University Hospital	Chief of Rehabilitation and Traumatic Brain Injury Care	H3
21.1.2015	Pekka Rantanen	Validia Rehabilitation	Director, Head of Medical Services	H4
21.1.2015	Jaana Sarajuuri	Validia Rehabilitation	Chief Psychologist	H5
6.3.2015	Anu Korhonen*	Aivovammaliitto	Rehabilitation planner	H6
11.3.2015	Tage Orenius	Orton Ltd.	Chief Psychologist	H7
13.3.2015	Jere Elonen	-	Patient	H8
21.1.2015	Henrik Jürgens	GoodLife Technology	CEO	HG1
27.1.2015	Arto Holopainen	Kuopio Innovation	Senior Advisor (Business Development, Technology and Business Foresight)	HG2
31.1.2015	Hannu Vuola	GoodLife Technology	Chairman of the Board	HG3
18.2.2015	Mark Evin	Jintronix	Chief Product Officer & Co-Founder	HG4
10.3.2015	Terhi Kajaste	Finnish Health Technology Association	Managing Director	HG5
13.3.2015	Johannes Koponen*	Herring	Co-Founder	HG6
16.12.2014	Patrik Uhinki	Turku Science Park	Project Manager (Game Turku)	G1
8.1.2015	Mika Luimula	Turku University of Applied Sciences	Principal Lecturer in Game Technology	G2
27.1.2015	Torulf Jernström	Tribeflame	CEO & Founder	G3
5.2.2015	Tatu Laine	NordicEdu	Creative Director & Co-Founder	G4
23.2.2015	Harri Ketamo*	SkillPixels	Founder & Chief Scientist	G5
6.3.2015	Reidar Wasenius*	BRIIM	Founder, Personal Brainer	G6
11.2.2015	Kari Korhonen*	The Finnish Funding Agency for Innovation (Tekes)	Programme Manager (Skene)	GF1
24.2.2015	Mikko Honkakorpi*	(various)	Digital Media and Video Games Professional	GF2
12.3.2015	Katariina Kallio-Laine	Kela	Neurologist, Medical Advisor	HF1
13.3.2015	Anna-Kaarina Lipsanen*	FiBAN	Angel Investor, Board Member	HF2
14.4.2015	Seppo Wickström	LähiTapiola	Specialist	HF3

⁴ * indicates that the interviews were conducted by a colleague in the project

3.3 Data analysis

The strength of qualitative research is dependent on the competence with which its analysis is carried out (Miles & Huberman 1994, 10), which is also the central challenge in qualitative research since there is no clear guidelines in conducting data analysis (Eskola & Suoranta 1998, 138). The aim of analysing qualitative data is to yield new information of the focal topic. Furthermore, in qualitative analysis, it is important to keep in mind that text is always just one version or one viewpoint to the phenomenon discussed, not an absolute truth (Eskola & Suoranta 1998, 143). Thus, the fertility and aptness of the interpretation ultimately lies in the hands of the researcher's scientific imagination (Eskola & Suoranta 1998, 147). The key criteria for a successful analysis are that the reader is able to adopt the same point of view as the researcher and find the same matters in the text that the researcher found regardless of whether the reader agrees with the point of view of the researcher (Hirsjärvi & Hurme 2008, 151).

In this study, to understand the context in which the medical games are hypothetically discussed i.e. the process of traumatic brain injury rehabilitation as well as the current state of the health games market is pivotal. The case description and the case study results were based on three main sources: (1) Ben Sawyer's tutorial and the Games for Health conference (26–28.10.2014), (2) document analysis (online materials e.g., articles, academic journals and reports), and (3) expert interviews. Interviews were the primary source of information; the other two were additional sources to offer support. During interview data analysis the researcher aimed at creating a cohesive picture of the focal topic that resonates with the theoretical framework proposed in section 2.4.

Each interview was transcribed and converted into written form to facilitate the analysis. The transcription made were exact and also described some nuances of the conversation e.g., laughing, silences, or doubting sounds. The transcriptions were done by Spoken⁵. Furthermore, to avoid misunderstandings, each transcription was read through afterwards to correct possible mistakes and mishearing as well as completing the parts that were unheard by the person transcribing it.

The aim of the analysis is to condense data without losing relevant information; on the contrary, the aim is to turn scattered data into something clear and meaningful, increasing the informative value of the data gathered (Eskola & Suoranta 1998, 138). To do so, the transcriptions were read through several times “interactively” i.e. while underlining and writing notes. Analysing qualitative data is an on-going process, thus, it involves continual reflection over data after each interview. After that, they were

⁵ A Finnish company offering transcription and proofreading services.

thematised according to the theoretical framework with the help of NVivo. Thematic analysis is one way of processing and analysing qualitative data and is based on patterns found in data. The themes were consistent with the framework presented in section 2.4; thus, the aim was to build a bridge between the data and the theory. Some of the themes were more explicit e.g. value propositions to different actors, whereas others were more implicit e.g. identifying the underlying institutions affecting the emerging medical game ecosystem. The latter required ‘analysing the meanings’ i.e. trying to find elements that are not directly said out loud in the text (Hirsjärvi & Hurme 2008, 137).

In the second round of the analysing phase, all the challenges mentioned in the interviews were listed in an Excel spread sheet with the original citation and a condensed explanation of the challenge. Based on these, statements about the current challenges in the medical games market were listed. All in all, 59 challenges (see Appendix B) were recognised at this point. These challenges were further on condensed to more general statements by combining their major features resulting in twenty main challenges.

This study has elements of *narrative approach*, thus, it aims at offering a vivid description that has a strong impact on the reader (Miles & Huberman 1994, 10). Narrative analysis does not have to describe an entire life story, but it can also be a description of a specific event or process (Makkonen, Aarikka-Stenroos & Olkkonen 2012, 291), thus, in this study, it illustrates the medical game ecosystem. Furthermore, the narrative approach enables combining various levels of narratives into a believable interpretation of network dynamics, i.e. in this study, a picture of the medical game ecosystem was created based on the narratives of the informants (Makkonen et al. 2012, 296). The key aspect was to identify the key actors in the ecosystem and understand how they ‘perceive, interpret and act upon the context’ (Makkonen et al. 2012, 295).

3.4 Trustworthiness of the study

With regards to qualitative research, validity and reliability in the traditional sense do not apply to the basis of the trustworthiness (Eskola & Suoranta, 1998, 212). Thus, Lincoln and Guba (1985, 294–301) suggested *credibility*, *transferability*, *dependability* and *confirmability* to assess the trustworthiness of a qualitative study. When these criteria are applied, the trustworthiness of this study can be clearly discussed and evaluated in every aspect. Furthermore, the criteria are relevant for taking into account the nature of the study as qualitative exploratory case study (Lincoln & Guba 1985). When establishing the trustworthiness of a qualitative study, the primary purpose is to assure the audience that the findings are worth paying attention to (Lincoln & Guba 1985, 290).

Credibility refers to the findings corresponding to the reality i.e. are the interpretations and meanings related to the data in line with the informants' insights of the focal subjects (Lincoln & Guba 1985, 301). In this study, by applying procedures such as persistent observation, triangulation and member checking the credibility was established (Guba 1981, 85). *Persistent observation* refers to an extended interaction with the research subject which leads the researcher to an understanding of what is seen essential and which critical characteristics concern the research context (Guba 1981, 85). Prior to the empirical data collection, the researcher attended the Games for Health Europe conference. In addition to the three-day conference, the researcher became familiarised with the health game industry by searching information online, e.g. reading articles in both journals and magazines, familiarizing with the actors operating in the sector, and reading reports concerning the sector. By using a persistent observation technique, the researcher had the ability to ensure that the likelihood to overlook some important aspects would be kept to minimum. Furthermore, the use of persistent observation enabled the researcher to identify the key characteristics and elements which were relevant to the research problem and created a more profound understanding about the medical game industry (Lincoln & Guba 1985, 304).

Guba (1981, 85) as well as Eskola and Suoranta (1998, 69) suggest using several methods in order to increase the credibility of the study. This procedure is also known as *triangulation* and it was applied during this study by using interviews and document analysis in data collection and analysis as well as supporting them with the information gained from the additional events. The interviews were used as the primary data collection method and document analysis was used to complement the interviews in order to gather more information in complex issues such as TBI rehabilitation and medical device regulations as well as enabling cross-examination of the empirical data. For instance Guba (1981, 85) argues that there can be no verification of any item of information if it not based on a minimum of two distinct sources. Nonetheless, according to Lincoln and Guba (1985, 314), to enhance credibility, the most important technique is doing *member checks* i.e. the accuracy of findings, interpretations and conclusions are checked from the ones who provided the information. In this study, the procedure of member checking was completed by sending the results of the case study to all the informants so that they could confirm them and mention possible misinterpretations.

Transferability refers to the extent to which the results can be transferred to other contexts and is achieved by describing in detail the process and the context of the study. This was referred by Lincoln and Guba as *thick description* (1985, 316). Thick description is done in order to make it possible for other researchers to repeat the study. Thus, the researcher should provide the tools for the reader so they can evaluate the study by describing the research process, collection of the data and the context to which

the findings refer (Lincoln & Guba 1985, 297). The procedure regarding thick description requires relevant data and consequently, the empirical qualitative data was gathered by purposefully choosing experts that can provide information of the focal topics of interest. The number of experts that were interviewed in the given timeframe was limited. However, the goal of this case study is not to make any statistical generalisations, but rather to gain deeper understanding of the focal phenomena in this specific context (Eskola & Suoranta 1998, 61). Thus, in general the trustworthiness of a qualitative study is not based on the amount of data, but rather on the quality of the data (Eskola & Suoranta, 1998, 18).

Focusing on the medical game ecosystem in the Finnish context provides some specific characteristics e.g., in terms of the specific features and funding mechanisms of the healthcare sector as well as certain underlying institutions that are typical for a welfare state such as Finland. It could be argued whether the results would be different if this study was conducted e.g. in the US. Nonetheless, the researcher argues that the findings of this study can be applied to other contexts i.e. in terms of utilising them in analysing medical game ecosystems in other contexts than traumatic brain injury rehabilitation

Dependability is attached to research quality and consistency i.e. how much of the results of the study are dependent on the research situation (Lincoln & Guba 1985, 299). Dependability includes evaluation of the research situation, considerations about the researcher, the research surroundings and the research subject (Tynjälä 1991, 391). The atmosphere in the interviews was always open, and the informants were motivated to participate in the study. The researcher had made the effort to familiarise herself with the services of the organisations prior to the interviews.

Confirmability refers to the objectivity and neutrality of the data, and is related to conducting research in an unbiased way, so that researcher's own motivation or interests are not dominating the research process. Triangulation procedure increased the confirmability of the research since the researcher acquired comprehensive data from variety of perspectives and this way the researcher's possible predilections were strenuously tested and possible biases were challenged (Guba 1981, 87).

Lastly, it is of importance to take into account that there are no set guidelines or tools on how the qualitative data analysis should be conducted; this means that the outcome of the analysis is highly dependent on the skills of the researcher (Eskola & Suoranta, 1998, 147). Furthermore, the reader should acknowledge that the choices of the interview themes, the data analysis as well as interpretations of data were guided by the researcher.

4 CASE DESCRIPTION

4.1 The Finnish medical game market

As stated by Christensen, Grossman and Hwang (2009), the healthcare industry is on the verge of reformation, which they referred to as a ‘disruptive innovation’. It aims at transforming high-cost and expertise-intensive healthcare services into something much more affordable and simple. Medical games can be seen as one part of this reformation aiming at more accessible healthcare services and self-efficacy in healthcare. Thus, there surely is demand for new effective technologies to enhance the current healthcare processes.

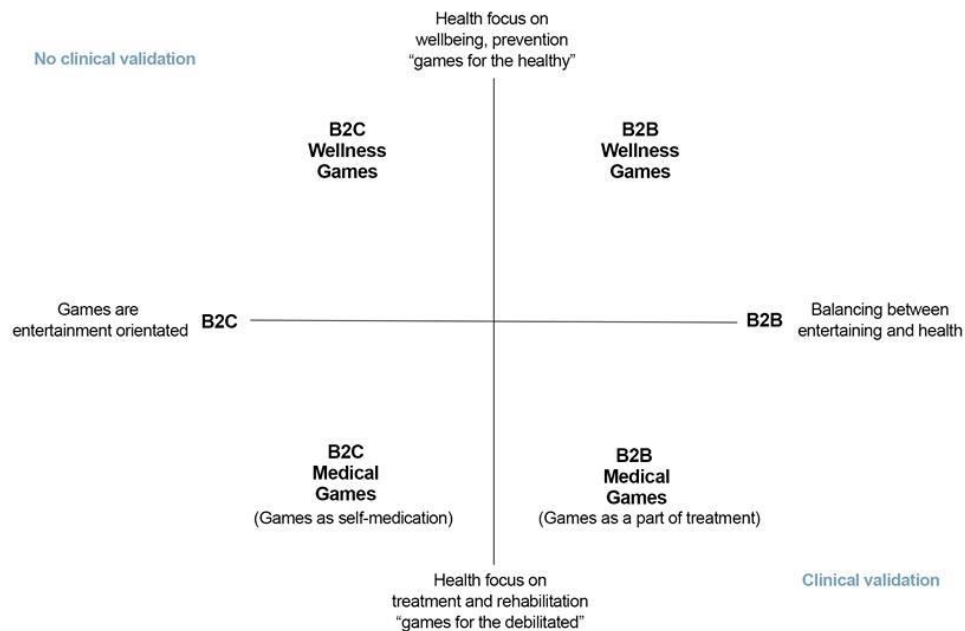


Figure 3 The nature of medical games and wellness games: the focus on this study is in medical games (adapted from Kaleva et al. 2013, 14)

Due to the initial state of the medical game ecosystem, however, there are not yet many actors doing successful business with health games neither in Finland nor globally as accentuated by HG1. In terms of health games, a general division into two can be made as indicated in Figure 3: (1) *wellness games* i.e. “games for the healthy” and (2) *medical games* i.e. “games for the debilitated”. Nevertheless, the line is ambiguous, but in general, medical games are used in treatment or rehabilitation, they have a health claim and clinical studies are required to validate their effectiveness. Wellness games, on the other hand, do not have a health claim and they are typically focused on the

preventive angle and general wellbeing. (Kaleva et al. 2013.) Especially in the medical game industry, very little success stories have emerged due to the complex nature of the business. The field is still mainly research-driven, which indicates that there are challenges in terms of securing the right funds for the development and marketing of the medical game services as pointed out by HG2. The medical games market is mainly based on scattered research projects and some of those innovations have remained in use in some separate healthcare organisations. The quiescent potential of the medical games industry is yet to be utilised.

“Universities and schools of applied sciences are of course co-operating with companies and hospitals but only few companies are developing serious games on a commercial basis, especially health games, because the market is not developed enough. Nor are the products for that matter, they have not been productised on an advanced level. They are more like practices, projects, experiments.” (G1)

Recently, organisation promoting the field and connecting the scattered actors to an ecosystem have started to emerge. The Games for Health Finland network aims at pairing up the healthcare sector together with medical game companies (HG2). Simultaneously, Serious Gaming Cluster has started to create a serious game ecosystem in the Finnish market. From 260 game companies in Finland, 179 have been founded within the past four years; indicating that the field is dominated by start-ups (Pietarila, 2015), thus, the challenges encountered are relevant to that. Most of the game companies are still focused on the entertainment game sector, yet an increasing amount of companies is sliding towards the serious game sector. In the process of striving for the ‘American dream’, the entertainment game companies alone are unlikely to become interested in the pension crisis and the challenges caused by the aging population as pointed out by G2, thus, the actors in the healthcare sector have to increasingly take the initiative to strive for disruptive solutions for healthcare.

H1 pointed out that doctors are already looking for ways to use new technologies in healthcare. The healthcare sector is beginning to see the opportunities in “gamifying⁶ the healthcare”. To strengthen the interest towards health games and technologies, the options should be promoted amongst the future healthcare professionals and developers: the attitudes should be planted in the education organisations. Thus, those who study

⁶ “Gamification is the use of game mechanics and game design in non-game scenarios (such as healthcare environments) in order to change behaviours and increase motivation to change” (de Boer, van Houwelingen, Adriani & Geerts 2015)

welfare technologies – those who naturally have an interest towards wellbeing issues – should have an opportunity to learn game technology. They could prove out to be the best and most motivated entrepreneurs in the field as stated by the Principal Lecturer in Game Technology (G2). In addition, the curiosity towards the medical games can be noticed as some pioneers are already actively striving for implementing gamified solutions to enable more efficient rehabilitation e.g., in private rehabilitation centre Neuron (H1). The trend towards wellness games and different kind of health trackers is growing, and simultaneously, the medical game trend is growing with them as emphasised by H1. Medical games are increasingly implemented in the processes in hospitals and smaller rehabilitation institutions, but also patients are using them on their own initiative. In several healthcare organisations, management is already agreeing that the traditional methods are not enough to respond to the challenge of the aging society and growing need for rehabilitation as stated by H1.

Moreover, observing medical game ecosystem as something isolated from the growing health technology ecosystem does not seem appropriate since medical games can be seen as a form of gamified health technology, that is, a tool to motivate patient and provide higher quality services in the context of healthcare. The game word itself yet often involves certain negative connotation in the health sector referring to something that is superficial and results in addictions (e.g. H7). Nonetheless, opportunities enabled by gamification and using game mechanics such as feedback, competitiveness and usability to enhance the quality of service, are already been recognised in various contexts. Currently, Finnish health technology is a well-known sector with an increasing growth and a significant trade surplus as accentuated by HG5. Finland is not an important market in terms of the size, but it can be seen as an important market in the sense that it is the first market for Finnish start-ups, and the importance of customer references is significant when gazing towards success in the global markets as HG5 pointed out.

4.2 Traumatic brain injury rehabilitation

To start building a roadmap to implement medical games in traumatic brain injury rehabilitation, it is vital to understand the phenomenon and its characteristics. The traumatic brain injury rehabilitation can be seen as its own service system, with its own resource integration activities amongst the actors as well as its own underlying institutions that affect how the resource integration is happening between these actors. Additionally, it is estimated that currently there are around 100,000 people with a permanent TBI in the need of some kind of rehabilitation in Finland (H5, H6).

In TBI where the whole brain is shaken, also the deficits are diverse, thus, one of the critical features of a successful rehabilitation stated in several interviews is an efficient *multi-professional co-operation* (H2, H3, H4, H5, H6, H7, and HF1). In practice, it means that in the rehabilitation process there are several experts available e.g., doctors, neuropsychologists, occupational therapists, physiotherapists, social workers and speech therapists. The process is always tailored to the individual needs. Patients' personal competences as well as the nature of the injuries affect the ability to commit themselves to the rehabilitation and eventually the extent of recovery as noted by H2. In addition, patients' relatives play a critical role in the rehabilitation process by supporting their everyday life at home, and motivating the patients as stated in several interviews (e.g., H3, H6, and H7).

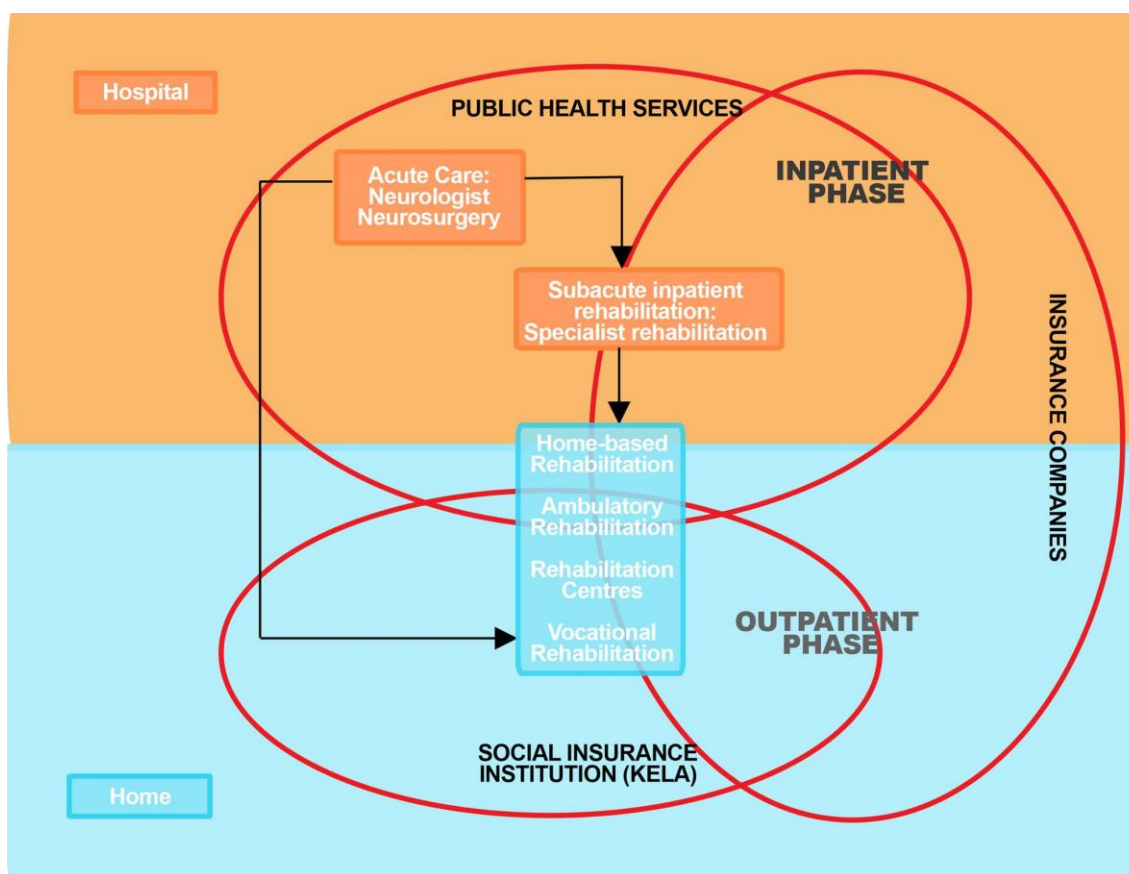


Figure 4 Simplification of the TBI rehabilitation context: inpatient and outpatient phase and how the funders influence them

No simplified diagram of the TBI rehabilitation could not be found, thus, one was made with the help of the healthcare experts interviewed (see Figure 4). The figure has its limitations, however, it assists in portraying the complex context of TBI. In a simpler manner, two major groups can be recognised in terms of traumatic brain injury rehabilitation: (1) the first group with a more severe TBI who often spend a long

time in the hospital, where the concluding part of the stay is rehabilitation-oriented and is aiming towards returning home and (2) the other, much bigger group, with a milder TBI return home from the acute care, or even from the first aid, but they are left with some disabling condition and they need rehabilitation that is conducted as outpatient rehabilitation (H3). Evidently, in reality the process is not that simple. Often patients might end up spending months at home after the acute care phase before understanding that they need to search aid, or they might have spent years at work or at school, before realising that their struggles in terms of everyday tasks are actually related to their TBI (H4, H5). There is no unified understanding of the definitions of mild, moderate or severe TBIs, and the diagnosis of a patient might change in the course of time (H3, H5).

In terms of payers of the rehabilitation, the process can be divided into the inpatient phase and outpatient phase. During the inpatient phase insurance companies and public health services are the payers. During the outpatient phase besides insurance companies and public health services, also Social Insurance Institution can be the payer in certain cases i.e. when the patient is severely disabled or e.g. participating discretionary institutional rehabilitation. (H3, HF1). Furthermore, the vocational rehabilitation is often covered by different lines of insurances such as pension, workers compensation or third part liability (HF3). Insurance companies are in general the biggest payer in the TBI rehabilitation since many of the accidents happen to those of working age or in traffic accidents. In the case of statutory insurance, i.e. traffic accident or occupational accident, insurance companies cover all the costs throughout the acute phase to the outpatient rehabilitation as well as possible disability pension. In case of optional personal insurances the payment plan depends on the terms and conditions of the insurance, e.g. maximum limits. (HF3)

Ideally, the nature of the TBI rehabilitation context should be understood in order to implement a medical game in the process successfully. If the game is implemented in a wrong stage, the patient does not get the desired benefits – or it could be potentially harmful. When it comes to risk-avoiding health sector, it is important to become conscious of the possible risks. As stated by H4, “the right game in the right place could work”. In the acute phase the brain needs rest so the game would not bring much value, and can even result in undesired results as noted by H3. The most suitable place for cognitive exercises, as which a medical game could be numbered, is in outpatient phase interwoven into other neuropsychological and multi-professional rehabilitation practices. Furthermore, cognitive functions could be exercised throughout a whole lifetime as accentuated by H5.

5 CASE STUDY RESULTS

5.1 Key actors in the medical game ecosystem, their roles and needs

5.1.1 *Medical game companies*

Service-dominant logic emphasises the finding that value is always co-created with multiple actors involved and not just within a single company (Akaka & Vargo 2013). Thus, the role of the medical game company is to locate the relevant resources in the ecosystem and interweave them together to create a service that offers value to the customers. They are coordinating the medical game development process. As stated in the interviews, the medical game companies are also the ones that have to justify the usage of their technology in healthcare i.e. they have to offer competitively compelling value propositions to the other key actors as discussed in section 5.2. That is, they have to prove solid arguments and undergo required validation to show how medical games can enhance the processes of all the other actors in the ecosystem (e.g. HG3, HG4).

The medical game company has to recognize a need in the healthcare sector and propose the medical game as a solution to that need. Furthermore, they need to develop a medical game that does not only help solving a problem but also has strong commercial potential. Developing an effective medical game requires a great number of resources right from the start. It was specified in the interviews that the medical games should be developed in such a way that they can be scalable to other markets i.e. creating a born-to-global business model (e.g. GF1, HG1). The target audience should not be limited to TBI patients in Finland but the technology or the intellectual property should be utilised in other segments or sectors as emphasised by HG1 e.g., the focus from the beginning should be to target all the brain damage patients globally including traumatic brain injuries and strokes.

5.1.2 *Customers*

Customers in the TBI rehabilitation context can be seen as e.g. patients, healthcare professionals (such as neuropsychologists, physiotherapists and speech therapists) or healthcare organisations (such as public health services, private hospitals and rehabilitation centres). Amongst the interviewees, different opinions came up in terms of whether medical games should be targeted directly at patients or the healthcare professionals conducting the rehabilitation. According to H3 the best option would be

that the game is available on the market for the patients to get for themselves, but the healthcare professionals would be aware of the different medical game options and thus, be able to recommend a suitable game for the patient. Nonetheless, the main source of information should not be the healthcare professionals, but rather peers and social media as suggested by H3. According to several interviewees, selling directly to the consumer market offers a greater commercial potential due to bigger volumes and faster reactions (e.g. G1, G5). However, the competition in the consumer markets is extremely high and the game distribution platforms are saturated as emphasised by G5.

If medical games are widely accessible in the free market, some related problems might occur. GF2 speculated whether it could be seen as harmful i.e. whether it is comparable to handing out Advil to all the patients. On the other hand, being implemented in a healthcare service keeps the control high and thus, keeps the possible risks under control as pointed out by GF2. The service of Jintronix is linked to the work of the clinicians so that there is always a clinician who guides the patient's programme (HG4). Many of the interviewees suggested that the initial step is to sell medical games to healthcare organisations and the next step is to distribute them e.g. via online stores for applications (e.g. H2, HG3). *"Physiotherapists are how we're going to live, and then end-users are how we're going to get rich"* as crystallised by HG3.

The **patient** is the centre of the rehabilitation process and everyone else in the service system should be working towards bringing better service to the patient. The patient's role, however, depends on the deficits and characters of the patient, whether he or she is an active participant. The goal is that the patient decides the guidelines of the rehabilitation together with the doctor. The needs of the patients can be roughly divided into two: (1) motivating and engaging in otherwise tedious tasks, and (2) helping them to get better and more accessible rehabilitation.

All brain rehabilitation is based on the plasticity of the brain. Once a patient gets a brain damage, a part of their brain goes offline, and there is no way to revitalize it. However, what they can do is to retrain another part of their brain to pick up the tasks that were previously managed by the part that is currently offline. The only caveat is that it requires around 10,000 hours of repetitive training, which can be tedious and demotivating as accentuated by HG4. In terms of traumatic brain injury rehabilitation, the cognitive functions are often proven to be even more challenging to train than the motoric functions (e.g. H8). When developing methods for TBI patients it should be taken into account that due to their deficits they can be vulnerable to different kind of addictions related to gaming (e.g. H7).

In addition, the treatment chain in its current state is not as efficient as it could be and e.g. misconceptions concerning the payer of the treatment can result in slowing down the treatment process as remarked by H6. Generally, the faster the rehabilitation can be started, the more the patients will benefit from it since the recovery is faster in

the beginning, even if recovery can happen at any point throughout the patients' lifetime (e.g. H6, HF1 and H7). At the moment, not all the patients who need rehabilitation can get it – or at least not as fast as it would be desirable. Taking advantage of technology and using it to free the resources of the therapist could potentially benefit those patients in line waiting to start their rehabilitation.

As stated in the interviews (e.g. HF3, H6), the problem in the current healthcare system is that it makes patients passive. Too often after a traumatic brain injury, or any other injury, the patient stays at home waiting for someone else to guide them through the process (HF3, H6 and H8). The healthcare sector has a high level of expertise but they should simultaneously motivate the patients to get interested in their own health and deciding to go back to work should be more powerfully emphasised throughout the whole process as suggested by HF3. The problem is that the current healthcare system does not provide ways to engage people in their own health and well-being. Currently, people are given complicated brochures and very little rewards. Furthermore, they do not think that they are in control of their own health. (Ben Sawyer, 26.10.2014, the Games for Health Europe conference)

In the interview, H3 stated, “the job of the **healthcare professionals** is to guide the patient's rehabilitation and give them the resources needed to rehabilitate themselves”. Furthermore, doctors are in charge of planning the rehabilitation together with the patient. Healthcare professionals, in general, have the opportunity to use their own judgement to implement treatment and rehabilitation methods they find useful. Often, when talking about the diffusion of new methods in rehabilitation, the initiative comes from eager healthcare professionals who concern themselves with the issue and are willing to develop and use those new methods as pointed out by H6. As noted by HF2, the healthcare professionals, too, have the responsibility to participate developing the healthcare processes since they are the experts and in the last resort they are the ones with an overall perception of how the processes could be enhanced in such a way that it would be beneficial for as many people as possible i.e. how to offer as effective rehabilitation as possible to all the patients in need with the existing resources.

What healthcare professionals need are better tools for treating the patients in order to respond to increasing patient flows. They need to better allocate their resources in the rehabilitation process. In addition, there has been an increasing talk about taking advantage of big data to facilitate the healthcare processes and treatment processes.

The importance of **patients' relatives** was stated in several interviews (e.g. H2, H3, H6, H7), and was emphasised in the case of young patients and seriously disabled patients where the relatives are responsible for the decision-making. Furthermore, a common deficit of a TBI is that the patients are unaware of their own disabilities i.e. *anosognosia* (e.g. H6, H7) that can affect their rehabilitation motivation, and thus, their recovery. Other common deficits such as lack of motivation, tiredness and dependency

(e.g. H7) can result in the increased relevance of the patients' relatives in terms of planning the rehabilitation. In addition, relatives can be a valuable source of information when planning the neuropsychological rehabilitation. Their information can prove to be more useful e.g. in situations where the patient is suffering from anosognosia (H7).

Depending on whether it is a private or a public **healthcare organisation**, the revenue logic differs i.e. whether they try to maximize or minimize the amount of patients visiting the healthcare organisation. In Finland, the decision making in the public health services is in general slow and bureaucratic due to the complicated structures. As remarked by HF2, global markets offer a lot of potential in terms of private clinics where decision-making happens faster.

The resources of the healthcare professionals should be more efficiently used due to the increased patient flows in developed countries where the population is aging. The general rule is that new methods implemented in the healthcare sector should be *better* than the current ones e.g. it enhances the rehabilitation process, shows the signs of faster recovery and/or lowers the expenses.

5.1.3 *Funders*

Financial support played an important role in the medical game development not only because the game development requires money but also because the clinical studies needed are often expensive. In terms of medical games, which are developed for TBI patients, the funders can be seen to consist of public funding agencies, private funders (investors, business angels etc.) and the traditional payers of the outpatient rehabilitation i.e. insurance companies, public health services and Social Insurance Institution.

Public funding agencies (e.g., the Finnish Funding Agency for Innovation, ELY Centres, Finnvera) are currently the leading funders of the medical games due to the initial state of the medical game market. Since many of the medical games are yet experiments and research projects, private funding is not an option. Recently, public funding agencies, too, have increasingly started to pay attention to the business aspect and scalability of the business plans in terms of medical game projects.

Private funders are currently observing the health technology markets with increased interest. HF2 pointed out that in Finland, there are in general a lot of potential health technology companies with good innovations, yet the Finnish investors, have not taken the risk to make a substantial investment into this market. Furthermore, HF2 emphasised that there is a lot of scepticism towards start-ups selling their technology to the public healthcare due to the risks caused by a complicated and slow decision-making procedures within the public healthcare. Nonetheless, if there were a medical

game with potentially significant markets, the most natural source of money would be private investments as stated by H3.

The insurance companies are the biggest payer of the traumatic brain injury rehabilitation. In case of traffic accidents or occupational accidents, insurance companies have *steering power* i.e. they can guide their clients to certain institutions. Rarely do they intervene in the treatment methods used as noted by HF3. Currently, the issue is that in general the treatment chain resembles a broken telephone i.e. patients often have to wait long times, which may hinder their recovery drastically. The processes are made in the terms of the health professionals; thus, the meetings are in general planned according to their calendars. Recently, instead of just paying the bills, insurance companies have made the effort to step up and more actively influence the efficiency of the treatment process. The goal would be to get rid of those ‘treatment gaps’, since all the waiting results in unnecessarily increased expenses to the insurance company as well as to the society. One of the Finnish insurance companies has established their own hospital⁷ to answer this problem; to make sure that the patients are treated ‘from the moment they walk in until the moment they leave’. (HF3)

Social Insurance Institution covers rehabilitation costs six months after the injury at the earliest. They have statutory and discretionary rehabilitation i.e. statutory in the case of seriously disabled, and discretionary if a person has a less severe TBI and he or she does not get the funding from anywhere else, and is still in need of one. Social Insurance Institution only gives lax guidelines on how the rehabilitation should be provided e.g. that in certain type of rehabilitation certain professionals have to be available. However, they do not go deeper in defining what kind of methods should be used. They have a list of qualified practitioners and they trust their expertise as mentioned by H4 and HF1.

Recently, the allowances of the discretionary rehabilitation have been cut down (HF1), which however, does not affect the quality of statutory rehabilitation. Consequently, this may result in the future in a situation where TBI patients that are not severely disabled cannot participate in rehabilitation even if they want to. The biggest shortage is in the accessibility of the neuropsychological rehabilitation. Neuropsychological rehabilitation should be carried out regularly e.g. once a week for a longer period of time as emphasised by HF1. There is, in general, lack of neuropsychologists, especially in the rural areas.

Public health services are also one of the significant payers in the TBI rehabilitation in the inpatient rehabilitation phase but also in situations where insurance companies or Social Insurance Institutions do not pay for the rehabilitation. Public health services,

⁷ Oma Sairaala, OP Pohjola

too, strive for facilitating the healthcare processes and lowering their expenses. The focus on this study is on Social Insurance Institution and insurance companies since their experts were interviewed.

5.1.4 Regulatory parties

In terms of regulatory processes, an essential question is whether a product should be considered as a medical device. Many of the healthcare software are defined as ‘border line cases’ in the directives and in many cases the definition depends on their purpose of use as noted by HG2. However, HG5 emphasised that often when it comes to medical games used in healthcare they fall into the category of medical devices by definition. There are different regulatory organs depending on the target market and their validation procedures vary accordingly. The legal requirements for medical devices can be complex and hard to comprehend. Nonetheless, it is essential to follow them accurately. Furthermore, assuming that medical games should be developed for global markets *per se*, it is essential to acquaint oneself with the relevant regulations of the potential target market. Therefore, when developing a product for healthcare purposes it is essential to consider the target market at an early stage. For a Finnish manufacturer, the European Union’s CE-mark is crucial, and in Finland this is granted by Valvira⁸. However, other regulatory organs might be important depending on the target market e.g., the US FDA (Food and Drug Administration), Health Canada, TGA (Therapeutic Goods Administration in Australia), or the CFDA (China Food and Drug Administration).

The bottom line is that all medical devices must be proven safe and effective. They must meet the requirements throughout the whole product life cycle. The strict demands concerning health technologies depend on the health claim and purpose of the technology, which define their risk class. Higher risk products must meet the requirements of (1) product safety and efficacy requirements and (2) quality management system requirements. For lower risk products, the latter one is not obligatory, though, recommended from a business point of view. In conclusion, all essential requirements should be taken into account in an early stage in the development process – afterwards it is challenging if not impossible. (Ståhlberg 2015.)

⁸ National Supervisory Authority for Welfare and Health

5.1.5 *Complementors*

In the medical game ecosystem framework, other relevant parties in the ecosystem are called *complementors*. Complementors can be e.g., academic institutions (the universities and schools of applied sciences), game and technology associations (e.g., Finnish Chapter of the International Game Developers Association, Finnish Health Technology Association), serious games networks (e.g., Games for Health Finland, Serious Gaming Cluster), developmental organisations (Kuopio Innovation), incubators and accelerators (e.g., Startup Sauna) or patient associations (e.g. Aivovammaliitto). They do not have similar kind of direct needs concerning the medical game nor are they necessarily always involved in the process. However, they have a major role in terms of building and strengthening the medical game ecosystem and affecting to the institutions.

Their role is to support the development of not just the medical game ecosystem but also the broader ecosystems of health games, health technologies, game technologies or start-up culture in general. All these ecosystems are interconnected and they support one another. In addition, they may aim at linking actors together and helping them to create relationships, supporting SMEs in growth and internationalisation, transmitting useful skills and knowledge, lobbying the decision-makers, and thus, affect to the underlying institutions and removing obstacles from the medical game developers. Furthermore, their goals are e.g., building a positive image of the field, supporting the patients and distributing relevant information to them. Complementors are one of the reasons why there is a positive hype around health technologies and health games as stated by HG2 and HG5.

5.2 **Value propositions to various actors in the ecosystem**

5.2.1 *Needs as a basis for value propositions*

Value propositions can be defined as “invitations from actors to one another to engage in service” (Chandler & Lusch, 2015). The results of the empirical data suggest that understanding the needs of the different actors in the ecosystem plays an important role as the basis of competitively compelling value propositions. When targeting the healthcare sector the services proposed should be needs oriented and able to solve problems. Thus, when developing a game for TBI rehabilitation, the needs of TBI rehabilitation have to be well understood. Furthermore, the problems in the healthcare sector are in general immense, thus, the solutions should be corresponding. As pointed out by the informants, the problem seems to be that the field of medical games is

dominated by start-ups with limited resources, and they tend to offer all kinds of bits and pieces: the type of gadgets that resolve only a fraction of an existing problem as described by HG5. These gadgets should be able to perform a mission impossible – they should be able to prove the customer that they can solve their vast problems, and that those gadgets could be successfully integrated in clients’ value processes.

HG1 and HG3 described the phenomenon through their prototype *Liitäjä*, a Kinect-based medical game for stroke patient rehabilitation. The game had five physiotherapy movements and a lot of positive feedback from the users. However, to truly be successful, one game and five movements are simply not enough: one needs hundreds of different movements and games. One needs a service that is *scalable*. Otherwise, it is difficult if not impossible to find a payer or a buyer for the product even if the patients in general have been satisfied with the product in the testing phase. (HG1, HG3) The Chairman of the Board of GoodLife Technology emphasised the problem as stated below:

“[It is almost like] it wouldn’t have been invented yet that the patients should be in beds. The patients are standing in the hospital. And you know that this is a problem, you know that the patients should be in the bed. And then you go and sell these guys in the hospital: ‘Buy pillows, and one day the patients will be able to use these’. I think it is a question of the same thing.” (HG3)

Articulated by one of the interviewees, the problem stems from the fact that most of the actors who end up in the serious games business tend to be those who failed in the entertainment games industry (HG3). However, the logic behind serious games, especially medical games, is very different compared to their entertainment counterparts. Serious games are more complex and require the knowledge about their context: they cannot be made with the same mind-set that aims at making an enormous break-through with a single game. One game cannot provide a solution to the extensive problems the healthcare sector is facing. It was pointed out in the interviews that the fastest way to prevent this from happening is that no single separate medical game project should be supported financially unless there is a bigger picture, a comprehensive solution, and not just providing a fraction of a solution (HG3). That would force the game developers to create scalable products that encourage them to answer to the real needs of healthcare sector and provide scenarios. In the healthcare sector, there is traditionally a good understanding concerning big information systems and comprehensive solutions, but when stepping into the world of games the healthcare professionals seem to be biased by this ‘looking through the straw’ mind-set and they lose the perspective needed to make these solutions work as accentuated by HG3.

5.2.2 *Value propositions to various actors in the ecosystem*

Value of a service, in this case, value of a medical game, is always ‘uniquely and phenomenologically’ determined by the service beneficiary (Vargo & Lusch 2008b). Thus, it is important to understand that the company can only “make and follow through on value propositions rather than create or add value” (Lusch et al. 2010, 22). Offering competitively compelling value propositions in medical game context is a multifaceted issue and requires understanding the bigger picture. It requires balancing between satisfying several needs of the relevant actors in the ecosystem. When developing a medical game, the company has to be able to explain its benefits to various key actors in the value network i.e. how the game will help or at least not detriment to what the healthcare professionals are doing, how it can enhance the healthcare processes and how it benefits the patient as pointed out by HG4. Further on, he emphasised that when targeting a healthcare organisation, it is not enough to just serve the patient. It is important to consider, based on the service provided, who are the most important actors to focus on at each stage.

As stated in the interview, one of the major reasons why most of the medical games fail is because there are too many people who can potentially ‘take the wind out of the sail’ of the medical game i.e. hinder the development or implementation of a medical game as explained by HG4. There might be a product that is engaging for the patients and at the same time annoys the clinician; or a product clinicians love because it helps them get all the data needed, while the patients do not get engaged. Even if the clinician and the patient both love it but there is no funding to buy it, it fails. “*It’s like Rubik’s cube*”, the CPO and Co-Founder of Jintronix (HG4) crystallises the problem, “*You have to be that perfect configuration, so in all sides, everyone is happy*”. Jintronix has managed to develop a solution to what happens to be a problem for all the relevant parties in their value network: patients, clinicians, healthcare organisations and insurance providers, thus, in that sense the market is in their favour as noted by HG4. The CEO of GoodLife Technology emphasised the same issue as stated below:

“It is from our point of view really important that we take into account the entire value chain: the client as well as the physiotherapist, and also the possible payer of the treatment, which might be an insurance company or something similar.” (HG1)

Moreover, the nature of value propositions in terms of serious games differ significantly from those of their entertainment counterparts since serious games should prove to have an adequate level of usefulness as stated by the Creative Director and Co-Founder of NordicEdu:

“It is immediately a longer story for me to tell why a person should play this game, if it’s a serious game. In entertainment games it [the value proposition] is more abstract and sort of higher, they are sold more with mental images--. When it comes to a serious game, you have to tell a little bit why someone would actually play this game – that it is possible to develop things a, x, y, z [with the help of the game].” (G4)

In addition, the intensity of value propositions varies and the value propositions are not always successful due to the abundance of value propositions in the market. Thus, even if a medical game offers a value proposition to the healthcare professionals they might choose to use another method to treat their patients due to the higher intensity of the other value proposition. Next, different value propositions that came up during the interviews as well as challenges in terms of them are discussed.

5.2.3 Value propositions to medical game companies

Value proposition to the medical game company, too, has to be competitively compelling in order to lure actors with relevant game technology skills and knowledge to create medical games. Thus, proving that the medical game industry has commercial potential can lead to a virtuous circle, thus, attracting talented entrepreneurs and resulting in success stories. GF1 accentuated that no company can be based upon anything else except profitable and growing business. As stated in the interviews, however, there has not yet been a success story that would have been solely a medical game company.

Ideally, to solve the problem of profitability, health games should be global and they should not be disease-based as emphasised by Ben Sawyer (the Games for Health Europe conference 27.10.2014). The results of the empirical study suggest that even if a medical game could improve individuals’ lives significantly, it might not be financially rational to develop that game. For example Herring⁹, a game that is still in use in a few hospitals around Finland and has been well-liked by the kids and the nurses, can have a significant impact in individuals’ lives. The Co-Founder of Herring revealed the significance with a story of an autistic little girl that had never been able to get a hearing aid because she had not been able to focus on the hearing test. However, thanks to

⁹ a game to help seriously disabled children to focus better on their hearing tests

Herring, she finally got one. Nonetheless, as explained by the Co-Founder, the game has no true commercial potential due to a niche target group:

"In a way in this case, as you probably understand, the extent of the market is ridiculously small. I have calculated that approximately one out of a million people need Herring currently." (HG6)

Furthermore, due to the strict regulations it is hard to sell it globally and the technology is not easily scalable to other sectors as explained by HG6. In this sense the 'hard-core' rehabilitation such as TBI rehabilitation is more challenging than focusing on more general healthcare problems such as shoulder pains, as pointed out by HG3. Consequently, it is important to consider the target audience to make sure that a medical game has a substantial amount of potential customers i.e. patients that are willing to spend time and money to play the game or healthcare organisations that are willing to implement the game in their rehabilitation or treatment practices. Furthermore, to offer a competitively compelling value proposition to the game companies, there have to be funding options available for a medical game company. This is naturally strongly related to the ability to reach large amounts of customers efficiently.

Additionally, the intensity of value propositions to the medical game companies are highly dependent on the underlying institutions e.g. validation practices and lack of innovation structures in the healthcare sector, which lower the intensity of the value proposition to medical game companies. Informants referred to complementors playing a crucial role in affecting to the attractiveness of the field e.g., aiming at lowering the entry barriers and affecting to regulations that might hinder business opportunities.

5.2.4 Value propositions to customers

5.2.4.1 Patients

When discussing the *value propositions* medical game can offer to the patient, it is essential to keep in mind the main goal of the TBI rehabilitation: the patient wants to get better, or even if full recovery is not possible, they want to be able to live their normal lives with their injuries in the best possible way. This main goal characterises the whole medical game market. That is, many other things are secondary if a certain rehabilitation method has the potential to significantly enhance the process of recovering, help normalising life or help getting back to work. After all, every TBI incident forms a tragedy to every TBI patient.

In terms of value propositions, this gives the medical game industry more potential compared to the wellness game market since in wellness games are in general competing against the entertainment games. People are not equally driven to prevent themselves from diseases than they are rehabilitating or treating themselves. Thus, the starting point for medical games compared to preventive wellness games is naturally very different as stated by G6 and HF2. Furthermore, the medical game does not necessarily need to be the best game if it is proven to be a better option than some other method as mentioned by HG6.

Motivation was stated in several interviews as the key value proposition medical games can offer to the patients rehabilitating themselves (H7, G1, G2, GF1, HG2, HG4, and HG6). Many patients neglect their training programme due to its tedious nature hindering the recovery as HG2 noted. The CPO and Co-Founder of Jintronix explained:

“Well, I think that the biggest value is very simple. The key is that you’re mentally engage in something while you’re doing your rehab exercises. So it’s bringing the mental state into a different level the when you’re doing something tedious.” (HG4)

Implementing a gamified aspect can enhance the rehabilitation process by encouraging performing those tasks more frequently and help the patients to rehabilitate themselves unnoticed as noted by G6 i.e. game creates an ‘in-between’ state where the patients do not really feel like they are rehabilitating themselves in the traditional sense as described by HG1 and G6. G6 further on explained: *“This is not meant as understating people but it’s the reality, if I want to help people it has to go this way.”*

According to the Chief Psychologist of Orton Ltd., the longing for enjoyment is something that is a part of human nature. Thus, he agrees that a rewarding experience can potentially make the TBI rehabilitation process more efficient and lead to better results in terms of the quality of life as well as reduced costs for the payers involved in the process. As the Chief Psychologist explained:

“Somehow in life, there is a built-in principle ‘towards enjoyment and away from resentment. If a game can bring that good feeling, even when the brain is damaged, I believe that it can assist [in the rehabilitation], especially if there are some technologies in the game that are focused on specific deficits.” (H7)

What the current effective and clinically validated computer-based methods are yet lacking is the rewarding mechanism, ‘the candy’, which engages the patients in such a

way that they keep on repeating those often-tedious tasks as accentuated by H7. Engagement can be a great asset as stated by CPO and Co-Founder of Jintronix:

“-- When you're mentally engaged in something, the physical task of doing something becomes a lot less tiresome.” (HG4)

Thus, as brought up in the interviews (e.g. HG6, GF2), the greatest commercial potential could be achieved by recognising the parts in the healthcare processes or rehabilitation that are the most tedious or cognitively the most burdensome, and develop and implement the medical game where the game could potentially enhance the treatment the most. Further on the Co-Founder of medical game Herring leaned towards gamifying the whole process of rehabilitation: *“It would be absolutely awesome if in the rehabilitation after an accident, the patient could ‘level up’. When you can walk you would reach level 3. It could be a very encouraging tool.”* As explained by the informants, motivation can be added with surprisingly small elements. Ben Sawyer, too, underscored showing people the progress they have made as one of the key element of a successful serious game (the Games for Health Europe conference 26.10.2014). The Founder and Chief Scientist of SkillPixels emphasised the importance of visible progress in the process of motivating:

“Visualising the motivation development, something that could otherwise be difficult. For example in the education side, it can be hard to see a child’s daily progress but if you earn badges and trophies in the game, it makes the progress surprisingly visible.” (G5)

In their current physiotherapy application, GoodLife Technology has introduced a progress bar they call ‘momentum’, which describes how well the patient is following the rehabilitation programme. The momentum bars are comparable between the patients despite their impairments as explained by HG1. According to several interviews, the power of extrinsic motivation should never be underestimated (e.g. H7, G5). All the elements that can possibly encourage the patients to further on work on their rehabilitation can be seen as useful (HG1).

“I wouldn’t want to admit that they [badges and trophies] work, but they just do.” (G5)

However, the challenge in terms of motivating the patient is balancing between utility and fun. This ‘dual purpose of serious games’ and challenges related to it was stated in several interviews (e.g., G4, HG4, G5, H7, and HG6):

“Most games are for entertainment only or entertainment with some education there. It’s okay. But our games are medically prescriptive games. There’s always a challenge and a tension between making this 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, very challenging.” (HG4)

“When you have two motivations, you can never be as fun as the guy who is just trying to be fun. Are you playing a game that gets you jogging at the same time or do you play GTA5? GTA5 is probably a better game.” (HG6)

Ideally ‘fun’ should never be the only value proposition of a medical game. Graphics and lifelike features can enhance the user experience but are in no way the fundamental goal of a medical game. If that is the case, the customer need is often not completely understood. The Founder and Chief Scientist of SkillPixels (G5) explained:

“Fun on itself is worthless. But in a way fun can be the reason for a kid or an adult to come back and continue playing. It should not be underestimated nor should it be the sole goal of a serious game. -- The goal of a serious game should be something else than having fun, but having fun can be a way to achieve that goal.” (G5)

In addition, fun is something subjective, and that is in general the reason why so few entertainment games are successful. It is hard to predict which games will end up being successful. In the case of many serious games it is known what the game should do i.e. what kind of skills it should teach and what kind of features should be involved, but the elements of fun are not predetermined as stated by the Creative Director and Co-Founder of NordicEdu:

“--We do know what should be taught in the seventh grade mathematics but what we don’t necessarily know is what seventh graders find funny.” (G4)

Also motivation is a delicate issue; it is different for everybody. Some people are naturally competitive and they are motivated by competition. When talking about games the competitive aspect – or the communal aspect in general – is often very important and it can have the effect to urge the patients to continue with more will as mentioned

by G6. An example is showing what level or ranking the other players are as proposed by HG6. However, according to the patient (H8) interviewed, TBI patients tend to be withdrawn and thus, a rehabilitation game should not further on encourage to that. On the contrary, if there is a medical game it should be introducing a social aspect:

“Well, because I think quite many of these people with a TBI are unsociable what I’ve seen. To get them socialise, at least with this game, at least during this game. I hope it could help them socialise because yeah, this is just a disability, it doesn’t have to ruin your life.” (H8)

“Well for example, [when playing the medical games] I always had to be alone in my room. Had to be dark, had to be quiet. So if you could somehow connect someone else in it, you could do it with somebody, and not alone in a corner of a dark room only focusing on that. Well, then it would be automatically more fun.” (H8)

As referred in the interviews, a medical game does not have to be as good as *Halo 3* – but if the process of play is good and it achieves its purpose, the game can be considered successful. When used in *prescriptive environments* such as therapies the game does not have to be the best game in the world as long as beats the traditional method and manages to bring added value to the rehabilitation (Ben Sawyer, the Games for Health Europe conference 26.10.2014; HG3). HG1 emphasised that when designing a service, it is crucial to keep in mind that the main goal is to *enhance* and *facilitate* the existing processes, not to make them more complicated. Further on, he noted that not everything should be turned into a game e.g., if it would normally take you five minutes to finish your exercises and the game takes half an hour to do the same, the service can easily turn against itself. Herring, the game helping small disabled children to focus on the hearing test, aimed at getting better results. The Co-Founder of Herring mentioned a hypothesis he had developed in which he presumes that a motivating game can lead to better results, especially in terms of the target audience being kids. He explained it by remarking that the game can help the patients to focus on the right things i.e. focus on the performance instead of focusing on being measured. (HG6)

In general it is hard to define a good (medical) game. However, according to G5, a good game is a game that makes the players return and play it over and over again, thus, in that sense it does not differ much from an entertainment game. Different things motivate different individuals and there are various ways to make games ‘sticky’ or ‘addictive’ as mentioned by G5 and G6. H1 emphasised progressiveness, narrative and challenge, whereas HG2 generalised that there is a need for similar rich and interesting content than in entertainment games. To see the results of playing a medical game (or

any serious game) one must play the game all over again, thus, if the patient does not take the game out often enough it is useless. As explained by the Founder and Personal Brainer:

“If there is one important aspect of a good game – I would say that it has to be such a game that can be present in a person’s everyday life as naturally as possible.” (G6)

According to Ben Sawyer, one of the most important value propositions is offering the patient the feel of an immediate health effect i.e. they feel like the game is truly helping them to achieve their goals and thus, are more motivated to play the games regularly (the Games for Health Europe conference 27.10.2014). G6 emphasises that training your brain is in many ways similar to traditional exercising: if there is no frequency there are no results i.e. repetition leads to habits and they make the difference. He further on noted that games affect the brain. Nonetheless, what really happens in neuron-level is by no means the point. The main point is whether or not new skills are learned e.g. new memory techniques or new behavioural patterns.

“-- This is why gamification is important, to give people such tasks that help them to learn, to function more skilfully in their everyday life.” (G6)

Furthermore, he emphasises that for learning to be beneficial it should happen in a natural environment with other surrounding stimuli, and is in favour of ‘heads up brain training’ i.e. games that utilise audio-based functions, instead of traditional ‘heads down’ training that is focused on visual stimuli. The same issue, i.e. the problem with the cognitive exercises not reflecting to real life functions, was brought up during the interview with the TBI patient (H8). He was not motivated by the cognitive games that had to be done alone in a quiet room, but rather by the real-life situations where he was socially engaged with other people. As explained by the patient:

“Well, I didn’t see a direct benefit there [playing games]. It might be that some new neuron--, synaptic connection was made in my brain. Very often I just made them because I was asked to, so that they would get some results for something. I had no other reason really, because they didn’t have any direct effect on me. Or I didn’t notice it myself.” (H8)

A game has the possibility to help the patient to recover faster due to the increased amount of time spent on rehabilitating oneself and increased frequency of training. To be able to enhance the rehabilitation process, however, the game should take into

account the individual limitations e.g. the difficulty should be adjusted since same load does not suit all the patients as noted by H3. As explained by the Project Manager of a private rehabilitation centre: *“For some patients a three piece puzzle is too demanding whereas others can succeed in a 50-piece puzzle.”* To enable the most effective rehabilitation possible, a medical game should be focused on training certain function i.e. the functions that are the most impaired. The problem with using games in rehabilitation is that they usually practice a variety of different skills simultaneously e.g., memory, vigilance and visual skills, which may result in lower effectiveness and difficulties in terms of proving the effectiveness. As explained by the Head of Medical Services (H4): *“Using a randomly chosen game is like putting the patient with an atrophied thigh muscle to walk and move around, and recommend him to move around as much as possible – the thigh muscle will grow there then.”* Further on, he speculated the great potential of focused, validated and available medical games:

“In the future, probably those games that have been studied in randomised controlled trials during long-term follow-ups, a game that has proven to be effective is found there. And if it is available in everyone’s mobile phone and we can play it during our free time when going from one place to another. And if people also get hooked on it, there is a global billion-euro market for that game that is for sure.” (H4)

The Chief Psychologist in Orton Ltd. (H7), too, emphasised the potential of games that are focused on training certain functions but additionally take advantage of the rewarding mechanisms of games:

“I am fully convinced that if there is a suitable game that has the right amount of content, which is focused on certain functions of the brain or certain cognitive functions, and if it is made tempting enough, I am astonished if it doesn’t have an effect. Because the current games already have an effect, and they’re pretty boring.” (H7)

Besides motivating and improving the frequency of rehabilitation, the other main value proposition brought up in several interviews, was supporting the patient in their home-training sessions and giving feedback about their training as well as the overall progress of the rehabilitation (e.g. H1, HG1, HF3). In the interview with H5 she emphasised that according to studies cognitive exercises are the most efficient when combined with the feedback of the therapist i.e. going through how the exercises went and what could have been done better. Thus, medical game could work as a link between the patient and the therapist encouraging to continuous communication. For

example the following step to the service of GoodLife Technology is that the patient will be playing medical games with Microsoft Kinect motion detector. Furthermore, they will be getting feedback on how the movements are made i.e. the game works as a ‘quality control’ as stated by HG1 and HF3. The problem in general is that people are quite alone with their training programmes in home environment as mentioned by HG1, HG5 and H8. Thus, the value proposition is that instead of therapy being constructed from mere episodic face-to-face meetings, it would be an on-going process, where the patient is more in control of their own scheduling, and yet the therapist can intervene and change the training programmes when needed. HG4 emphasised the multifaceted value proposition of their service provision:

“The game is one aspect of our system. A very important aspect but we got more than games. We’ve got assessments. We’ve got exercises. We have tele rehab components. We have a clinician management control. We’ve got outcome measures, how performance in measures. So all these aspects are all part of what our product is. We don’t consider ourselves like just purely games for health. It’s more of a full on healthcare technology.” (HG4)

An important thing to keep in mind when discussing value propositions is that they are not always successful. As any other treatment method, a medical game is not necessarily a suitable alternative for everybody as pointed out in several interviews (e.g. G5, HF1, H8). The age has been mentioned to be a significant actor when discussing the effectiveness of medical games in rehabilitation, but several medical games have gained positive feedback despite the age of the patients as mentioned by H1 and HG1. People have in general a variety of preferences in terms of what kind of games they like i.e. there are several ‘archetypes’ of players as described by G5 and HF1 e.g. female players who are less competitive and take a joy in developing their character as noted by H1.

The value propositions of competitors’ medical games also affect the successfulness of company’s value proposition. There are, in general, several serious games, which are poorly made, and that affects the value proposition of well-made medical games. That is why it is important to be distinguishable and build a strong brand e.g. in the learning game of SkillPixels they have reversed the traditional roles: instead of a game teaching a kid, the kid teaches the character in the game (G5).

“With this we get more motivation, and in the long run better learning results, because the kids are working for their game characters. Not for the teacher, not for their parents, and not even for themselves, but for the

character in the games, which is incredible that small kids are more willing to work harder for the game character than for themselves.” (G5)

The underlying institutions in terms of healthcare and games ecosystems are also affecting the intensity of the value propositions. One of the biggest challenges in terms of all health games and eHealth solutions is the role of the payer. This is emphasised in a welfare culture such as Finland where the healthcare services are mainly fee and 80 % of healthcare is offered by the public sector as pointed out by HG2. This has resulted in the Finnish people have the mentality that everything health-related should be for free. As stated in the interviews, the challenge is how to change this underlying institution, and move towards models where additional services could be paid by the patients (HF2, HG2). In addition, games, too, are nowadays highly accessible, good quality, and mostly free. The problem is that in general, paid apps do not seem to be making a lot of profit amongst all the free apps as stated by the CEO of Tribeflame:

”If we go to Google Play, usually there [in the top 100 games making the most money] is only Minecraft [that is a pay-to-play game]. So, you either make a free-to-play game or then you make Minecraft.” (G3)

In terms of young TBI patients, who are a potential target audience for medical games due to their natural interest towards gaming, it is important to understand that the customer is, indeed in this case, the parents of the patients i.e. the **patients’ relatives**. According to the experiences of G5, when it comes to children, the purchasing models have to be carefully considered e.g. how much you can offer in-app purchases, how much can be advertised, and what should not be done. Parents are, in general, more eager to buy a book-like commodity for their kid where the fee is paid at once:

“It doesn’t matter if it costs two euros or ten euros as long as it doesn’t annoy you every day.” (G5)

Therefore it is crucial to take into account the target audience and their nature when planning the pricing model. The dominating free-to-play pricing model in terms of games for smart devices has proved to be problematic for serious games as pointed out by G5. He notes that in-app purchases are troublesome for serious games because they can easily give a ‘greedy touch’, which is something you would like to avoid especially if the target audience is young (G5): *“Even if it is old-fashioned to sell pay-to-play premium app, it is ethically best business.”*

5.2.4.2 Health professionals

Medical games enable the healthcare professional to *allocate their resources* more efficiently. They do not necessarily have to stand next to the patient giving instructions, which can prove to be a big saving in costs as noted by GF2. In addition, providing *useful analytics* was stated in several interviews as one of the most important value propositions for health professionals (e.g. H1, H7). Instead of compiling a list in Excel or scribbling down the progress in a corner of a paper, the healthcare professionals get analytics automatically, which helps them to develop their processes further on as mentioned by HG1. H1 pointed out that analytics are not a necessity, but recommended to better serve the interests of the healthcare professionals. With the help of a medical game, objective data can be continuously collected and analysed e.g., what kind of exercises have been prescribed to whom and for which ailment, and how much time a patient has spent on the rehabilitation process in total. The data offers value to all those actors whose primary concern is the effectiveness and efficiency of the treatment methods. Furthermore, when looking at it from the e.g. physiotherapist's point of view, training with a motion detector enhances client contact because the physiotherapist can objectively see how the client has practiced at home. Thus, the *quality* of the overall process is higher. In order to offer competitively compelling value propositions, it is important to emphasise that the game is a 'tool', as something that will enhance the expertise of the professional, rather than something that threatens to replace them. Thus, the value proposition is that a game can reduce the amount of routine work and leave more time to the more relevant tasks (e.g. H1, G5).

To avoid the resistance of change, GoodLife Technology has adapted a gradual step-by-step approach in introducing their new service for the physiotherapists. The first step was changing the exercise library for physiotherapy in digital form, replacing the traditional emails and hand-outs. The application works as a means for physiotherapists and their clients to *communicate* and enables e.g. changing of training programmes based on the data collected. GoodLife Technology aimed at creating a service that does not substantially change the everyday routines of the physiotherapists; the service is integrated to the technology the physiotherapists are already working with. The new features of the first phase do not take much effort from the physiotherapists' side, which facilitates the implementation process. The Co-Founder of Herring (HG6) took the same approach to avoid the resistance of change: the nurses did not have to change their process at all when implementing the medical game. As explained by the CEO of GoodLife technology:

“If it [a health game] requires a lot of new to learn in terms of the everyday work, or if it strains the daily programme, then it is immediately found negative” (HG1)

The processes in the healthcare sector are in general well defined and there is a reason why every pinprick is made as it is as pointed out by HG6. Thus, the resistance to change is in many ways reasonable. To ask someone to change his or her routines for your service requires a high intensity value proposition.

“That's a pretty tall task to ask of somebody, to expect to somebody [to change their routines], and for you to be able to do that, to succeed at that, your offering has to be extremely good.” (HG4)

Asking the clinicians to integrate a new technology in their work is as if asking someone to change their email account from Gmail to something brand new as described by the CPO and Co-Founder of Jintronix:

“You're going to be very, very cautious about doing that because this is your job. These are your contacts and this is how you do your work. You'll be very conservative, like 'I don't know. I'm pretty good with Gmail right now. I don't think I'm ready to change', you know. So it's kind of similar to a little bit lesser extent but there's something similar that you're asking clinicians to change how they work.” (HG4)

To minimise the resistance to change, training the therapists to use the new technology is essential as pointed out by HG1 and HG6. The healthcare sector is conservative after all, and there is always resistance to change as noted by HG3. Every time GoodLife Technology brings a new service in the market, they train the physiotherapist to make them realise the value of the new service. They emphasise how the service adds value to the physiotherapists as professionals and what kind of value the service can bring to their customers and possibly to the payers of the treatment. HG4 emphasises that their biggest challenge is to get the clinicians to engage in using a technological tool and integrate it as a part of their clinical practices. As explained by the Chairman of the Board of GoodLife Technology, the medical game company has the responsibility in offering competitively compelling value propositions to customers:

“Those [negative] attitudes cannot be changed by anyone else except the ones who are going to take over the market and that's when I toss the ball to us, to our competitors, but not to the public sector. We need to be

able to convince the most critical physiotherapist why they should be using our product. It is our job. It gets all mixed up if someone else is beginning to do it for us.” (HG3)

Thus, it is important for the medical game companies to understand how to convince traditionally sceptical and risk-avoiding target audience of healthcare professionals to be able to offer them competitively compelling value propositions.

5.2.4.3 Healthcare organisations

The value proposition to the healthcare organisations depends on whether the customer is a public or private healthcare organisation i.e. whether they are aiming at minimising or maximising their patient flows. For the public health services, a medical game can help them in the process of moving the responsibility of the treatment and rehabilitation away from the healthcare organisations and more towards people’s home and thus, help them to cut expenses as stated in the interview with H3. In terms of private health organisations, medical games can broaden their service selection and help them to use their resources more efficiently. In other words, regardless of whether it is a private or a public healthcare organisation, implementing a medical game is in many ways a matter of *cost savings* as stated in several interviews (e.g. H1, HG2, and HG6).

“I believe that in all disruptive business if you want to enter the market as a newcomer, you have to be able to offer a better product cheaper.” (HG6)

Therefore, even if the idea of the medical game is good and it could have significant benefits on the individual level, the value proposition is not necessarily successful due to its low intensity e.g. if the patient flows are not strong enough it is not cost-effective to implement a medical game as noted by H7. HG4 explained the issue:

“You have a great [medical game], your patients love it, clinicians love it but neither don’t have any funding to buy it. Now, the hospital administrators say: ‘You know, it’s a cute idea, very quaint and lovely. But we have a bunch of other things we have to deal with and the problems that your game is going to solve are just not the top priority for us right now. And as much as we love what you’re doing, we can’t devote any resources to it so I’m sorry.’ Then you’re out of luck.” (HG4)

For example in the case of the medical game Herring, there was a dual cost savings in terms of the treatments failing less frequently, and less nurses were required to perform the treatments as accentuated by HG6. The price of the medical game can be justified with cost savings and without them it is hard to sell anything as HG6 pointed out. He further on mentioned that the healthcare sector does not necessarily require cost saving if the treatment will be enhanced drastically:

“The healthcare sector might be just the exception – no one wants the second best treatment.” (HG6)

According to the Co-Founder and Chief Scientist in SkillPixels, talking about cost saving is what may be more likely to open more doors. However, he liked to see the most important value proposition more as ‘allocating resources to one another’. In education context this means that with the help of technological solutions the group sizes can be bigger but simultaneously the teacher will have more time to individual guidance of those who are struggling with their learning (G5). Putting this to a healthcare context would be trying to fix the problems in the healthcare processes and offer better rehabilitation to more people, not necessarily reduced total costs. The same phenomenon in the health context was brought up in the interview with the Project Manager of private rehabilitation centre Neuron (H1) where technology-based methods were used to enable group rehabilitation instead of traditional individual rehabilitation, and thus assists in using resources more efficiently. Furthermore, the technology-based rehabilitation was proven to be at least equally effective as the traditional individual rehabilitation as explained by H1. In addition, medical games enable extended healthcare services such as tele-rehabilitation (HG4), which might answer some of the current problems encountered e.g. the lack of neuropsychologists in rural areas highlighted by HF1. HF2 speculated during the interview a shift towards ‘automated healthcare’. She pointed out that the big data gained from medical games could be utilised to sift the ones who are in need of face-to-face meetings with the healthcare professionals, further on reducing the costs and accelerating the efficacy of the healthcare processes.

“What will the world look like after 10–15 years? The healthcare system will look a lot different. And doctors are going to be the next endangered profession.” (HF2)

Thus, medical games can be an essential part of the reform of the healthcare sector due to their features that are likely to become even more valued in the future of healthcare

e.g. collecting objective healthcare data and enhancing patient participation and self-efficacy.

5.2.5 *Value propositions to funders*

5.2.5.1 *Traditional funders in TBI*

The traditional funding actors in the TBI service system e.g. Social Insurance Institution and insurance companies can be traditionally seen to have a dual role in the medical game ecosystem: they can (1) be involved in the medical game development phase if they have interests in terms of the medical problem that the game is trying to tackle, or (2) they can compensate the price of the game for the patients, and thus, increasing the amount of games sold and giving some flexibility in terms of pricing.

The value proposition for the TBI funders is reducing their costs by helping patients to recover faster. If a game gets patients to better follow the rehabilitation instructions, and thus, recover faster or if the rehabilitation process is getting more efficient due to the increased data, it means less costs for all the traditional TBI funders (HG1, HF2, HF3). Insurance companies have expressed interest in using this data for their own purposes e.g., recognising the bottlenecks in the rehabilitation process. However, the regulations concerning healthcare data are strict, and the data of the patient cannot be handed over to a third party. To be able to provide data for the insurance companies, a totally different interface has to be designed: something that shows the problematics without revealing the original raw data, as explained by HG1.

Nonetheless, the *intensity* of the value proposition has to be high enough for the traditional TBI funders to accept it and be willing to participate in the value creating resource integration activities with the medical game company. Thus, whether it is an insurance company, public health services or Social Insurance Institution, the game has to be strongly linked to the problems these actors are facing in their own value processes. Thus, the medical game has to offer a significant amount of potential cost savings as noted by HF3. Additionally, several other actors are continuously offering value propositions and it is often neither possible nor feasible for an actor, in this case the TBI funders, to accept them all (Chandler & Lusch 2015).

Social Insurance Institution allocates some of its funds regularly towards development work. However, it is aimed at public sector actors and rehabilitation providers, and is not granted for commercial purpose or for individuals (HF1). In terms of medical games, this causes problems since medical games developed alone within rehabilitation provider institutions or educational institutions have not yet proven to be

successful due to the lack of resources required. The commercial aspect offers a suitable platform for successful iterative development work as well as better guarantees the continuity of the development. In addition, when looking at the bigger picture, rehabilitation is a relatively small item of expenditure for Social Insurance Institution compared to the subtotal, and TBI rehabilitation represents only a fraction of it as noted by HF1. Thus, this also affects the intensity of the value proposition to Social Insurance Institution.

The Finnish insurance companies, on the other hand, do not generally do principal product development. Nonetheless, they do have an increasing interest towards supporting the development of new technologies in rehabilitation for obvious reasons i.e. to improve the patients' recovery processes and thus, decrease their own expenses. In this sense, medical games could be seen as a means for insurance companies to facilitate the rehabilitation of their clients. In general, insurance companies strive for more efficient rehabilitation forms by (1) *directly* e.g. by participating Tekes funded projects, and (2) *indirectly* by directing their clients to their subcontractors who use these new efficient technologies, thus, increasing the revenues of those organisations.

However, as pointed out by HF3, insurance companies are currently focusing on the basics; it makes financially sense to concentrate on the areas of rehabilitation that affect the claims ratio the most (e.g., musculoskeletal diseases, shoulder injuries and back injuries). Even as the biggest funder in the TBI rehabilitation, the potential savings that could be gained from making the TBI rehabilitation process more efficient remain marginal compared to other relevant fields. The amount of TBI patients remains limited in a country with a small population like Finland. Thus, in the case of some other medical condition than traumatic brain injury, the intensity of the value proposition of a medical game could be substantially higher. It was stated in several interviews that insurance companies are interested in and are already participating in developing new technologies for healthcare, including medical games (HG4, HG5, HF3).

Furthermore, as pointed out by H5 and HF3, insurance companies could potentially compensate the usage of a medical game for a patient at least in the initial phase of the rehabilitation, similarly to what they are already doing with some computer-based rehabilitation methods (e.g. Foramen rehab). Afterwards, the payment would possibly be the patients' own responsibility. According to HF3, there has already been talk about insurance company renting out rehabilitation related equipment during, e.g., tablets or smartphones, which would increase the potential of medical games.

In the future, the interest amongst the traditional healthcare funders might increase if medical games can more efficiently answer their needs and offer more competitively compelling value propositions. It was speculated in the interviews (e.g. HG5, G2) that in the future medical games could be utilised to observe whether the patients have been

following their rehabilitation programmes i.e. done the exercises prescribed by the therapist, and this could affect the compensations gained from an insurance company.

5.2.5.2 Public funding agencies

HG1 points out that in looking for financing, the scalability is important regardless of whether the funders are private investors or public funding agencies such Tekes. The medical game service should have the potential to enter the global markets *per se* and be utilised in some other segment or sector as accentuated by HG1. For example Tekes aims at helping companies to turn a developable idea into profitable business. They strive for advancing the global competitive advantage of the companies, helping to increase production and exports. Thus, the value proposition to public funding agencies is simple: a medical game should be potentially making a great sum of money and help creating jobs, and therefore, benefit the national economy. In general, the public funding agencies are supplementing the financing method of a company together with banks and private investments. In addition, public funding agencies, too, are looking for projects that are potentially profitable.

GF1 emphasised that instead of funding the development of medical games with taxpayers' money or public subventions, they should get the profit primarily from their customers. Further on he speculated that there could be medical games developed for some health issues that could be beneficial to be developed with the public funding due to their significance as public health issues. However, the main focus should always be that the money is flowing from the global markets as pointed out by GF1. The problem with offering a competitively compelling value proposition is that the process of game development is in general risky, and even for skilled teams it often requires a few tries before they can create the kind of game the target audience wants (G3, HG1). G3 pondered whether it is reasonable from the public funding's point of view to invest a few millions from their budget to support medical game development.

5.2.5.3 Private funders

In the eyes of a funder, whether it is a public or private one, a good game is in general something that sells, something that is bought and downloaded a lot. It requires the users of the game to make the decision to spend their time and their money to use a certain service or a health game in their spare time, and when they make this decision it usually means that money is flowing to the developers of the service, the company and its owners as emphasised by GF1. The most important value proposition to the private

fundamentals is to be able to prove that in the future the cash flows will be significant. Thus, the medical game company has to solve the problem of reaching the customers when there is no established distribution channel for medical games. Investors will not invest in business that is just profitable; they want significant return on investments, and if there is no way that it is going to realistically happen, the medical game company will not get any investment money as pointed out by GF1.

“A cash flow statement is maybe the most important document for the investor. Thinking about the cash flow and solving it is very important. It has to be credible.” (HF2)

According to GF2, the investors rarely jump on-board when it comes to medical game projects due their risk profile, which rarely suits their strategy.

HG5 remarks that the most potential solution in the commercialisation phase is to gain the funding through private investments. Lack of success stories in the field has resulted in precaution amongst the investors. G6 speculated that if someone made a proper break-through it would benefit the whole field of serious games. HG1 noted that the current atmosphere in terms of private sector financing remains ‘expectant’:

“No one will press money on you. Not at this [initial] phase. Let’s say, when you have results to show, maybe it is another situation.” (HG1)

Nonetheless, the medical game sector has the potential to become an interesting venue of investments for the private investors. HG2 emphasises the potential of medical game investments since health technologies are already seen as an increasingly interesting venue for the investors. Furthermore, as pointed out by HG3, there is no denial that the entertainment game industry is an extremely interesting setting for investors. However, the entertainment game industry resembles a lottery, since it is based on designing separate games only a fraction of which ends up being good and successful (HG3, G3). HG3 emphasised that the life cycle of an effective medical game would be considerably longer than the ones of their entertainment counterparts and thus, they could provide long-term profits. In terms of getting investments, the most important thing is to do your homework and assess the possible risks as explained by the CPO and Co-Founder of Jintronix:

“Put it this way. If you know your market as well as you should and using your rational mind, you still feel that it's a good idea then there's no reason why you shouldn't get investment. So if you do a really proper job asking yourself the tough questions and going out and getting the

answers, from enough people to build the case, there's no reason why you shouldn't get invested". (HG4)

The challenge is that medical game companies need to figure out innovative ways to get beyond the game development, validation and marketing phases in a way that is still promising revenues to the private funders. According to the CEO of the entertainment game company Tribeflame (G3), in the entertainment game sector there is “a rule of three” that the game has to be able to fulfil before it is even considered smart to make it: the game has to enable (1) short repetitive sessions, it has to have (2) a long-term retention, and (3) there has to be the possibility to splurge. A successful game has to offer all these aspects: there has to be a reason why a player would be playing the game 5–10 times a day at least for a period of six months, and, if wanted, a true enthusiastic has the possibility to spend an infinite amount of money on the game. It is difficult to see medical games making money amongst their entertainment counterparts in Google Play or App Store; the volumes are smaller so the average amount of money gained per customer has to be high. Due to the lack of scalability it is not profitable for them to work with the same logic than entertainment games, most of which can be downloaded for free and will pay themselves back with micropayments as explained by G3:

“A good game makes few euros [per download], and bad games can still make some cents, so it requires a huge mass of players to cover the costs of a game studio. Which also means, if we make a serious game, and the customers are the end users who might be thousands of people in Finland, or the hospitals, which are three or four or five, so per customer they have to pay insane amounts. Especially from stuff that feels like Candy Crush Saga. If Candy Crush Saga is for free and end customer maybe pays 50 cents or a euro if they like it. -- Commercially it is going to be very challenging to make them work.” (G3)

There are roughly two types of successful games in the online application stores: (1) games that have huge amount of downloads and players spend little money per person to in-app purchases (Candy Crush Saga) and (2) games that have smaller volumes but the average amount of money spent per player is relatively high (Game of War). G3 speculates that is it hard to find a hard-core fan that would end up spending 500–1000 dollars on e.g. a memory trainer game, thus, it breaks ‘the rule of three’ and makes it difficult to lure the investors on-board as stated below:

“And because there is a risk that you don't even get it [the invested money] back and there is no upside that it [the game] would earn the

invested money back tenfold, it is so and so whether anyone wants to make that [game].” (G3)

To truly get the investors interested in the medical game industry, ‘the philosopher’s stone’ has to be found in terms of finding a functioning financing method and thus, be able to create a good game, as pointed out by GF1. He further on remarked that those people that are succeeding in traditional entertainment industry do not necessarily have the answers or the commitment needed to be involved in the medical game industry:

“It is hard and cold business, they [the ones succeeding in the entertainment business] are focusing on their own thing. If they don’t see some clear potential, business that will make profit in short-term, -- it is useless to ask their resources or commitment for a product development project that will take several years – something that is typical in the healthcare sector.” (GF1)

Nonetheless, to be able to attract investors, the medical game companies have to be able to solve those problems. They have to be able to answer the investors’ tough questions and prove the true commercial potential of the sector. Additionally, it is likely to differ substantially from the successful solutions of the entertainment game sector.

5.2.6 Value propositions to regulatory parties and complementors

The value proposition for *regulatory parties* differs from the ones for the other actors due to the unique type of relationship between the regulatory parties and the medical game companies. Thus, the value proposition offered is the same from all companies producing medical games that belong to the category of medical devices. Thus, a compelling value proposition to regulatory parties is providing safe and effective medical devices that are thoroughly documented throughout their whole product life cycle and are doing the things they are said to be done. (HG5)

Respectively, the value proposition the regulatory parties offer to the medical game companies is the credibility in that specific market where the regulatory party is operating e.g. if Valvira grants the CE mark to a Finnish medical game company, they are able to operate within EU countries or if a medical game is cleared by FDA, they are able to operate in the United States.

The value propositions to *complementors* are various since the types of complementors vary significantly in the medical game ecosystem. In general, the value propositions to complementors are mainly focused on supporting the market and the

ecosystem. Thus, successful medical game companies can for one's part help increasing the amount of foreign investments in the Finnish market and create a general hype in terms of health games and health technologies and therefore, support the work of health game and health technology related associations.

5.3 Relationships enabling access to relevant operant resources

5.3.1 Collaborative competence as sustainable competitive advantage

All actors are fundamentally doing the same things i.e. “co-creating value through resource integration and service provision” (Vargo & Lusch 2010). This empirical case revealed that the medical game market is still dominated by start-ups; thus, many challenges are strongly linked to their lack of resources. Lack of resources, in particular, *operant resources* (e.g., skills, knowledge, knowhow, expertise, experience, information) results in a situation where developing a complex network of relationships is crucial for a medical game company. The most valuable relationships are those that centre on competences (e.g. skills and knowledge) and relationships (Vargo & Lusch 2004) as well as information (Lusch et al. 2007). Therefore, the success of the medical game company can often be explained by the type of relationships they are able to build and maintain (e.g. Håkansson & Snehota 1995). In other words, *collaborative competence* is pivotal to any company striving for sustainable competitive advantage (Lusch et al. 2010). It enables a company to better use its partners and their resources to improve its own viability (Lusch et al. 2007). Not being able to develop certain crucial relationships or secure certain resources can be detrimental as suggested by several informants. The empirical data showed that the crucial resources the relationships provided were especially operant resources. Successful medical game actors are thus, creating, developing, fostering, and integrating those vital resources in cooperation with their partners.

Collaborative competence helps companies to acquire the knowledge that is needed to achieve competitive advantage. Despite being one of the most important assets of the company, however, maintaining relationships naturally requires plenty of time and effort as the following statement shows:

“It takes a huge part of my work week. In a way I run --, of course it is not strictly speaking the right thing to say, but I run a company of 30 people, which is not true in a way. But when referring to this whole

network of partners, then it is sort of true. And it requires a lot of time from a CEO or an entrepreneur to manage and communicate.” (G6)

When it comes to securing relevant skills and knowledge, some of the interviewees were of the opinion that the company should strive for securing as many relevant skills and knowledge *within* the team whereas others thought the most beneficial strategy is to focus on their *core know-how* and take as much use of the resources in their relationships as possible. SkillPixels, a company who develops educational games, emphasised securing relevant skills and knowledge within the team as stated below:

“Actually, we have the kind of a team that has all the relevant [skills and knowledge] in our possession, we have the developers and the visual side, business [know-how] and the scientific teams.” (G5)

On the contrary, GoodLife Technology’s strategy is based on their unique partnership with PhysioTools, the global market leader in exercise software. GoodLife Technology provides the technological solutions whereas PhysioTools provides the contents (i.e. physiotherapy movements) and the distribution channel allowing both parties to focus on their core know-how.

“Well, I think we have a good combination. We have an extremely good understanding of the game world and cloud services in our company. We don’t understand anything about physiotherapy. Our partner is the world’s leading content provider in physiotherapy who understands nothing of the game world.” (HG3)

Thus, functional relationships can be seen as one of the most valuable competitive advantage of the company as stated by the Chairman of the Board of GoodLife Technology:

“We don’t have any one unique factor but as a whole we cannot be copied.” (HG3)

For example Neuron, a private rehabilitation centre, has actively been participating in different projects in terms of developing new technologies to reform their rehabilitation processes, and their Project Manager (H1) emphasised the importance of resource integration practices in value creation: on your own it is hard to get results. Especially when it comes to the complex field of health technology and medical games there is a general need for various types of specialised skills and knowledge. Co-creation can

bring great value to all actors involved as accentuated by H1. G1 speculated that the next successful medical games are likely to be developed in consortiums such as Turku Game Lab, where researchers, universities and students are brought together and thus, an immense amount of resources (e.g., skills and knowledge) are involved.

GF1 discussed the various resources needed in terms of potentially successful medical games, emphasising the need to secure the essential *operant resources* (e.g., skills and knowledge). He underscored understanding the consumers and the consumer market in terms of games industry in general but also in terms of understanding the patients and their needs in terms of their medical condition. It requires strong expertise, business intelligence and the right kind of intuition in terms of recognising beneficial partnerships and services those relationships can potentially offer. In the medical game context, it is crucial to understand the consumer business as well as the heavy and complex business context of the healthcare industry all at once.

“When these kind of people start coming [that have those operant resources] and are being found, then the first problem is already solved, because in terms of entrepreneurship and start-ups, the most central thing is that you have a good team, that you have a kind of dream team in terms of what you are doing.” (GF1)

Core skills and knowledge that came up during the interviews are discussed in the following subchapters. They are divided into central resources due to the fact that there are different ways to secure the same relevant resources. In other words, the same resources can be found in different relationships depending on the specific context of the medical game developed.

5.3.2 Software development know-how and knowledge on user experience

Understanding gamification and game design are obvious resources needed in a medical game company as noted by GF1. However, the developing attitude is different in comparison with the traditional way of developing entertainment games. According to GF1, the situation in terms of game know-how is promising in Finland due to the recent success stories in the entertainment game sector. This has led to an increase in foreign investments as well as resulted in Finland being *a hot spot* in Europe in terms of game development, which has created a virtuous circle: the industry attracts a lot of talent and thus, there are plenty of relevant game developing skills and knowledge available on the market. Of course there is the other side of the coin, the Finnish market is relatively small, and thus, there are only so many promising talents and innovators who can be

available in the population. The structures supporting innovation and entrepreneurships are crucial in this sense as emphasised by GF1.

In terms of game know-how, networking with other game companies, was brought up in the interviews as a supreme asset in terms of the Finnish game industry (G3, G4). In the Finnish game industry, there is a strong sense of communality, which tides over all the companies in the industry. This can be seen in the number of active game hubs and associations such as Igda or Neogames. More recently, their serious game counterparts have been starting to emerge e.g. Games for Health Finland and Serious Gaming Cluster. According to G4, it is important to go out from the office and talk to other people in the gaming industry that might be struggling with similar issues. Thus, a game company should use their *absorptive competence* to draw upon the external environment to gain know-how and understand the emerging trends in the industry. Furthermore, G4 emphasises that the game industry is typically changing rapidly, thus, networking with the other actors in the game ecosystem helps keeping up with relevant know-how. In a complex and turbulent environment such as the game industry, a company's *adaptive competence* is crucial and further, a company's collaborative competence i.e. its ability to use its partner companies as 'mechanisms for adapting to change' (Lusch et al. 2007).

There is not one right way of securing the resources required. HF2, for instance, emphasised on securing a coder, preferably as one of the owners. This is essential in the initial state of the business due to the fast-paced nature of the product development phase. Having a coder within the team makes it easier to adapt in the agile development style, whereas subcontractors are likely to make the process less agile as noted by HF2. Ben Sawyer, on the contrary, advocates outsourcing the actual coding of the game for an actor specialised in it, thus, a game company (the Games for Health Europe conference 26.10.2014).

G4 pointed out that user experience is getting more relevant now that consumers are used to playing games with top-level playability. HG3 remarked that one of the major issues with the current medical games or gamified technology in healthcare is the huge gap between the expensive technology used and the poorly coded and simple gamifications. G5 pointed out that tablets have enabled opportunities for serious games in terms of providing easy-to-use interfaces but at the same time it can be seen as a challenge: customers are so used to casual games that if it takes more than usual to understand the logic of the game, they change the game. This all happens in a matter of seconds. The game or application has to convince the user with its usability: it has to be clear and understandable. "Angry Birds is only one click away" as noted by the CEO of Kaasa Health (the Games for Health Europe Conference). The CPO and Co-Founder of Jintronix explained why user experience is one of the most important resources in terms of making a medical game:

“We actually hired someone full time to solely be involved 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 healthcare oriented product come alive.” (HG4)

The software development know-how and knowledge on user experience will result in a better game experience. Furthermore, that will make the patients get more engaged and return playing the game. No one is likely to play a bad game whether it is a serious game or an entertainment game, even less when it is a serious game as emphasised by HG2. Thus, the game experience and playability are crucial in order to make a successful medical game.

5.3.3 Health expertise and knowledge on regulatory requirements

As pointed out in the interviews, the medical claims, exercise effects and potential security risks involved require other type of people and expertise compared to the entertainment games or the wellness games (e.g., G2, HF2, H4, H5). There has to be relevant experts from the field depending of the health claim and the use of the game e.g. physiotherapists, psychologists, doctors etc. GF2 emphasises that the effectiveness studies should be peer reviewed; it is not credible enough to have the study signed by one professor.

HG4 emphasises that the researchers alone rarely have the resources to be constantly iterating and developing the actual product since it is endlessly requiring further improvements. However, they have their place in the product development process in terms of understanding the theoretical understanding of what works and why:

“So, I think that the best collaborations between academic institution -- that the best ways that I think that researchers could be involved is by partnering up with commercial companies, being the side of informing how the products should be created, being that scientific foundation, and then doing the evidence at the end. And that's where we found our most successful collaboration.” (HG4)

Collaboration with researchers was brought up in several other interviews (e.g. G1 and G2) as a potentially beneficial relationship in the medical game development process. G2 points out that research institutions and educational organisations can work as an intermediate between the game industry and healthcare actors. Furthermore, G1 suggested that the most fruitful resource integration practices happen when several parties are involved as stated below:

”In cooperation with companies and in cooperation with hospitals. I think this kind of a tripartite is quite good, especially in terms of the kind of medical game you have in rehabilitating traumatic brain injury patients and such.” (G1)

As discussed in several interviews, proving the effectiveness and safety of the product is essential yet time consuming and requires a lot of resources in terms of the clinical effectiveness studies and also in terms of understanding the regulatory requirements of each market (e.g. HG2, HG4 and HG5). GF2 pointed out that the complexity and requirements of global regulations can result in a downfall of a whole medical game project, and thus, should be taken into account in the early stage of the medical game development. Jintronix used the help of a regulatory consultant to pull through the documentation required for Health Canada and FDA.

In Finland, developmental organisations such as Kuopio Innovation and the Finnish Funding Association for Innovation as well as Finnish Health Technology Association are striving for helping health technology start-ups with the regulatory procedures by giving them e.g. useful information as noted by HG5. Furthermore, being accepted by the relevant regulatory parties, gives the medical game the authority needed to e.g. convince the healthcare organisation of the safety and effectiveness of the game.

5.3.4 Knowledge on customers and their needs

In order to survive and prosper, a medical game company has to be able to understand continuously changing customer needs and market requirements. Furthermore, as the value network of a medical game extends to global markets and becomes more complex, agility, adaptability and constant learning are even more crucial in order to survive and grow (Lusch et al. 2010). In the process of making a successful medical game – a medical game that sells and is being played – it is essential to see the process through the patients’ eyes. G5 emphasised during the interview that it does not matter if the game is the best possible medical game, i.e. a game that affects the brain in just the optimal way, if only one out of ten patients will continue on playing the game. In other

words, the point is not to make a perfect game, but rather make an effective game that also engages the patients to such degree they will continue playing the game (G5).

“A perfect game for a thousand [customers] or a good game for ten million [customers]? That’s the difference.” (G5)

This is why involving patients in the development process from the beginning is crucial. Thus, proactively engaging customers in co-creation activities will provide competitive advantage to the company. When developing Herring, HG6 was taking into account the feedback of their target audience i.e. small kids:

“Even if their feedback wasn’t the most analytic, it clearly guided the conclusions we made.” (HG6)

HG6 emphasises involving all the customers who are going to use the medical game. The current trend is that customers are increasingly motivated to get involved in co-production. In Herring’s case, this included the nurses conducting the hearing test to the little children. Therefore, from the beginning of the product development they were tightly cooperating with the healthcare professionals and benefit of their expertise. In addition, the need came initially from medical physicists, nurses and doctors; thus, the whole process was based on value co-creation together with the customer as explained by HG6. Furthermore, a medical game company can serve a customer only by adapting and learning to continuously offer competitive value propositions as explained by HG4:

“-- there's no magic formula but I would just say that it took years at iteration, rapid iteration, constantly watching people used it [the medical game], taking notes, understanding what clinician needs are and understanding what their constraints are in terms of time, clinical expertise, trying to understand how they approach a patient rehab, what hierarchy of concepts do they use so we can mirror it in our products.” (HG4)

The end users have to be taken into account on every step of the development process to make sure that the service is responding to their needs accordingly. In addition, G2 emphasises that the healthcare professionals have the crucial understanding of the rehabilitation and treatment processes that also affect the rewarding mechanism of the game substantially. Thus, in order to make a promising game for TBI rehabilitation, the game developers have to understand the TBI patients in order to create a game that motivates them. The Founder and Chief Scientist of SkillPixels emphasised the deep

knowledge on psychology as one of their key resources and thus, their competitive advantage:

“In our team, we have, not just me, but three people with the same competence [psychology]. Thus, it makes [the knowledge] much deeper when we see the things with a little bit different perspective.” (G5)

In this empirical data, the healthcare professionals were seen as one of the most important gatekeepers due to their influence in implementing the medical games as well as in recommending the game for their patients. Thus, the CPO and Co-Founder of Jintronix recognised the healthcare professionals as their most important relationships:

“Because I believe that the clinicians have the tremendous amount of influence both in terms of influencing how patient should -- they've got accessed to the patients. And they actually are the ones in to my perspective that have really pushed the system upwards to administrators. So, the most important partners for us had been working with clinicians to help develop a product, understand the patient needs, understand the field in general.” (HG4)

Informants referred to relationships with a private hospital or an insurance company as being beneficial since they can offer a pilot platform for testing the medical game such as Jintronix is already doing (e.g., GF2, HG4). In the TBI context, a beneficial cooperation could be together with a brain injury rehabilitation centre as pointed out by HF2. Piloting is essential for a start-up in terms of getting the relevant feedback as early as possible and understanding the nature of the customer need. HF2 underscored the importance of good customer partnerships where the healthcare organisation is equally committed to the medical game development process. G2, too, emphasised involving the healthcare organisations; it may be even crucial, especially in those cases where the existing technologies in the healthcare organisations are playing a relevant part in the medical game service.

5.3.5 Healthcare business know-how

GF1 accentuated that for a start-up, in general, it is essential to have the understanding of the revenue logics and user acquisition to be able to take things forward soundly. However, he also pointed out that it might not be enough to consult actors doing successful business in the entertainment sector because they might not have the right

solutions. Therefore, GF2, too, was emphasising the relevance of healthcare business know-how since medical game business differs radically from the traditional game business. Thus, it is essential to have the understanding on business models and commercialisation in medicine and the healthcare sector. The entertainment game business and the healthcare business are two very different worlds and they are in no way comparable. (GF2)

“Doctors seem to be professionals who are in general distrustful towards everything new. And I guess it’s for a good reason when you see what e.g. pharmaceutical industry is bringing to the market all the time. There is... I would say that if you want to make these [medical games] a big business it requires that there is business knowledge in terms of healthcare business in the background. That’s the only way to enter the market.” (GF2)

According to HF2, business angels are able to bring a great amount of ‘sweat equity’ to the company and helps in getting the things in order i.e. business angels can give advice and support so that the company could avoid the common pitfalls. In addition, having a business angel on boards broadens the network significantly enabling access to even broader amount of valuable resources. HF2 emphasises that finding a business angel who has experience in the field of health technology, would be extremely valuable. Further on she pointed out that it does not matter whether a company has an investor or a business angel, it is important that they have the required experience in the field, and along that the understanding of health technology, so that they are able to benefit the development of the game (HF2).

The public funding programmes such as the ones of the Finnish Funding Agency for Innovation (*TeKes*) has a significant role in terms of financing health game start-ups as well as partnering them up with research institutions. It is crucial to help them to finish their first product as noted by HG5. Relationships with developmental organisations, serious games networks or technology associations were seen in different light by the interviewees. For some, they can be of great value offering useful contacts that might develop into beneficial relationships, or offering sparring in terms of business ideas or provide useful information. Nevertheless, they were also criticised in terms of not having enough business insight or having enough impact i.e. after entering an incubator programme ‘the same firm comes out’ and not much has changed. Bigger scale efforts are more useful such as the business network Neogames for game companies.

5.3.6 *Marketing skills*

The problems concerning marketing and reaching the customer have proven to be major challenges in terms of successful serious games as mentioned by several informants. In the medical games industry, the distribution channel represents an important part of the marketing practices and the lack of an established distribution channel has proven to be a major concern for medical games. Thus, solving the problem of reaching the customer is essential to accomplish success. There are a few potential options that were brought up in the interviews: (1) excessive sales work, (2) partnerships with an established actor in the field, or (3) using the existing entertainment game distribution channels e.g., Google Play Store or App Store.

Even if a medical game is developed within the TBI service system where there is an existing know-how of the (medical) functions needed and the understanding of the target audience as well as the availability to pilot test the service, the process of making a successful medical game is still challenging. First of all, there is no existing game know-how, and those games tend to lack the gaming experience and an apt reward mechanism. Secondly, even if there is an effective service that is validated, it is not going to spread if there is no know-how to market it in an adequate way. Thus, marketing know-how is needed so that effective methods would not be left in a desk drawer, but the people – the patients – would know about those methods as emphasised by H5. The marketing and distribution of medical games are challenging since there is no established distribution for clinically validated medical games. G2 and HG2 are speculating whether in the future doctors could prescribe medical games from App Store or some other specific distribution channel for health games.

Relationships are traditionally seen as a means to access the resources needed. However, in some case, the relationships can be seen as resources as demonstrated in the case of GoodLife Technology. The CEO of GoodLife Technology explained how their partnership with PhysioTools works as their distributing channel as well as their marketing channel. PhysioTools has a large existing clientele of physiotherapists using their products worldwide. Through PhysioTools, GoodLife Technology can reach up to 250,000 physiotherapists in 80 countries. Through the partnership, they can take advantage of an exercise library of approximately 25,000 movements, which is the most extensive selection in the market. GoodLife Technology's strategy is to expand to the other areas of healthcare with the same logic:

“The idea is to partner up with the most respected and the most well-known actors in the field and cooperate with them.” (HG1)

Thus, their partner provides the expertise and contents; GoodLife Technology is not a content provider neither do they want to be. Without their relationship with PhysioTools, their organisation structure should be loaded with marketing and sales efforts, but however, as it is now, the relationship with PhysioTools serves as a means to market the service (HG1). For GoodLife Technology, the physiotherapists are the ones in direct contact with the end-users and the ones with the power to recommend (or not to recommend) their service to the patients. CEO of GoodLife Technology emphasised the importance of knowing one's value network as stated below:

“It does not differ a lot if you think about the game industry -- It might be that the distributor or publisher has the game, but in the last resort, the person selling it to the customer might be a shop assistant in the sock department of Prisma¹⁰. First you have to sell it to that person, so they can sell and advertise it [further on]. It's the same situation there. When you create a product for the end-user, you have to know who is the gatekeeper through whom the product passes on to the consumer.”
(HG1)

Similarly, in the case of clinically validated medical games, an insurance company could be a possible partnership; they could potentially work as a marketing channel and recommend medical games to their partners as stated by HF3. A partnership with an established, respected and trusted actor within the healthcare industry (such as an insurance company or PhysioTools) could act as a positive signal to the potential customers creating credibility and trust. In addition, insurance companies have recommendation power in terms the implementation and spreading of new technologies.

HG6 pointed out that a major setback for Herring was the inability to build the relationships needed to be truly profitable. In terms of marketing, building a strong partnership with the manufacturer of the hearing test device would have been extremely beneficial since those two technologies were integrated, and thus, the medical game was highly dependent on the other. Even manufacturing the game in-house would have been a potential alternative. However, the product development department of the manufacturer was too busy so they could not get the cooperation work. One of the biggest values of partnerships of this kind is to be able to benefit from the existing global sales organisation of the established companies as accentuated by HG6.

¹⁰ A Finnish supermarket chain

“From a single firm’s point of view it the smartest way is to try to benefit from them [the established companies]. Build partnerships. Create ‘road through partnership’ kind of deals where a firm is making quite considerable revenue sharing in order to grow their own markets.”
(HG6)

The right partnerships enable small companies to gain global success without them necessarily needing to be physically present in all the countries they are operating in as stated by HG1 and HG6. Thus, relationships can make use of resources more effective and efficient.

5.4 Institutions coordinating the medical game ecosystem

Doing business in the healthcare sector requires recognising, understanding and taking into account the underlying *institutions* (‘rules of the game’) of the healthcare sector. The ecosystems approach accentuates that complexity of the context fundamentally results from the increased embeddedness of social networks, the multiplicity of institutions within a service ecosystem and the diversity of resource-integrating practices that reproduces both (Akaka et al. 2013). GF2 emphasised that companies with an entertainment game background have to learn a whole new set of logics in terms of developing a game that meets the demands of the healthcare sector. Furthermore they have to understand the institutions affecting the sales processes in the healthcare sector that has been made complicated by large pharmaceutical companies. There are several norms connected to the sales process such as pitch talks. According to Akaka et al. (2013) when similar institutions (i.e. social norms) guide the actors’ collaboration, the interaction is more likely to be successful. Thus, if game companies are guided by different institutions i.e. the ones of the entertainment game industry, it might prove to be difficult for them to collaborate with the actors in the healthcare context that are guided by their respective institutions.

Furthermore, there are immense amount of institutions affecting the emergence of the medical game ecosystem, either enhancing its emergence or hindering it. Some of them are linked to the institutions in the game industry, while others are strongly related to the healthcare context. In addition, some are culture-specific and depend on their target market. In this chapter, *institutions related to the healthcare sector* are covered, and more specifically, the institutions that were discussed most frequently in the interviews i.e. *validation* requirements in the healthcare sector, the *lack of innovation structures* in the healthcare sector and the rising *consumerisation* affecting the healthcare sector.

5.4.1 Validation in the healthcare sector

When it comes to serious matters such as a person's health and well-being, there are strict existing regulations as GF1 emphasised. According to GF1, there are two different approaches to health games: (1) either they are addictive games based on good playability and secondary health benefits, or (2) the games are based on scientific foundation i.e. traditional game mechanics are used to create a game that treats or rehabilitates patients. GF1 emphasises that in the latter case the games are likely to belong to the healthcare regulations and thus, require a different kind of approach. The healthcare professionals are traditionally risk-avoiding. GF2 accentuated that scientific evidence concerning the effectiveness of the medical games is in general required to implement new methods in the healthcare organisations since in healthcare they already have their traditional methods, thus, the new method should be proven to be more effective and add value to the process. Furthermore, H1 highlighted that evidence is needed to prove how the game supports the therapy, serves the patient in their everyday life and helps them to rehabilitate themselves. H7 noted that in medicine, there is a general norm that a new pharmaceutical product has to have enough benefits and few enough unfavourable effects, and suggest a similar approach to be taken to medical games.

GF2 mentioned that the obligatory validation process should be kept in mind from the beginning of the game development e.g., keeping the game simple avoids having to deal with a trillion different variables in the clinical validation phase. Furthermore he accentuated that simplicity should be emphasised when it comes to complicated issues such as brain injuries where a medical game may be reciprocal effects that might be hard to anticipate prior to the clinical studies. Nonetheless, the process of proving the effectiveness is always *crucial* to ensure that the best possible methods are being used in the rehabilitation. H5 underscored that caution is exercised to guarantee that the time of the health professionals and the patients, and the money of the funders are not being wasted. In addition, effectiveness studies were stated to be a prerequisite for funding in terms of investors and traditional TBI funders (e.g. HF1, HG4 and HF3).

5.4.1.1 Proving effectiveness and assessing risks

Proving effectiveness and assessing risks were discussed in several interviews from various viewpoints and opinions were expressed regarding the challenges the strict validation process creates for a game company as well as its necessity in terms of offering high-quality health services to the patients. HG2 summed up the problem by explaining that game developers in general see the health sector, especially the medical

games industry, as a challenging field due to its regulated nature. In terms of medical games the minimum requirement is to conduct effectiveness studies showing that implementing a new technology cuts costs, *improves* the patients' results or *facilitates* the healthcare processes as explained by HG1. According to Ben Sawyer, in general, the effectiveness studies conducted in terms of medical games are not reliable since they are often conducted with just a small number of patients and without a control group. Effectiveness should be tested in randomised controlled trials with at least 100 test subjects. (Ben Sawyer, the Games for Health Europe conference 27.10.2014)

The problem with conducting effectiveness studies in general, is that the process is time-consuming and requires a great amount of resources. According to H4 and H5, the process of planning, executing and repeating a study of randomised controlled trials can easily take up to 10 years. The problem is emphasised in terms of TBIs where the variety of the symptoms makes it more challenging i.e. there is no standard injury, thus, there is no 'standard TBI patient' as noted by H3. Furthermore, TBI related issues, such as vigilance, are not as straight-forwards as measuring blood pressure; they are complex phenomena, they vary depending on the day and are thus hard to measure even when it comes to healthy people as emphasised by H3. Furthermore, H2 underscored that it is hard to prove how long the skills learned during a game will have an effect and whether those skills are applicable outside the game in 'real life'. H2 further on pointed out that in a situation where there is a rare medical condition or a medical condition that is demanding to study, it is possible that rehabilitation and treatment methods can be implemented according to case studies performed since it is hard to prove them with RCTs.

In Finland, one of the existing institutions guiding the use of treatment and rehabilitation methods is using the *Current Care Guidelines*. The current care guidelines are "independent, evidence-based clinical practice guidelines" that cover important issues related to health, medical treatment as well as prevention of diseases in Finland (Current Care Guidelines). The guidelines are recommendations for treatment decisions, and can be used by healthcare professionals as well as citizens. They consist of recommendations from A to D based on how strong the recommendations are, thus, they may "include well-founded comments on significant health care issues for which no scientific evidence is available" (H4; Current Care Guidelines). However, as pointed out by H5, the guidelines for the treatment of TBIs are still rather unclear even if recently steps have been taken forward. The Current Care Guidelines for TBIs were first established quite recently, in 2002, and an updated version came out in 2008. However, the guidelines do not oblige anybody; they are merely recommendations, and to put them into practice, a lot remains to be done. In the healthcare sector, the Current Care Guidelines work as an *authority* – if something is mentioned in the Current Care Guidelines and the evidence is strong enough (e.g. class A recommendations in Current

Care Guidelines), health professionals, Social Insurance Institution as well as insurance companies find it credible as stated in several interviews with the health experts (e.g., H4, H5, H6, H7, HF1, HF3).

According to H5, there is an existing foundation for medical games in the Current Care Guidelines since the computer-based rehabilitation is already mentioned as one of the cognitive methods recommended. However, H7 contemplates that the process of getting actual medical games mentioned in the Current Care Guidelines is still likely to take some time. Thus, H1 noted that it is a challenge for the rehabilitation providers to find the games that would really support their patients in terms of their deficits. She further on proposed that what is needed is a high quality classification of medical games in which games are easy to find based on the deficits and needs of the patient.

In this sector, measuring potential risks can be difficult, yet it is essential. The healthcare professionals are often used to dealing with addictions, thus, they are extra cautious about the possible risks as pointed out in several interviews (e.g., H2, H3, H4 and H5). Thus, even if a study shows that most of the test subjects are benefitting from a certain method, if it is harmful for some, in a way, the statistical result is zero as pointed out by H3.

5.4.1.2 Medical device

Some of the medical games do fall in the category of medical devices resulting in certain obligatory procedures that are worth doing well. As pointed out by HG1, the procedure of registering the medical game as a medical device is its own chapter: the procedure requires a great amount of time and money as well as results in prolonged development process. HG2 underscored that the purpose of use and the health claim of the medical game are two major factors affecting to what kind of procedure it has to go through. HG1 accentuated that it is worth checking carefully whether the product is required to have a medical device status in the target market. The regulations concerning medical devices in the European Union countries are based on an EU directive defining ‘a medical device’. Basically it means a device that diagnoses or treats the patient HG5 summed up; e.g. if there is a rehabilitation device that claims to speed up the rehabilitation process, it leans easily towards a medical device, and thus, it has to meet the quality criteria required. Small health game start-ups with limited resources might see it as a burden, but the health technology professionals (HG2, HG5) emphasised in the interviews that the procedures are there for the benefit of all parties:

”Often it is a blessing because then you have to do things well. Then you have to make sure the solution is really working and high quality, and it

has to be documented well. And when it is executed well and documented well it enables the further development.” (HG5)

Traditional game companies are not used to considering factors such as whether or not their game could be harmful for their target audience. Thus, as brought up in several interviews, it is a challenge to strike a happy medium between the two extremes: the agile game industry and the risk-avoiding healthcare industry (e.g. GF1, HG2 and HG5). Engineers and developers, often find it hard to embrace themselves in the safety-seeking mind-set of the healthcare industry as remarked by HG2 and HG5. Being used to agile and constantly iterative development processes they may find it hard to do things the way the healthcare sector requires: meticulously and systematically.

“--and there, in-between [those two extremes] new starting points, new starts can be found.” (HG2)

In addition, HG5 notes that nowadays, also health technologies are being developed utilising agile processes, but regardless, all the documentation required is still taken care of.

One major challenge in terms of medical game internationalisation is that the legislative issues and medical certificates (*institutions*) vary globally i.e. there are no global standards, not even Europe-wide. Thus, if a company is aiming to perform globally, they must go through series of different validation processes depending on their target markets (e.g., EU, USA, China). HG1 remarked that this requires a good deal of information about the target market, e.g. in Germany the protection of privacy and patient information system regulations are extremely strict; all information systems need to be in offline mode. Being part of the EU, Finland, amongst other EU countries, is guided by the European Union legislation, and once the product has a CE mark it is suitable for all EU countries. However, in every country, a separate marketing permit is needed, which is a fairly easy procedure after the obligatory CE mark has been earned as HG5 pointed out.

5.4.2 Lack of innovation supporting structures within healthcare

The structures supporting innovation in the public healthcare sector has a significant impact on the development and implementation of healthcare innovation. The public healthcare sector is a significant healthcare actor in the Finnish market and would potentially be an important client for medical game companies. As its best, the healthcare service structures can support the innovation development an example of

which is a growth strategy for health technologies created together with e.g., various ministries, the Academy of Finland and the Finnish Funding Agency for Innovation aiming at creating a Finnish innovation ecosystem for health technologies as noted by HG5. On the contrary, the lack of adequate structures within the healthcare sectors consequently affects the medical game ecosystem negatively.

One of the issues strongly related to the healthcare structures in Finland is the social welfare and healthcare reform that has been figured prominently in the Finnish media lately. The aim of the social welfare and healthcare reform is to ‘create a novel service structure for Finland's public social welfare and health services’ as well as to ‘strengthen basic social welfare and healthcare services and create smooth service and care chains’. Consequently, the healthcare services would be provided more efficiently and cost-effectively. (*Social welfare and health care reform*) The current healthcare system is scattered and the decision-making is a complicated and slow process resulting in e.g. scepticism from the investors’ side (HF2, HG5). HG5 accentuated that a solid foundation i.e. a functioning healthcare service structure would offer a solid foundation for development of healthcare innovations.

HG5 brought up the benefits of a centralised decision-making within the public healthcare. Coordinated decision-making would result in fewer solutions being sold, but at the same time, the ones that are being sold could lead to a higher amount of sales. Bigger procurements would enable more considerable sales for those offering the best solutions to solve the problems of the healthcare sector. In addition, more centralized decision-making would hopefully lead to the healthcare sector being able to offer ‘pilot platforms’ for innovations so that the innovation processes would start to establish within the healthcare service system.

HG6 and HF2 both emphasise that selling to hospitals is extremely demanding for a start-up. The sales processes are established practices formed by the traditional healthcare actors such as large pharmaceutical companies. Thus, getting a sales contact can already turn out to be a challenge for a start-up. In addition, HF2 noted that even if a medical game company could get to discuss with the higher-level administrators they do not necessarily know about the problems at grass roots level and thus, do not automatically accept the value propositions of the medical game companies. HF2 suggests that the true potential for medical game start-ups will be found in the private clinics abroad since those clinics can implement in their processes any technologies they find useful. Thus, they have structures supporting innovation and new technologies and they are striving for offering more effective and efficient services.

HG5 emphasises that the healthcare sector should endeavour taking more initiative and actively look for innovative ways to improve their processes. Furthermore, HF3 sees that the prospects to success are highly dependent on the abilities to create new forms of treatments and rehabilitation. However, as stated in the interviews, the

healthcare sector does not currently have the internal structures needed to support innovation (e.g., HG5, HG6). At the moment they do not have people that are able to carry out innovation development – the employees are merely focused on treating patients as remarked by HG5. Thus, the Managing Director, of the Finnish Health Technology Association (HG5) emphasised the significance of supporting structures for innovation and the right type of management to empower that as stated below:

“-- If we can manage to fix the service structure of the public healthcare services and fix the management systems and funding systems, then you could imagine that we have finally the capacity needed to innovate new ways. Currently, the capacity goes somewhere else.” (HG5)

Creating a continuous innovation processes within the healthcare organisations would be desirable. Additionally, another problem stated in several interview was the existing attitudes towards medical games and new technologies in general hindering the development of innovation processes (e.g. H1, HG4 and HG5). Implementing medical games would be easier if there is an existing culture encouraging people to be open-minded towards new ways and have desire for innovations.

“--hopefully an ecosystem, in which needs oriented innovations are going to be built more systematically, also keeping commercialisation in mind.” (HG5)

Also mentioned in several interviews, there is a variety of different information systems and technical solutions, which can be a challenge if developing something that needs to be integrated in the existing systems (HF2, HG5, and HG6). The ‘strong legacy’ within the healthcare sector does not only refer to the old information systems being used but also the old practices as stated below:

“-- When one has used the same routines and same methods since the 80’s, everything that might change it is confronted with a little bit of resistance to change.” (HG1)

Altogether, there are a number of fundamental problems regarding the healthcare infrastructures that should be solved before developing new systems on top of it. The legacy of old information systems varies depending on the different areas of healthcare. Thus, HG5 emphasised that in those areas where they do not have such a strong legacy of the existing information systems, there is more potential for implementing new health technologies e.g. elderly care.

Further on, HG5 accentuated that in the future the healthcare sector will need the internal know-how concerning innovative solutions in the organisation. They need to follow the progress as well as be part of making the progress. Otherwise, they will not have enough know-how to evaluate the utility and the readiness of innovations and thus, they cannot answer to the challenges caused by the increasing patient flows. As emphasised by HG5, these are big questions and require technological management skills and innovation management skills. Further on, HG2 was pondering whether the general opinion could be changed in such a way that in the future doctors could write ‘game prescription’ instead of medical prescriptions.

5.4.3 Consumerisation of the healthcare sector through games

Today’s ‘born-digital’ generation – the first generation to grow up with internet – crave gameplay in a way that the older generations do not (McGonigal 2011, 127), thus, offering an interesting setting to benefit from gamified solutions in healthcare. This ‘born digital’ generation takes game-like features such as high-intensity engagement and active participation for granted as stated by a game researcher Marc Prensky: ‘engage me or enrage me’. Whole new generations of digital natives together with proliferation of smart devices and games, has resulted in people becoming more aware of the user experiences in all aspects of life. Furthermore, as noted by GF2, people in all age groups are increasingly using their spare time to play games. Slowly people are starting to demand these same qualities (e.g., engagement and usability) in other services too, eventually resulting in changes in the healthcare services as pointed out by G1. In the same way, patients’ expectations are changing and they are starting to demand the updated versions of the traditional rehabilitation methods such as A4 hand-outs and pen and paper tactics as stated by HG3. The Chairman of the Board of GoodLife Technology (HG3) described how the healthcare sector is currently at a critical stage:

“I would say that at this moment, if you think about it, pretty much everybody under 60 years old are active users of smart devices and the traditional methods of physiotherapy date back to the 80s, and in reality, they are proud of it, that they date from the 80s, which is in itself funny. But well, yeah so it, the consumerisation of the rehabilitation, it has partly arrived already. I do believe that it actually comes quite fast if our solutions are what consumers want.” (HG3)

Further on he emphasised that the success of a medical game is in the last resort in the hands of the consumers and whether or not they accept the value proposition of the medical game. He, too, suggested that *consumerisation* is going to be the next trend in healthcare and mentioned offering high-intensity value propositions for the patients as one of their most critical challenges:

“Have we found just the right concept for the end customer wants to take in use? It is sure that this so-called consumerisation will come to the health business, there’s no doubt about that. But is our solution the kind of that answers to that need? We are in the right sandpit, but have we found the right toys?” (HG3)

Consumerisation is partly a result of the available technologies and the easy access to online information i.e. with the rise of Internet and all healthcare information being available to patients, they are better informed and enabled to participate in the healthcare decision making process. As HG1 pointed out, the gatekeeper has changed from physicians and payers being the dominant actors towards patients being more involved in decision-making. The concept of consumerisation refers to patients being seen more as consumers wanting to affect their own treatment process and how their treatment is conducted. Similarly, this was seen when interviewing the patient (H8). He described his own role and his therapist’s role in their therapeutic relationship:

“I am the payer. I am the consumer. She [therapist] can ask me [to do the cognitive exercises], and sometimes I say yes.” (H8)

According to Ben Sawyer, medical games should aim at creating a sense of self-efficacy for the patients; thus, they can feel like they are in charge of their own treatment (the Games for Health Europe conference 26.10.2014).

Additionally, HG6 and H3 emphasised that the healthcare sector is continuously moving away from hospital-centric model towards people’s homes i.e. towards people treating and rehabilitating themselves at home and taking more responsibility for themselves. Consumerisation enables great potential to those medical game companies that know how to take advantage of it. Furthermore, consumerisation is encouraged by the healthcare sector due to the potential cost saving when the responsibility is moved more to the patients themselves as noted by H3. He further on remarked that it does not just benefit the healthcare organisations, but also the patients by enabling an improvement in the frequency and the effectiveness of their treatment or rehabilitation. HG1 noted that not yet much have been done in terms of better serving the customer in healthcare. Thus, the patients should actively urge towards variety of choices

concerning their treatments and well-being. However, the stagnation of the healthcare sector can be seen in a way as an opportunity as stated by the CEO of GoodLife Technology:

“But on the other hand, it brings a lot of opportunities when nothing has happened in a long time, and in a way there’s a huge gap between the expectations of the consumers and the current offerings so that the consumers are really excited. And then if we get the consumers to demand for better tools and better services the healthcare sector has to react to it.” (HG1)

The results of the empirical study indicate that if consumers push for better tools and services, eventually, the healthcare sector has to react. Despite the fact that it is public, it is still business like anything else as emphasised in the interviews. Furthermore, the development of technologies continues to enhance the potential of medical games in the healthcare context. Technologies such as bio-techniques, wearables and Oculus Rift as well as better and more accurate cameras in smart devices and computers enable the development of medical games that can even better serve the consumers. Being able to play a medical game on existing devices lowers the threshold of playing it and makes it more available for larger audience. After all, one of the main purposes of medical games is making healthcare more available and affordable for those in need as stated by H1.

5.5 Emergence of a medical game company’s ecosystem

5.5.1 Need for resources and relationships over time

As emphasised in the interviews, the fundamental structure of a company’s value network is constantly adapting and morphing to achieve the best possible set of resources. Thus, over time, the relationships and resources that are the most valuable for a (medical) game company in a given time vary (e.g. HG4, G5 and HF2). HG4 described how their medical game business idea was in the initial stage a pet project’; they started with the project while they were still studying and working on other projects on the side. G4 described a similar kind of starting point for their serious game company NordicEdu. GoodLife Technology was initially a part of an entertainment game company Nitro Games and only working on serious games projects on the side. In the initial phase, in general, the business is not yet paying anything back as pointed out by HG4. Furthermore, due to the validation procedures required, the beginning of the

medical game development is often characterised by testing. Thus, when designing the test bed, researchers as well as relevant healthcare professionals are the critical *relationships* since they are the ones having the right skills and knowledge to comprehend what has to be done in terms of clinical studies and how the effectiveness can be proven (e.g. G5, HG4). In addition, they have the scientific knowledge as well as the health expertise required. As explained by G5, the researchers can comprehend the whole history of the ‘genre’ and the field in terms of which the medical game is developed, and therefore they can better visualise the future. All the information gained is critical in terms of further success. In the initial phase it is crucial for the company to be able to understand the context where they will be working and understand the needs of the target audience as well as the necessary regulations concerning the medical game.

At some point, the crucial decision of whether or not to fully invest in the idea has to be made i.e. whether the medical game developers believe in the business idea and its true commercial potential. HG4 described that the moment when they started to graduate was their ‘do or die’ moment. For GoodLife Technology, a similar kind of moment could be recognised in 2013 when they spun off from Nitro Games and founded Serious Games Finland (HG3). Usually in the early stage before investments are available the money comes from the co-founders themselves or their circle of acquaintances as mentioned by HG4 and HF2. As pointed out by HG4 and HG1, it is hard to get investors on-board without proper clinical validation or evidence that the medical game is effective. G5 emphasised that immediately when starting to create the actual product it is important to secure a Lead Designer, someone who creates the graphic design and takes care of the user experience e.g. is thinking how the game should feel and how the users will experience it. If all this is added later on, it easily gives the air of the design ‘being glued on top of the game’ and thus, affects the game experience. Securing business know-how, especially in terms of the healthcare business, should happen as early as possible to guarantee that profitable business can be made. Furthermore, G5 pointed out that researchers might actually struggle with creating the real commercial games because even if the test bed has been perfect the game itself might need to be reduced with 30-40 % to refine the type of product the customers would want to buy.

After proving the effectiveness of the game and showing results the company should be able to get an investor on-board (e.g. HG4, HF2). Besides money, the investor or the business angel can also bring the company a lot of valuable *know-how* and *experience* that they did not previously have spurring the processes within the company as accentuated by HF2. Altogether, the crucial *relationships* are continuously changing according to the phase of the medical game company’s ecosystem as stated by the CPO and Co-Founder of Jintronix:

“I think that the network had definitely matured significantly. It started with really being partners with researchers and clinicians and it has moved to over the last year, two years. It's moved to more focus on executive at large hospital networks. So, naturally, it's been the shift.”
(HG4)

Thus, as emphasised by HG4, only by doing thoroughly good job throughout the whole process, the ecosystem is able to emerge, develop and mature, since all the key actors are expecting that every stage of the development process has been conducted well. Furthermore, as explained by the CPO and Co-Founder of Jintronix, it is important to build up the knowledge about the target audience to be able to use the right marketing message and channel in the latter phase to reach the customer and truly speak to them:

“You want to make sure by the time you do that large scale marketing push, that you have all the assets in place, you know exactly what the message should be, you know who you're talking to and why.” (HG4)

Ideally, the medical game company needs to have the ability to keep up with the emergence of the ecosystem. Thus, they have to continuously evaluate which relationships and resources are most valuable for them in the given time. Maintaining a value network requires time and effort and thus, it is important to focus on the most beneficial relationships.

5.5.2 Major challenges in the emerging medical game ecosystem

The major challenges in the emergence of the medical game ecosystem discussed in the interviews are summarised in Table 3. It was created by combining and reformulating the 59 challenges mentioned in 24 interviews (see Appendix B). In Table 3, the challenges are divided into four categories based on the theoretical framework created in section 2.4: (1) resources, relationships and value propositions, (2) validation, (3) lack of innovation structures and (4) consumerisation. In the first category, the challenges discussed are linked to the ability to offer competitively compelling *value propositions* to the *key actors* in the value network as well as the company's (in)ability to utilise their *relationships* to secure the (*operant*) *resources* required. Furthermore, the three other categories of challenges are linked to the *institutions* affecting the healthcare business. However, all these challenges are intertwined and have an effect on one another e.g. the challenges connected to the institutions in healthcare are simultaneously often connected to value propositions, resources or relationships as indicated in Table 3.

Table 3 Challenges regarding the critical elements of the emergence of the medical game ecosystem identified in the interviews

Challenges in the medical game ecosystem	Critical elements
<i>Resources, relationships and value propositions</i>	
Finding the customer (e.g. distribution and marketing)	resources, relationships, value propositions
Offering high-intensity value propositions to all key actors	resources, relationships, value propositions
Finding a mutual ground between the safety-seeking healthcare industry and the agile game industry	relationships, value propositions
Securing the (operant) resources needed	resources, relationships
Finding the funding for the game development	resources, relationships, value propositions
<i>Validation</i>	
Variety of requirements of medical states and individual differences	value propositions
Proving and measuring the effectiveness and assessing risks (especially in terms of complex medical conditions)	institutions, value propositions
Time consuming clinical studies requiring numerous resources	resources, relationships
Finding an effective and suitable game for each patient	institutions, value propositions
<i>Lack of innovation structures</i>	
Developing a game that facilitates and enhances the healthcare processes	value propositions
Building innovation structures within healthcare organisations and making healthcare professionals open towards new technologies	institutions
"Strong legacy" i.e. old methods and information technologies hindering the development and implementation of new technologies	institutions
<i>Consumerisation</i>	
High expectations on usability and gameplay due to the proliferation of games and technology	institutions, value propositions
Data security issues and the ethics of using health data	value propositions
Game offering an adequate balance of fun and utility	value propositions
Game answering the preferences of different customer segments (e.g. age, archetypes)	value propositions
Consumer finding the right medical games (lack of established medical game distribution channel, saturation of game distribution platforms)	institutions
Answering to the patients' growing need to take more responsibility in their own health	institutions, value propositions

The challenges identified in the interviews are altogether causing challenges in terms of the attractiveness of the medical game market by e.g. hindering the commercialising of the medical games and making it hard to design a profitable business model. Complicated validation procedures, lack of innovation supporting structures in healthcare as well as high expectations on user experience caused by consumerisation are all affecting the potential of the medical game. Thus, they have all resulted in a situation where entry barriers to the medical game market are high and developing a game for medical purposes is a long, time-consuming and expensive procedure. In order to make a successful medical game, a game company has to recognise a commercially potential need, provide a service (a medical game) with high-intensity *value propositions* to various key actors, have all the *relevant (operand and operant) resources* at the ready, and be able to reach the masses. This all has to be done in such a way that the medical game has the appropriate credibility in the eyes of the healthcare professionals as well as the production process is fast-paced enough to be profitable and enable private investments. This often requires skills to build a functioning network of *relationships*.

Challenges related to the *validation* process are the main reason why so many resources are required from the beginning of the process. A medical game without adequate validation procedures (e.g. effectiveness studies or medical device clearance) is unlikely to be credible enough to be widely implemented in healthcare. However, the heavy validation process hinders the agile development processes and results in the lack of private funding. On the contrary, the lack of an adequate validation process results in problems in finding customers. The challenges related to validation are multifaceted: firstly, a game used in medical purposes has to take into account the medical condition of the patients (e.g. H1) and thus, e.g. using existing (entertainment) games can prove to be challenging since they are often too difficult for those with disabilities. Therefore, the games should be adjusted according to the limitations of individuals so that the patients are able to stay in the *zone of proximal development (ZDP)*¹¹; thereby the medical game is encouraging and advancing their individual learning. Furthermore, the validation process concerning complex medical conditions may be

Challenges related to *lack of innovation structures in healthcare* are strongly linked to the fragmentariness of the medical game solutions as well as the underlying institutions. Firstly, medical game companies should strive for creating comprehensive solutions that answer the healthcare problems to truly facilitate the healthcare processes.

¹¹ ZPD = "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers" (Vygotsky 1978, 86).

Secondly, the public health services do not currently support innovative work and it is challenging for start-ups to even begin negotiations with the healthcare organisations. Furthermore, the 'strong legacy' of information systems and methods used in certain healthcare areas hinders the implementation of new technologies. However, there are signs that the healthcare sector is striving for renewing its services to better respond to modern day expectations. In reality, this is likely to take some time. However, meanwhile, there are ways to bypass the lack of innovation structures i.e. many private clinics or rehabilitation centres can more flexibly try and implement new technologies such as medical games in their practices.

As a result of *consumerisation*, in many sectors, technology is already being utilised to provide enhanced services as well as better engage consumers. It offers certain challenges: variety of (entertainment) games is in general broad and the playability in them is high-quality resulting in high expectations for medical games amongst those patients who are already gamers. On the other hand, many medical games are targeted to those who are not traditionally playing (video) games such as the elderly people. Thus, medical games have to be able to be appealing to all the different segments: old, young, those with a lot of gaming experience, those with no gaming experience at all as well as different preferences in terms of the types of games people like. They have to be able to offer an adequate balance of fun and utility. However, games used in prescriptive environment such as therapy do not necessarily need to be as good as the patients' favourite game in order to be good medical games; it is enough if they bring additional value to the patients and assist them to enhance their rehabilitation.

Furthermore, in terms of a medical game collecting health data, it is extremely important to be able to deal with the challenges related to data security as well as ethical use of data. The usage of healthcare data, too, is strictly regulated and if planning to use it for e.g. strengthening medical game company's value proposition to insurance companies, the company has to be very aware of the limitations concerning the healthcare data. Finally, if targeting the patients directly (not via a healthcare organisation), which offers a huge commercial potential, a medical game company should figure out a functional distribution channel for medical games. The current application stores are very saturated and for a medical game with generally lower volumes than the traditional entertainment games it is exceptionally challenging to gain proper visibility needed to be profitable.

6 DISCUSSION AND CONCLUSIONS

This study contributes to service science literature, and more accurately, to *service ecosystems approach*, as well as to *medical game research*. Service-dominant logic is mainly a fruit of conceptual thinking, thus, there is a general need for empirical research on ecosystems. In addition, medical games have gained scarce attention in academic literature. The prior studies have been scattered and mainly focused on presenting the results of clinical studies (e.g. Lieberman 2001) or presenting how games are used for patient treatment (e.g. Adams 2010) with no articles focusing on the network aspect of the medical game ecosystem. This implies that there is an existing need to examine the current medical game ecosystem analytically. Furthermore, intertwining ecosystems approach to medical game research assisted with systematically examining the phenomenon as well as making the current challenges of the emerging ecosystem explicit. Thus, a reframing of the mind-set about the emergence of a medical game ecosystem from a service ecosystems point of view provides a broader yet realistic scope for analysing the challenges encountered. Furthermore, this study manages to capture the multifaceted nature of the medical game ecosystem. The purpose of this study was *to explore the critical elements underpinning the emergence of the medical game ecosystem*. The research objective were divided into three sub-objectives:

1. What kind of *key actors* are involved in the medical game ecosystem and what are their needs?
2. What types of *resources* are required to make successful medical games and what types of *relationships* are needed to secure those resources?
3. How the existing *institutions* ('rules of the game') are affecting the emergence of the medical game ecosystem?

In order to attain the research purpose, an empirical case study was conducted. This study suggests that medical games cannot be made in isolation and emphasises the dynamic and constantly changing nature of the medical game ecosystem. The *key actors* in the ecosystem were identified and divided into five categories: (1) medical game companies, (2) customers (e.g., patients, patients' relatives, healthcare professionals, healthcare organisations), (3) funders (e.g., private funders, public funding agencies, insurance companies, Social Insurance Institution, public health services), (4) regulatory parties (i.e. different regulatory bodies depending on the target market e.g., Valvira in Finland), and (5) complementors (e.g., academic institutions, game and technology associations, serious games networks, incubators, patient associations). Key actors' needs were strongly linked to increasing the patient motivation, resulting in faster

recovery and thus, facilitating the healthcare processes. These will all result in drastically reducing the expenses of the parties involved.

Collaboration with the key actors in the medical game ecosystem enables the medical game company to gain access to different dynamic and flexible (i.e. operant) *resources* required in the process of creating a successful medical game. To recognise the essential resources and beneficial *relationships* in order to secure those resources, is crucial for medical game companies that are traditionally start-ups with limited resources. When developing a game for healthcare, medical game companies are encouraged to secure at least seven types of operant resources: (1) software development know-how, (2) user experience knowledge, (3) health expertise, (4) knowledge on the regulatory requirements, (5) knowledge on customers and their needs, (6) healthcare business know-how and (7) marketing skills. Furthermore, proficiency in managing the company's value networks can be used to reduce its relative resource costs and enhance its relative value propositions and thus, leading to increased efficiency and effectiveness.

Ecosystems approach further on emphasises how social context i.e. *institutions* influence and are influenced by value co-creation processes within and between ecosystems (Vargo & Akaka 2012). The multiplicity of institutions influences the complexity of the medical game context. In this study, three significant healthcare institutions governing the medical game ecosystem were identified from the empirical data: (1) validation process, (2) lack of innovation structures in healthcare, and (3) consumerisation of the healthcare sector. A validation process is generally required when it comes to serious matters that involve a risk for people's health. Validation is a socially created norm or regulation guiding all the key actors operating in the healthcare business (e.g. healthcare professionals, healthcare organisations, insurance companies, Social Insurance Institution) and thus, affecting which rehabilitation and treatment methods they find credible. To support the market creation and enhance the status of the medical games, there is a general need for an official and documented database for validated medical games.

Furthermore, the validation process together with the lack of innovation supporting structures in healthcare slows down the development and implementation of health games. On the contrary, the rise of consumerisation in the healthcare sector offers potential venues for medical game development. In the future, when the patients will actively call for more engaging and up-to-date treatment and rehabilitation methods, medical games will have great potential answering those emerging needs. Ideally, S-D logic perspective leads to a situation where all the members in the medical game ecosystem should strive for offering treatment '*for and with the patient*' instead of the traditional viewpoint of offering 'treatment to patient' (e.g. Vargo et al. 2007). In other words, the findings will challenge the way service providers (medical game companies

and rehabilitation providers) do and should view their customers in order to gain competitive advantage. Next, conclusions regarding the key findings are presented as well as managerial implications are proposed.

6.1 Critical elements of the emergence of the medical game ecosystem

Based on the analysis of the empirical data, critical elements for the emergence of the medical game ecosystem were identified. They include *operant resources* that are required in the complete process of developing and commercialising medical games, beneficial *relationships* for medical game companies as well as competitively compelling *value propositions* that the medical game may offer to the *key actors* in the ecosystem. In addition, the critical underlying *institutions* in the healthcare sector and their effects on the key actors were recognised. All these critical elements are summarised in Table 4.

Table 4 Critical elements of the medical game ecosystem

					Institutions within the healthcare sector		
Key actors		(Operant) resources	Beneficial relationships	Value propositions (of a medical game)	Validation	Lack of innovation structures	Consumerisation
Medical game companies		collaborative competence, absorptive competence, adaptive competence (software know-how, user experience, health expertise, regulatory knowledge, customer needs, business know-how, marketing skills)	<i>better collaborative competency enables company to manage their value network more effectively and efficiently</i>	potentially profitable and growing (global) business	affects resources and relationships needed: understanding on regulatory requirements and clinical studies	Hinders implementation to the healthcare processes. Affects resources and relationships required: healthcare business know-how	Affects the kind of services built and resources and relationships required: understanding the consumer needs
Customers	Patients	recommendation power, knowledge on the consumer needs, knowledge on the user experience	cooperation in game development to ensure the required elements to make the game work	motivation and engagement, more effective and accessible rehabilitation, support and feedback, communality	Ensures that the best possible methods are used in the rehabilitation so the resources of healthcare professionals and patients would not be wasted	enhancing the innovation structures will result in better treatment and more variety in the methods used	Patients (and their relatives) are becoming more active and they are demanding better and more individually tailored rehabilitation
	Patients' relatives	recommendation power, knowledge on the consumer needs	involving them better in the recovery process	more effective and accessible rehabilitation, involving the relatives in the process, keeping them up-to-date			
	Healthcare professionals	health expertise, recommendation power, knowledge on the consumer needs	advisor (healthcare context, patient needs), recommender (patients, administrators)	allocating resources, better tools to treat the patients, professional asset		Hinders the adaption of new technologies. Healthcare professionals have a significant impact on the innovation structures.	Have to offer better individually tailored rehabilitation to fulfil the growing needs of the patients
	Healthcare organisations	health expertise	potential piloting platform	enhancing the processes, cost savings, allocating resources, 'automated healthcare'		innovation management skills are needed to support new technologies and innovations	Need to offer better services to fulfil the growing needs. Responsibility moving towards people's homes saves resources.

					Institutions within the healthcare sector		
Actors		(Operant) resources	Beneficial relationship types	Value proposition of a medical game	Validation	Lack of innovation structures	Consumerisation
Funders	Private funders (investors, business angels)	contacts, business know-how, experience (in healthcare business)	advisor, supporter	significant return on investment	Validation creates credibility, but should be done in an agile way to guarantee profitability	Investors are sceptic towards slow decision-making processes in the public healthcare	Consumerisation offers interesting business opportunities to those who can react to it in an adequate way.
	Public funding agencies	contacts, business know-how	advisor, supporter	global and scalable business			
	Insurance companies	existing customer base, steering power, authority, marketing skills	distributor, recommender	cuts expenses significantly, enhances healthcare processes	validation creates credibility (and is required) in the eyes of established healthcare actors	The challenges in diffusion of new technologies resulting from rigid structures cause extra costs due to unnecessary inefficiency	Patients' passiveness has been identified as a problem. Patients' initiative can enhance the treatment process.
	Social Insurance Institution	existing customer base, authority	distributor, recommender	cuts expenses significantly, enhances healthcare processes			
Regulatory parties	Various organisations globally	credibility	authority	safe and effective medical games throughout their life cycle	Validation is required in order to be a medical device		E.g. FDA considers the inclusion of patient preference information into submissions for approval of medical device
Complementors	Academic institutions	educational knowledge, scientific knowledge, software development know-how, business know-how, health expertise	scientific foundation, partner in validation, intermediate between healthcare and game companies	enhanced appreciation, scientific advancements, more profit	Validation process enhances the importance of academic institutions in terms of their know-how and participation in clinical studies	The seed of innovation should be planted in the educational institutions (offering health professionals tech courses)	Complementors have a crucial role in recognising current trends and spreading the knowledge in their network.
	Game and technology associations, serious games networks, incubators	health technology know-how, knowledge on regulations, software development know-how, business know-how, contacts, information	advisor, supporter, lobbyist, network builder, information provider	advancing the industry	Complementors can be valuable asset for company to deal with the complicated validation process thanks to their knowledge.	Associations and networks are striving for affecting the underlying institutions	
	Patient associations	support, information, recommendation power, health expertise	recommender, information provider	supporting the patients	Validation creates credibility, are more likely to recommend the game to the patients.	Unnecessary inefficiency in the healthcare is recognised as a major problem.	Consumerisation can result in increased significance of patient associations.

Seven types of critical resources were identified in the empirical data: software development know-how, user experience knowledge, health expertise, knowledge about the regulatory requirements, understanding of customers and their needs, healthcare business know-how and marketing skills. However, the most important resource for a medical game company is their *collaborative competence*, which further on leverages two additional meta-competences *absorptive competence* and *adaptive competence*. This helps them to use their existing relationships or create new relationships that will enable access to the critical (operant) resources needed. Thus, it creates a situation where the medical game company itself does not need to have the possession over all the resources required to develop and commercialise a potential medical game. Thereby, they can utilise their value network to gain access to the resources required.

As clearly visible in Table 4, there are numerous elements that have to be taken into account before a medical game company can become successful. The current challenge in the emergence of the medical game ecosystem is that there are so many pieces that have to click into place simultaneously. It resembles a Rubik's cube in many ways; a company has to have a perfect configuration and furthermore, moving one piece will in consequence affect the other elements too. Ideally, on every side all the element have to be just right. Thus, e.g. *all* the value propositions to the key actors should be sufficiently compelling as well as all the operant resources should be sufficiently secured. In addition, the firm's *absorptive* and *adaptive competences* assist in continuously absorbing the ambient trends and adapting value propositions, resources and relationships required according to the dynamic and turbulent environment.

Furthermore, it is important to comprehend that not all the elements illustrated in Table 4 are equally critical or that is to say, some elements are substantially more critical than others. Depending on the level of control necessity of the game, social rules and regulations concerning validation and regulatory clearance are pivotal and thus, resources related to those are crucial. User experience is a major issue but e.g. failing to create visually appealing graphics will not inhibit the usage of a medical game, whereas failing to conduct an adequate validation procedure may result in not being able to sell the medical game. Furthermore, different critical elements are emphasised depending on the stage of the emerging ecosystem, e.g. whether the medical game company's ecosystem is in its initial phase or whether it is already established. Due to the dynamic nature of the medical game ecosystem, value propositions and relevant relationships have to be continuously rethought.

Moreover, it is crucial to take into consideration the underlying *institutions* (i.e. social norms, rules and regulations). They have a complex effect on the emergence of the ecosystem. They affect the medical game *directly* e.g. the complicated validation process requires numerous resources and the rigid healthcare structures make it challenging to sell a medical game to the hospitals. Additionally, institutions may affect

the medical game company also *indirectly* e.g. the lack of innovation structures may affect the interest of funders that are sceptical towards the risks the rigid structures of the healthcare sector or growing amount of digital natives craving for high-intensity engagement and active participation in every aspect in their life can force the healthcare organisations to renew their rehabilitation and treatment methods and procedures and thus, offer auspicious business opportunities for a medical game company. In addition, institutions, too, affect to the other institutions, e.g. recently FDA, the regulatory party of the US market, announced that they are considering including patient preferences into submission for approval of medical devices. This would mean that medical device makers would need to be able to consistently collect and quantify patient preferences of their products. (Shafrin 2015.) Thus, they need to better take into account the opinions and preferences of the consumers.

6.2 Developmental trajectories of the emerging medical game ecosystem

Networks have been much discussed in the business literature (Moore 1993), yet the prior literature provides little assistance in understanding the underlying logics of their *emergence*. The key actors in the medical game ecosystem, too, are constantly co-evolving. The resource integration practices between actors in the ecosystem also affect the actors who are not directly involved as well as the ecosystem as a whole. Based on the empirical data of the study, the general trajectories of the emergence of the medical game company's ecosystem were identified over the time. Thus, a four step developmental trajectory model was created to illustrate the dynamics of the ecosystem emergence (see Figure 5).

In reality, these evolutionary trajectories of the ecosystem blur and the (operant) resources and beneficial relationships in different trajectories are overlapping. However, the developmental trajectory model is aiming at simplifying the process of the emergence of the medical game ecosystem on a general level. Thus, the developmental trajectory model can be reflected in other medical game contexts than the one of the TBI rehabilitation. Furthermore, the developmental trajectory model emphasises that the medical game ecosystem is in many ways a process of co-evolution with other key actors (Moore 1993). That is, the medical game company is evolving together with the customers, funders, regulatory parties and complementors.

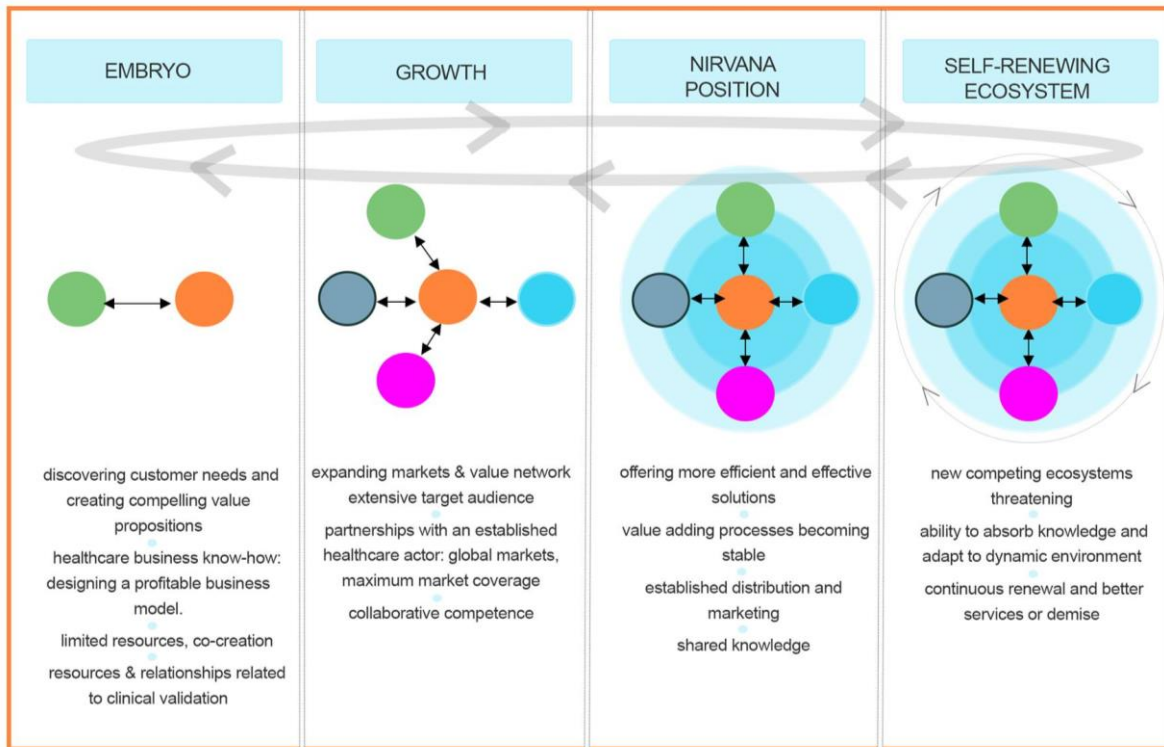


Figure 5 The developmental trajectories of a medical game company's ecosystem

The four developmental trajectories portrayed in Figure 5 are as follows:

First trajectory: “embryo”

In the first trajectory, a medical game company aims at providing a strong *foundation* for a successful medical game by conducting the relevant background work. Firstly, it is crucial for a medical game company to discover the customer *need(s)*. The medical game company needs to define and evaluate value propositions to the customers as well as to the other key actors in the ecosystem to create competitively compelling *value propositions*. Further on, *healthcare business know-how* is required to design a profitable business model to serve the target audience. The effectiveness studies are conducted and thus, *resources* and *relationships* related to the clinical validation practices are crucial. Thus, in this phase, the seed of innovation is planted and it can further on grow into revolutionising service in healthcare. This phase is strongly characterised by cooperation due to a medical game company's often limited resources and the amount of resources required in the initial phase. Ideally, the value is co-created together with customers and other partners to eventually offer value for the customer.

Second trajectory: “growth”

In the second trajectory, the company is striving for expanding their markets and their value network. It is crucial that a business concept with as strong commercial potential

is found i.e. a company is providing a service that a large number of customers will value. In other words, to grow the business, there has to be broad enough target audience available. Therefore, e.g. illness-based medical games are challenging, especially if they are targeting rare medical conditions. Even if there is strong potential in an individual level, it is unlikely to be profitable business in the long run. Thus, in this phase the company is aiming at transferring its technology or intellectual property to other sectors or other markets in order to make the business more profitable. In general, partnering up with an established healthcare actor and using their existing organisation structures is often a preferred strategy for extending to global markets and pursue maximum market coverage. Thus, *collaborative competency* is seen as a key *resource*. However, various target market specific *regulatory institutions* may hinder the medical game company's endeavours to rapidly expand to global markets due to the regulatory requirements and the *resources* that are required to undergo the regulatory processes.

Third trajectory: “nirvana position”

“Nirvana” position refers to company's ability ‘to offer more efficient and effective solutions to the marketplace’ (Hunt 2000, 139). Thus, during this trajectory, the structure of the company's value adding processes, which are central to its ecosystem, becomes reasonably stable. This means that the medical games should have all the essential resources secured in an effective way. In addition, they should have an established distribution channel for the medical game and marketing practices in order to keep the business profitable. Furthermore, in this phase additional value is gained from shared knowledge within the ecosystem, which is applied in co-creating value to better serve the patients.

Fourth trajectory: “self-renewing ecosystem”

Eventually, new rising ecosystems and innovations will threaten maturing medical game ecosystems. Thus, to maintain the nirvana position, the medical game company has to be an adept manager of their ecosystem and environment. To do so, they have to have superior *collaborative competency*. Having that, the company can better utilise its value network to absorb useful information and knowledge and thus, can better adapt to the dynamic and turbulent environment of the medical game ecosystem. Thus, the medical game company has to continuously work with innovators to bring new ideas to the existing ecosystem. Furthermore, the ‘chief innovator’ is the beneficiary of the service, thus, it is beneficial to involve them in the service development process. To maintain a “nirvana position” the medical game company has to be able to renew itself dynamically according to the changing environment and remain sensitive towards emerging trends amongst the target audience e.g. identifying what form the rising

consumerisation will take. In addition, technology is continuously changing and a medical game company, too, has to grasp on new opportunities provided by upcoming technological innovations such as Oculus Rift or biotechnologies. Not being able to adapt to the dynamic and turbulent changes of the environment can result in the demise of the ecosystem. Thus, the inability to renew oneself can have calamitous results. In this trajectory it is important to continuously evaluate whether the company is linked with the best possible partners. In addition, the medical game company has to challenge itself to assess whether it is betting its future on the most promising ideas.

6.3 Managerial implications

The results corroborate that when establishing relationships to other actors in the ecosystem, management should pay close attention to the goal of the partnership and aim towards finding efficient ways to secure the relevant resources. This calls for skills to manage the network (*collaborative competency*). Furthermore, although similar operant resources (e.g. skills and knowledge) are needed in terms of creating medical games with true potential, the set of relationships where those resources are gained, can vary significantly. Thus, the researcher further on suggests that companies should keep an open mind in order to find the most beneficial partnerships i.e. instead of seeing insurance companies simply as funders they could work as a marketing and distribution channel. In addition, for medical game start-ups, partnership with an established and well-known actor in the healthcare sector is strongly recommended to e.g. benefit from their existing (global) sales organisation that facilitates internationalisation and broadens the target market significantly. Importantly, different (operant) resources and beneficial relationships are emphasised in terms of in which trajectory of their ecosystem building a medical game company game is currently at i.e. in the initial phase of their medical game development e.g. clinical validation and knowledge about regulatory requirements are critical. The issues regarding the healthcare regulations e.g. medical device clearance are hard if not impossible to restore afterwards and in the worst-case scenario, the medical game must be recalled resulting in enduring a great loss.

Further on, the researcher recommends that in order to improve their chances of success, medical game companies should comprehend the logics in the healthcare sector. Thus, medical game co-creation with a healthcare organisation does enhance the quality of the medical game due to the expertise available and the availability of patients for pilot testing. However, what is possible of greater importance is that co-creation with a prestigious healthcare organisation can further on advance the *credibility* of a medical game and lower the resistance to change. Thus, medical game co-creation may

enable an efficient marketing communication strategy where a medical game company gives credit to the healthcare organisation and uses their name and names of appreciated doctors in their marketing communications i.e. benefit from the brand image of the healthcare organisation and professionals. This results in lower resistance from other (less prestigious) healthcare organisations and they are also more eager to implement the game into their practices since they become more confident about the credibility of the medical game. Furthermore, engaging the healthcare organisation and their healthcare professionals in the medical game development process will get the (prestigious) healthcare organisation more involved. Additionally, if the healthcare organisation sees the medical game as their accomplishment it results in better overall attitudes towards the new technology within the healthcare organisation. Resistance to change is always lower when people are involved in the planning process of change and they understand the motives for change, thus, involving the healthcare professionals in the development process will further on reduce the resistance to change.

Since the medical game companies are mainly start-ups they do not have any existing brand recognition or status. Thus, they can benefit from the credibility of an established healthcare organisation or a well-known and respected healthcare professional to gain the trust and interest of other healthcare organisations and patients. Healthcare professionals and healthcare organisations, on the other hand, need success stories and publications. Developing a medical game can possibly be seen as a bigger achievement than traditional publications and may help them to achieve more fame, thus, on meso level it may also attract financiers for private healthcare organisations. On macro level, being in a development team of a medical game can be a great personal achievement, thus, it can be a valuable asset in a doctor's résumé. Medical game companies, however, can afford to share credits with doctors and other healthcare professionals since it does not dilute their merits but rather boosts them. Being able to co-create the medical game with an established healthcare actor enhances the credibility and expertise of the medical game company and without it, it would be challenging to prove that they have the required operant resources (e.g. skills and knowledge) to create a medical game with the health effects required. Thus, if doctors or other healthcare professionals as well as healthcare organisations are not involved in the medical game development process, the resistance to change might be too great of a challenge to overcome and medical game companies might not be able to implement the medical games in the healthcare organisations.

Currently, another issue is that the credibility of the medical games relies mainly on scattered effectiveness studies conducted. There is no collection of studies or database to go through the scientific evidence of the existing medical games, thus, the scientific evidence does not cumulate in an adequate way that would benefit the whole field. Even if a healthcare professional or an organisation would like to implement a medical game

they have to make an immense effort to go through a mass of different medical games and effectiveness studies related to them. Furthermore, they have to compare different medical game alternatives and see how they fit in the individual needs of the patient, before choosing one. All this effort is not reasonable resource-wise. The main problem does not seem to lie in the healthcare sector's unwillingness to strive for more effective treatment and rehabilitation – the bigger issue seems to be that they do not have the resources needed to make the change happen in an effective way.

Thus, the researcher suggests that medical games could be made more available for healthcare by establishing a Current Care Guidelines equivalent for medical games. It would be a database of medical games classified in terms of the symptoms of the patient (e.g., memory training exercises). In addition, they would be classified in terms of the amount of scientific evidence available: from A to D where A-class rating indicates scientifically acceptable RCTs conducted with a large number of test subjects, similarly to the Current Care Guidelines for treatment and rehabilitation. This database would enable the cumulating of the relevant knowledge related to medical games and thus, serving all the parties involved. At healthcare's point of view, it would facilitate finding the right game for each patient. In addition, the biggest problem in terms of medical games seems to be finding the customer and thus, making the business profitable. Therefore, at the medical game company's point of view, the database would support the medical game's credibility and help them from the marketing communications perspective to get the validated and functioning games to the end user. Furthermore, in terms of complex medical conditions such as brain related issues, conducting credible studies might take several years. Thus, the database would help the healthcare professionals to introduce the medical games in the rehabilitation based on e.g., B or C class recommendation in the database facilitating the medical game industry. In other words, health professionals could implement a medical game in the rehabilitation or treatment programme based on studies proving that the game has some satisfactory evidence on its effectiveness.

To build such a database, the researcher suggests that someone needs to 'orchestrate' the project. This requires an actor with a higher vision, a functional network of relationships and the ability to bring together the actors required to make this type of established database possible. Medical game companies and organisations (such as Games for Health Finland) are encouraged to actuate the development of this kind of institution that would be beneficial for all parties involved in the medical game ecosystem. The database does not have to be extensive from the start, but rather continuously completed according to the new scientific evidence available.

6.4 Suggestions for further research

This study centres in a focal topic that has not traditionally gained much attention in the academic literature. However, during the time period of writing this study, Journal of Service Research had an open call for papers in Health Service Research, one of the essential themes of which was the role of new technologies in providing healthcare services. Thus, this indicates that the interest towards the topic is increasing. This study shows that taking the ecosystems approach as its theoretical lens provides interesting future opportunities for research on medical game ecosystems. Comprising of a single case approach, further research on this topic is needed. Further on, more qualitative research is needed to explore the dynamics of the emerging medical game ecosystem giving a solid foundation to forthcoming quantitative research.

This study has emphasised the importance of various crucial relationships with the actors in the ecosystem in terms of beneficial resources. However, the researcher proposes that studying the importance of each relationship or each resource i.e. building an equation of actors to find an optimal set of relationships for a medical game company would be an interesting research topic in the future. With the equation, a medical game could hypothetically plan, which relationships they should focus on in order to gain the most profit e.g. if an insurance company does not cover the cost of the game for a patient, does it affect the profitability of the game and how much.

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APPENDICES

Appendix A: Outline of the interview themes

Healthcare related themes:

Traumatic brain injury rehabilitation process

The objective was to understand the TBI rehabilitation process. Possible questions: What are the key challenges/ success factors/ decision-making actors? Is there a need for new rehabilitation methods/tools? How new healthcare methods are implemented? Who is the payer?

The value network of TBI rehabilitation

The objective was to develop an understanding on the key actors 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? How new rehabilitation methods are introduced?

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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/challenges/success factors in the process?

The commercialisation 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? Who is the target audience? 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 kinds of relationships are beneficial? Who are the key partners? What is the role of different actors (e.g. universities/ insurance companies/ the public sector)? How is the value network managed?

Appendix B: The challenges discovered from the interviews categorised in four main areas of challenges: (1) resources, relationships and value propositions, (2) validation, (3) lack of innovation and (4) consumerisation

Challenge defined
<i>Resources, relationships and value propositions</i>
Productisation of medical games
Intellectual property issues when developing a medical game in co-operation e.g. universities, rehabilitation centres
Commercial potential is low and the field is not yet seen as very desirable
The lack of success stories in the medical game market
Challenges in finding a profitable business model e.g. the best practices
Making any kind of game is risky and expensive e.g. due to the variety of preferences
The field is mostly based on scattered research plans with no clear business aspect
Finding a profitable pricing model for a medical game
(Global) scalability of the medical game innovation
Medical games created for niche groups, have really limited commercial potential
Identifying the right needs and answering to those
Finding the customer e.g. no established distribution channel
Marketing and sales practices e.g. reaching the masses, coverage, sales practices in healthcare
Separating oneself from bad health games (branding, graphics, user friendliness)
Taking into account all the relevant stakeholders
Finding the payer for a medical game
Convincing the target audience of the usefulness of a medical game (the reason for the game)
Recognising the gatekeepers in the process and offering them compelling value propositions
In a welfare state people are not traditionally used to paying for health-related services
Finding the balance between agile and risk-seeking game industry and regulated and risk-avoiding health industry
Keeping up with the constant change of the game and technology industry; development as an agile process
Most of the firms in the industry are start-ups with very limited resources
Securing the essential operant resources e.g. game expertise and know-how, art director, business developer
Finding enough adequate entrepreneurs and innovators in a small market like Finland
Being too humble, acting too slow
Challenges in getting funding for medical game development (before there are any results)
Finding the right public programmes in the beginning
The golden rule of getting investors (B2C): long term retention, short sessions, ability to spend infinite amount of money on a game
Challenges in the medical game market proving to be a highly profitable business to lure venture capitalists
The development budgets of medical games projects are usually limited
Being able to answer the tough questions of potential investors; draw up a credible cash flow statement
<i>Validation</i>
Incorporating right features (e.g. focused, takes into account the disabilities, difficulty can be adjusted)

Immediate health effect i.e. skills in a game reflect to real life
Risk assessment in terms of medical games (e.g. addiction, social exclusions, aggression, tiredness)
Proving and measuring the effectiveness of the medical game
If targeting directly consumers in medical games sector: dilemma of validation and responsibility
Time consuming, expensive and difficult validation process slows down the product development and requires resources
There are no global standards in terms of medical game validation
Due to the complex validation procedure, medical devices are traditionally incredibly expensive to buy: patients cannot buy them themselves
Getting medical games to the Current Care Guidelines
Validation process is lacking a high-quality classification and thus, suitable medical games are hard to find
<i>Healthcare innovation structure</i>
Knowledge of the complex processes in the healthcare sector and the context as a whole
Building a medical game requires a broader combination of know-how e.g. game technology and health expertise
Developing a game that actually facilitates and enhances the healthcare processes
Challenges in terms of patient flows being strong enough for it to financially make sense to implement a medical game
The healthcare professionals understanding the value of new technologies in their processes
The healthcare sector is lacking the structures to support innovative acquisition (bureaucracy)
The strong legacy' of the healthcare sector in terms of old methods and information systems that demand reform
<i>Consumerisation</i>
High expectation of the technologies leads to high demand on usability; game has to convince the player immediately
Customers are worried about data security and ethical issues concerning healthcare data
The dilemma of two goals: finding the balance between the game experience (e.g. narrative, fun) and the health effect
Providing the entertainment aspect and good content that consumers are willing to pay and spend their time on
Managing to create rewarding experience for the patient: offering extrinsic motivation i.e. the "candy"
Making the right service that answers to patients' needs i.e. understanding the consumer business
Medical games should be affordable enough for patients to get them home
Age gap affecting the way patients who can and are willing to use technology
Introducing a social aspect
Accessibility of the medical games: it is hard to find the right medical games and to know which games are good
Answering to the challenges of consumerisation taking root in the healthcare sector