Mapping the full potential of the emerging health game markets

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SiTRa

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Preface

Is gamification the latest hype? Are we supposed to believe that playing games will cure diseases and keep us fit? While it is easy to disregard the ongoing talk of gamification as something relevant only to those of us who play just for entertainment, we believe there's more to it than that – it's about solving pressing issues in a positive and fun way.

To prove the point, a famous example often used is the Swedish speed camera lottery: obey the limits and you can win money. This approach takes the positive route instead of giving you the stick. And the results were impressive: a 22 per cent reduction in speed for the 24,857 cars that drove past during three days. If gamification works for speeding, it must work for increasing well-being.

We Finns have made mobile games a global success story. Finland is also among the countries currently investing heavily in research for eHealth solutions. An appealing conclusion would be to see the gamification of well-being as the next source for new companies and new jobs, but it is incredibly important to keep in mind that global success stories have not really happened in this field, anywhere, yet.

This report makes use of the experience gained in the Finnish core-game industry. Its goal is to make Finland the winner in the "who creates a new profitable gaming domain" competition, to enable Finnish companies to become the new Facebooks and Googles of the emerging health games market.

Early on in our Gesundheit 2013 health games competition, we realised that while there is great potential in health games, there is not much information about the market. Our reaction was to commission Neogames ry to study the health games market in more detail, the result being this report.

Sitra sees the possibilities and great potential in the health games industry and will continue supporting the companies building that domain.

Happy reading,

Antti Kivelä

Tiivistelmä

Huolimatta merkittävistä panostuksista terveyspelejä koskevaan tutkimukseen, vain harvat terveyspelit onnistuvat murtautumaan terveysalan markkinoille. Jotta aloittavat start-up yrittäjät eivät ottaisi turhaan suuria riskejä panostaakseen markkinoihin, joille pääsystä heillä ei ole takeita, pitäisi alan toimijoiden pyrkiä luomaan mahdollisimman realistinen kuva terveyspelien eri markkina-alueiden tilasta ja erityispiirteistä.

Tällä hetkellä globaalit terveyspelien markkinat ovat vasta syntymässä ja alan ilmiöitä kuvaava terminologia on vielä hahmottumatonta. Lisäksi, roolit arvoketjussa ovat jäsentymättömiä ja yksityisten ja julkisten toimijoiden halu investoida erityisesti lääkinnälliseen terveyspeleihin on matala. Toisaalta terveyspelien markkinat ovat siis todella haastavat. Toisaalta kilpailu on vasta alkamassa ja alan suuryritykset odottavat vielä perustajaan.

Tämän selvityksen perusteella terveyspelien kehittäjien tulisi erityisesti:

- Pitää huoli siitä, että pelit ovat mahdollisimman viihdyttäviä huomioiden pelialustoissa olevat teknologiset rajoitteet ja sen kuinka pelin tavoittelemat terveysvaikutukset rajoittavat pelimekaniikkaa.
- Kiinnittää huomiota sellaisen teknologisen alustan valitsemiseen pelille, joka mahdollistaa tavoiteltujen terveysvaikutusten teknologisen toteuttamisen ja pelien saattamisen tavoitellun kohderyhmän käsiin. Lisäksi kehittäjien tulisi tarkasti kartoittaa kyseisellä terveyssektorilla jo olemassa olevat tuotteiden jakeluväylät ja muut toimijat ja tehdä yhteistyötä kyseisten toimijoiden kanssa tai harkita ryhtymistä terveyspelien julkaisijaksi tai jakelualustaksi.
- Kunnioittaa ihmisten terveyteen liittyvän tiedon yksityisyyttä ja arkaa luonnetta sekä ottaa huomioon terveystiedon omistamiseen liittyvät lainsäädännölliset esteet.
- Panostaa riittävästi hyvien suhteiden ylläpitämiseen oman pelinsä kannalta keskeisiin sidosryhmiin, kuten julkisen sektorin toimijoihin ja vakuutusyhtiöihin. • Kartoittaa tarkasti jo olemassa olevat ohjelmistotuotteiden lisenssointimallit, jotka mahdollistavat tuotteiden samanaikaisen lisenssoinnin yksityiseen ja kaupalliseen käyttöön.

Urheilu- ja lääketeollisuuden laitevalmistajien tulisi:

- Avata laitteidensa tuottama raakadata sovelluskehittäjille, jotka pyrkivät ohjelmistoja, jotka muuttavat datan tiettyihin terveysvaikutuksiin tähtäävien pelien ohjaussignaaleiksi

Julkisen hallinnon pitäisi:

- Tarkastaa, että julkisella rahoituksella kehitetyillä terveyspeleillä on takanaan kestävä liiketoimintamalli, joka ottaa huomioon sekä terveysalan ammattilaisten erityisvaatimukset että potilaiden tyytyväisyyden.

- Euroopan tasolla: tarjota kootusti informaatiota kunkin Euroopan unionin jäsenmaan terveydenhuollon markkinoiden toiminnasta ja taata, ettei unioni menetä kilpailuetuaan suhteessa Yhdysvaltioihin terveydenhuollon laitteita ja tarvikkeita koskevaa regulaatioympäristöä uudistettaessa.

- Kansallisella tasolla: määritellä millaiset terveyspelit katsotaan julkisen hallinnon kilpailutuksia koskevan lainsäädännön valossa terveys- ja sosiaalialan palveluiksi, tiivistää yhteistyötä Suomen terveyspelialan ja puolustusvoimien välillä ja taata, että terveyspelien vientiä tukevat organisaatiot hallitsevat kohdemaidensa markkinat ja regulaatioympäristöt.

- Paikallisella tasolla: kuntien tulisi tarkastella mahdollisuuksiaan investoida yhdestä kahteen prosenttia terveydenhuollon menoistaan uusiin ja innovatiivisiin tuotteisiin ja palveluihin, taata kansalaisjärjestöjen ja yritysten tasa-arvoinen kohtelu, tuottaa ohjeet terveyspelejä koskevien kliinisten kokeiden toteuttamiseksi paikallisessa sairaalassa ja pitää huolta siitä, että uusia sairaalajärjestelmiä tilatessa niiden tarjoajat velvoitetaan avaamaan tuotteidensa data terveyspelikehittäjille ja kannustaa lääketieteen tekniikan opintoja tarjoavia yliopistoja sisällyttämään terveyspelit opintosuunnitelmiinsa ja totuttamaan lääketieteen opiskelijat ja pelisuunnittelun opiskelijat yhteistyöhön opintojensa alusta alkaen.

Executive Summary

Whilst there is a lot of public funding available for research on health games, at the moment the entry barriers to health care markets are still extremely high. Therefore those working in this field need to do all they can in order to draw a realistic picture of the market situation for newcomers to the market. The worst thing that can happen is that we will see a large amount of start-up companies taking massive risks on entering to markets that do not yet really exist.

At the moment global health game markets are just emerging. They are still at an early stage, where the terminology used to describe the market phenomena is vague, the roles in the value chain are unclear, and public and private investment in the sector is low. This makes the health games market extremely challenging, however the competition is just starting and the Microsoft, Facebook and Google type entities of the health games market are yet to be founded.

Based on the findings in this paper, a health game developer should:

- Develop as entertaining games as possible which consider the technological limitations of the targeted gaming platform and any possible limitations the desired health effects pose for the gameplay.
- Carefully select a technological platform based on the combined possibilities of producing the desired health effects and the means the platform offers to distribute the game to a desired audience. There is also the need for developers to map those already existing market platforms that provide medical services and to exploit the possibilities for either co-operating with them or alternatively becoming health game publishers or platforms themselves.
- Respect the highly sensitive nature of personal health information and carefully map legal obstacles related to its use.
- Pay careful attention to relations towards public bodies and medical insurance companies.
- Carefully benchmark the existing licensing models from the software industry providing different licenses for personal and business use.

Third party device developers should:

- Open the raw data from their devices to software developers looking to analyse the raw data from the input device and transform it to an input signal for health related games targeting specific diseases.

Public government should:

- Ensure that medical games developed with public funding have a sustainable business model and they take into account all the requirements of the health care practitioners, as well as the needs of the patient.

- On a European level, provide updated information on how health care markets work in each member state and secure a competitive advantage by not making regulation concerning medical devices as strict as that currently in place in the USA.

- On a national level, define under what circumstances health games are to be considered as health and welfare services under existing Public Procurement Act..

- On a local level, examine the idea of using one or two percent of their annual investment in health care on new and innovative services; secure the equal treatment of NGOs and companies; produce guidelines taking into account the specific issues related to game development for conducting clinical trials in local hospitals; ensure that the data provided by medical devices is made accessible to third party developers when investing in new health care systems; encourage universities offering bachelor or master degrees in medical technology to introduce health games into their curricula, and help medical students and students focusing on game development to run joint projects from the beginning of their studies.

1 Introduction

As the population of industrialised countries is getting older and health care costs are constantly rising, a global demand for finding new more cost-effective ways of providing health care services is emerging. Consequently, the European Union, Japan, USA and Australia are investing in research related to eHealth services, and considered among this is the field of health games. Of these countries, the USA is the leading market area, although the European Union is not far behind. Within Europe, according to an eHealth benchmarking survey[1], especially the Nordic countries (including Finland) are pathfinders.

Thus it is no surprise that the Finnish government is making considerable investment in research targeting eHealth solutions. However, in this area, the outcomes of the projects targeting health games have been modest at best, although the booming Finnish games industry itself is one of the world market leaders. During the spring of 2013, The Finnish Innovation Fund Sitra launched their **Gesundheit 2013 competition**[2] for new innovative eHealth solutions. In order to ensure maximal exploitation of the outcomes of this competition, Sitra asked Neogames to find out the major barriers which make so many health game projects to fail.

Neogames is the hub of the Finnish games industry and we have years of experience in accelerating, supporting and co-ordinating the development of the games industry in Finland. Over the years we have realized a number of studies on the megatrends reshaping the Finnish games industry and have built a number of recommendations on overcoming different market barriers. Consequently, this paper also has a strong market ecosystem focus, with strong emphasis on the challenges game developers face while developing health games. We strongly believe that it is both appropriate and timely to answer why so many health game developer studios fail, despite scientific evidence supporting the rehabilitation effects of medical games becoming stronger everyday.

In order to secure an optimal market relevance for this paper, all recommendations are based on interviews of key health game industry actors[3]. These interviews were conducted during the summer of 2013 and this paper reflects only the market realities of that time. Due to the rapid development of the games industry, it is also acknowledged that parts of this paper reflecting the technological boundaries and nature of potential business models are likely to become obsolete in the near future.

As the key conclusion of this paper, we would like to observe that although there is a lot of public funding currently available for research on health games; at the moment, the barriers to entry into the health care markets are still extremely high. Therefore, those working in this field should do all they can to draw a realistic picture of the market situation to inform newcomers to the field. The worst thing that can happen is that we will see a large amount of start-up companies taking massive risks on entering to markets that do not yet really exist.

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[1] https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/ehealth_benchmarking_ 3_final_report.pdf
[2] http://www.sitra.fi/en/well-being/gesundheit-2013
[3] The list of industry experts interviewed for this paper can be found in Annex2

As the health game markets are only just emerging, there is a current lack of definition for even the basic concepts of the field. Andrzej Marczewski[4] summarises the difference between key concepts in the area of games industry and sectors closely connected with it in the following way:

Figure 1: The difference between key concepts in the area of the games industry and sectors closely connected with it according to Andrzej Marczewski

	Game Thinking	Game Elements	Game Play	Just For Fun
Gameful Design	●			
Gamification	●	●		
Serious Game / Simulation	●	●	●	
Game	●	●	●	●

The focus of this study is on health focused serious games - namely health games and core-games. The issues related to gameful design and the gamification of health care services are not discussed in this study, as the outcomes of such consultation services are not usually games per se.

For the purposes of this paper, we will use the term **health games** to describe those markets of games which claim to have some kind of effect on health in general. In traditional health care markets we have health games that claim to have clinically tested medical effects. Within the field of health games however, there are two major separate subfields. In this study we refer to them as either **medical games**, or those games that are closer to the mainstream game markets and do not claim to have clinically tested health effects, which we refer to as **wellness games**. In order to separate these games from more entertainment-oriented games, we will refer to such games as **core games**.

4 http://marczewski.me.uk/2013/02/25/gamification-and-serious-games/

Within these categories, we have specific subcategories for games focusing on specific health effects. Fitness games for example, focus on engaging you to do physical exercises, whilst neurogames focus on developing games based on your brain activity. However, as the purpose of this study is to address the general market barriers of all health games, we will not discuss the specific challenges of these subsectors. Instead, in Section 2 we focus on evaluating the current status of the Finnish health game markets and their potential, as well as discussing in detail the specific characters of wellness games and medical games. In Section 3, we focus on the technological and business trends and barriers shaping the health game markets. We finalise our paper in Section 4 by addressing the role public actors can play in securing the growth of this sector.

2 The evolution of health games market segments

2.1 The current status of Finnish health game markets

At the moment, the Finnish health game ecosystem is taking its first steps as a spin-off of the highly successful Finnish core games industry targeting entertainment markets. Until recently, health games were either developed by game developer studios focusing on business-to-business (B2B) related serious games, on specific projects, or on subcontracting in general. Often these studios ended up undertaking eHealth related projects when they faced financial difficulties because their games were not selling well enough in the core game markets.

Because the focus of these studios was more on core games rather than health game markets, unfortunately, such studios were rarely held a long-term commitment to the health games they developed and consequently developers easily abandoned the games at the very moment the project funding ended. Those who did not, often found out that the market potential of the games was not high enough to run a commercially sustainable business. Thus, the current situation is that many health games (and especially the medical games available in the markets) are both over expensive and poorly developed.

As in the core games markets, in the health games market it is impossible to achieve good results without a strong focus on succeeding within the particular market segment. Only recently, partly as an outcome of the increase in public funding and partly due to fact that the core games markets have started to become saturated, there are a few companies who from the outset have tried to build their success solely by focusing on health games. As later discussed in detail in section 4.2, the challenge currently faced is that the public funding of the procurement of health games has not increased as much as the public funding of the research on health games. Thus the actual markets existing for the games which are developed are extremely limited, especially in the area of medical games.

Furthermore, as game developers and medical experts come from two very different fields, it takes a long time for them to learn to co-operate effectively. As medical experts are needed for developing medical games, this is an important barrier that remains to be overcome. When the new generation of young doctors (who are foreseen as having more experience with gaming) graduate, this problem is likely to lessen, however, it is not likely to go away as many actors involved in the sector are either afraid that new technology will take their jobs, are too conservative to be interested in new solutions or are simply too busy to focus on anything else than the urgent tasks in hand.

Consequently, it can be concluded that a Finnish health game ecosystem does not exist at the moment. In the area of wellness games, some kind of market for health games was created by the success of Wii Sports and other *motion as an input* based applications, although a similar success story has yet to happen in the area of medical games.

2.2 The potential of health game markets

Although there is currently no Finnish health game ecosystem, this does not mean that health service markets would not exist, either in Finland or globally. Traditionally, there are four different market sectors of health services, each with their own specific characteristics:

— **Promotion of Healthy Lifestyle:** there are markets for services related to promoting a healthy lifestyle. These markets are mainly dominated by different non-governmental organisations.

— **Prevention of Disease:** there is a potential (although currently very small) market for preventative health services.

— **Curing Disease:** in 2011, Finnish municipalities and insurance companies alone used the majority of their 17.1 billion euro annual funding for the provision of health care services on curing diseases.[5]

— **Rehabilitation Services:** KELA (the Social Insurance Institution of Finland) alone uses about 274 million euros each year to fund different rehabilitation serves.[6]

In this context, one should not forget that on a global level, each market area has their own traditions and methods to facilitate a healthy life style. Where Western traditions rely heavily on medicalization, Eastern traditions give equal emphasis to wellbeing in addition to curing disease. Lately however, these two approaches have also been seen as starting to blur in the West.

Consequently there is market potential, but this is not the only reason why the amount of game developers focusing on serious games (and especially on health games) is likely to increase in the near future:

• During recent years, playing games has become an essential part of the everyday life of a vast majority of Europeans. Thus, people are starting to expect more and more game-like features from other service sectors.

• Both the European Union and the Finnish government are increasing the public support of health games in order to tackle the challenges created by an aging population and increasing health care costs.

• As game developers get older, they are likely to become more interested in health related issues.

• As the size of the Finnish games industry increases and more people enter the field, the focus spectrums and moral values the developers will broaden. Thus, in the future, there might be more actors in the field who are not interested solely in entertainment, but also in building games that produce global change.

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[5] http://www.thl.fi/fi_FI/web/fi/tilastot/aiheittain/talous/terveysmenot
[6] http://www.kela.fi/flash/toimintakertomus-2012/Kela_Toimintakertomus.pdf

- Due to rapid technological development, it will become more and more easy to make games with beneficial health effects (e.g. the development of sensor technology and the deeper understanding of neuroplasticity).

However the health games markets themselves are still at an early stage and there are still many challenges to overcome:

- **How to access the markets?** The barriers of entry are significant, especially for medical games. It may even be asked, if these barriers are so high that in fact the markets do not exist at all. (For further information see section 3 of this report)
- **How to reach the talent?** Even in core game markets, there is a lack of talented game developers in Finland. Consequently, finding employees who are passionate about both game development and health related issues is extremely difficult. (For further information see section 4.5 of this report)
- **How to access funding?** It is hard to convince private investors to invest in potentially highly profitable core-games, and it is even harder to make them invest in health games. (For further information see section 4.1 of this report)

Consequently, as the global health games markets are still as immature as those in Finland, global competition is just starting and the Microsoft, Facebook and Google equivalents of the health game markets are still to be founded by those actors able to overcome the barriers posed by the sector.

2.3 Characteristics of health games

Introducing health games to the health care market segments we have outlined is highly challenging, as those markets have traditionally relied on poorly scalable retail products and services, and as games are becoming closer and closer to highly scalable digital services. From the perspective of a health game developer, another crucial question is whether games are targeting end-consumers directly (business-to-consumer - B2C) or whether games are developed for those third party actors providing health and welfare services to end-consumers (B2B).
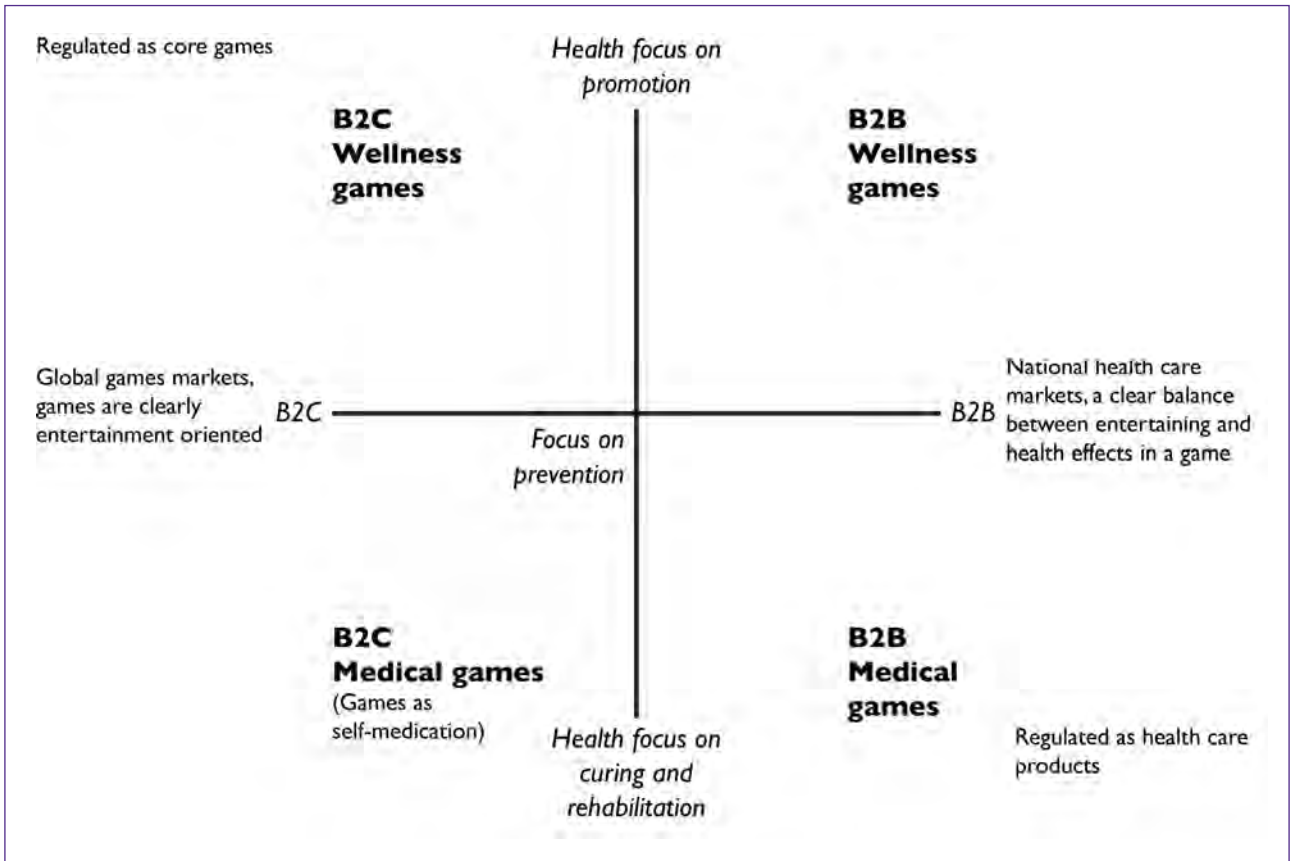
Figure 2 content:

Regulated as core games

Health focus on promotion

B2C Wellness games

B2B Wellness games

Global games markets, games are clearly entertainment oriented

B2C

Focus on prevention

B2B

National health care markets, a clear balance between entertaining and health effects in a game

B2C Medical games (Games as self-medication)

B2B Medical games

Regulated as health care products

Health focus on curing and rehabilitation

Figure 2: Health game markets

The revenue share of game developers is usually bigger in the online and mobile distribution platforms of B2C markets than it is on the very project funding oriented markets of B2B. In B2B markets, the actual production risk is lower since a consumer usually takes care of financing the development process, but the possible upside for the health game developer is significantly smaller if exits at all.

B2C games are competing with core games or other core applications in the distribution platforms. Consequently, they have to be excellent games and applications in order to be successful. On the other hand, B2C markets have a much bigger market potential due to their global nature than the more restricted, often national, or at least globally extremely fragmented B2B markets. Thus, the closer health games are to the core-game markets, the more they have to compete against the leading games of the quickly developing core games industry. Only those games that are seen more as medical devices than games can avoid this comparison, and even they have to be good games, in order to be successful.

What makes a good game? It has to be entertaining. Consequently, as the enormous success of Wii Sports demonstrates, health games have to be developed to be primarily entertaining and the health effects should be seen as additional elements of the gameplay. If health games are developed primarily to have health effects and only secondarily to be entertaining, then they are likely to be extremely bad products and thus unsuccessful. Thus, in general, it is not enough to add a gamified layer on the top of the material providing health effects. In order to be successful, the whole health product or service has to be developed from the outset as a game based on the conventions of the core-game games industry and it should contain all the essential elements of a game.

It can be asked whether or not core games are the right reference for current health games at all. On the other hand, a mobile-based Moves[7] or an online-based Lumosity[8], for example, are closer to mobile and online applications with some game like mechanics, than core mobile or online games. Consequently, they do not try to compete with core mobile games at all. On the other hand, many of the most successful mobile applications are games, and thus if one wants to reach a mass audience, one has to ensure that the applications are entertaining to use.

Furthermore, there is clear difference between the limitations of the gameplay between wellbeing and medical games. In the area of medical games, gamers usually have disabilities or diseases that the games are trying to treat. The effects that these diseases or disabilities have on a gamer and the desired actions needed to treat them have to be taken into account as general restrictions, similar to the technical restrictions of the gaming platform. For example it might not be the best idea to build up the themes of a game targeting depression, on the black humour related to death. Furthermore, the gameplay of a game targeting ADHD patients, might have to be so simple that it does not distract their very limited focus.

While developing B2B health games however, game developers usually act as the subcontractors of third parties. As market success is not usually the main goal with these games, there is an increased thematic freedom and the game mechanics do not have be so strictly focused on monetization. Common examples of such games are the browser games developed for organisations fighting unhealthy lifestyles like obesity and smoking. However, these games are usually more in the form of individual projects, rather than taking the form of games-as-a service.

The lifetime of wellbeing games closely follows the lifetime of games in the core games markets, but this is not the case with medical games. As medical games are in general sold for professional use, their lifetime is also connected with the medical equipment they are associated with (e.g. EEG equipment) or with the lifeline of the therapy methods they are gamifying.

Also the development processes differ between wellness games and medical games. The closer the health games get to the medical games however, the longer it takes to develop them due to clinical testing. Overall though, developing the games themselves takes about the same time as the development of core-games on targeted platforms.

Consequently, it is no surprise that a *game-as-a-service* approach is especially relevant for medical games, where as wellbeing games can still be more easily developed based on core game industry business models.

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[7] http://www.moves-app.com
[8] http://www.lumosity.com

Recommendations:

- Health games should be developed to be primarily entertaining and the health focus should be considered as an additional constraint, similar to the technological limitations of the publishing platform.
- A Game-as-a-service approach is especially relevant for medical games, where as wellbeing games can be more easily developed based on the business models of the core game industry.

2.3.1 Wellness games

Within the health care market segments**,** wellness games usually focus on the promotion of a healthy lifestyle and the prevention of disease. B2C Wellness games are usually sold directly to the end-consumers through the digital distribution platforms of the core games industry. They include a wide range of applications from core-games, promoting healthy lifestyle through their theme (see for example Yoga Retreat[9]). These may include simple applications focusing on the prevention of disease, for example, by encouraging people to move more by tracking the steps they walk each day. Health game developers focusing on B2B wellness games usually act as subcontractors for big NGO's, for example, in fields such as fighting obesity.

2.3.2 Medical games

Medical games are usually developed for rehabilitation use, although some core games can potentially be used to actually treat disabilities[10]. Usually the games intended for specific medical use go through clinical tests before being released to the markets. Beyond games developed for physiological rehabilitation, so-called neurogames have recently been introduced to address psychological diseases and disabilities.

Due to their medical nature, medical games are subject to much more detailed legal regulation than wellness or core games. Furthermore, often public funding (e.g. from Tekes - the Finnish Funding Agency for Technology and Innovation) is needed, as private investors are, in general, disinclined to invest in these kinds of risky projects.

As scientific proof about the rehabilitation effects of a game are, in practice, a compulsory requirement for entering the medical game markets, what clearly differentiates medical games from wellbeing games are the clinical trials that ensure that the games do indeed have the health effects they claim. With wellbeing games however, this is seldom the case. Consequently, in practice, building up a medical game requires a strong partnership with a medical university or hospital which runs such clinical tests. In this context, it is very important to remember that clinical trials and game testing are two different things: the clinical trials focus on the health effects the game has, whereas the game testing process focuses on ensuring that the game is simply a good game.

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[9] http://www.arcticstartup.com/2013/03/25/gajatri-studios-receive-further-funding-to-bring-yoga-retreat-to-mobile-platforms
[10] http://www.scientificamerican.com/article.cfm?id=video-games-make-treat-dyslexia&

A major problem for a developer of medical games is the fact that each country has a unique way of providing health care services for their citizens. Consequently, the markets are extremely fragmented and each country has extremely powerful gatekeepers (e.g. public government or medical insurance companies). Because of this, it is highly important for game developers to be included in the lists of products these gatekeepers are ready to pay for. Thus, in the area of medical games, securing good relations and a strong partnership with public sector actors is very important. Usually, this also entails a significant additional investment in public relations.

At the moment, the markets for B2C medical games are quite limited. The aforementioned Lumosity is one of the first successful examples in this field, but there is a long way to go before games will be used on a self-medication level, similar to the levels as drugs are currently used. However, the emerging *Quantified Self movement* [11], focusing on the collecting of as much data digital data about the condition of your body and daily activities as possible, can be seen as a weak signal of consumer behaviour moving in this direction.

Recommendations:

- In an ideal situation, a medical university or hospital district would produce guidelines taking into account the specific issues related to game development for conducting clinical tests.
- The European Union should provide updated information on how health care markets are structured in each member state, from the perspective of the health game developer.
- Medical game developers should pay increased attention to the way they conduct their public relations activities towards public bodies and medical insurance companies.

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[11] For further information, see for example: http://aether.com/themacroscope

3 The trends shaping the health games market

In this section, we evaluate what kind of effects the main barriers and trends shaping the games industry may have on the emerging health games ecosystem. In 3.1 we start by evaluating the technological trends challenges. Although the technological development of gaming devices has been relatively quick during recent years, each type of gaming device has their own technological strengths and limitations. As medical games especially are often targeted to user groups with special needs regarding the user interface, such limitations might be crucial for the success of the game.

We continue in 3.2 by focusing on more business-oriented issues. Mobile handhelds have helped the games industry to widen the markets to much wider consumer segments, and are slowly replacing video game consoles (namely PlayStation, Wii and Xbox) as the most significant widespread gaming platform. However, due to the rapid development of gaming platforms, it is hard to predict how big a role the emerging smart-TV markets and wearable platforms like Google glasses will take, even in the near future.

In 3.3, we discuss the suitability of the main business models present in the core-games industry for use with health games. In this section we describe in more detail the issues related to the B2C markets and B2B markets mentioned earlier, with B2C offering potentially higher revenue, whilst B2B offers potentially easier access to the public health care markets.

3.1 Technological limitations of gaming devices

3.1.1 Mobile handheld

All major smartphones and tablets come with advanced geolocation and device orientation features. This has made them an attractive platform for some health games (see for example "Zombie, Run!"[12], or Team Action Zone[13]). Furthermore, the fact that people carry smart phones with them most of the time makes them also ideal for games focusing on diet tracking.

Due to fact that cutting edge smartphones are still a big investment for end-users, they are reluctant to use them in activities that run the risk of breaking them. For this reason, many people prefer to use other electronic devices than their smartphones, for example, when listening to music whilst playing physical sports or exercising in a wet environment.

Furthermore, the very limited battery life of smart phones places significant limitations on their use as tracking devices. The popular game like tracking application Moves for example, focuses on the amount of steps you take daily, but decreases the battery life of your smart phone significantly, which makes it hard to use if you do not have the possibility to charge your phone during the day.

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[12] https://www.zombiesrungame.com
[13] http://www.taz.fi/?page_id=25

In addition, the current smart phones still have very limited sensors if compared to emerging wearable electronics (for more information see section 3.1.5). For example, The phones do not have EEG or heart rate sensors, and it looks like it will take some time before wearable electronics will be easily integrated into gaming platforms. That said however, both the Apple iWatch and Google glasses can be seen as weak signals of this being actualized.

The user interface of handhelds is usually based on touch screens. This makes them also accessible for gamers, who due to a disease, injury or old age are no longer able to use interfaces such as a keyboard and mouse. On the other hand, if the handheld manufacturers have not taken the special requirements of such users into account while developing their touch screens, a combination of keyboard and mouse can be much easier to use.

Recommendation:

- While developing health games for handhelds, the specific limitations of the devices should be carefully taken in the account, e.g. in terms of battery life and the risk of breaking the device.

3.1.2 Consoles

Motion as an input was the distinctive new feature introduced by the seventh generation of video game consoles. Nintendo started the trend in 2006 when it released the Nintendo Wii console, making motion tracking a central part of the gameplay. After the Nintendo Wii turned out to be a success, other console manufacturers quickly introduced their own motion tracking devices. Sony introduced the PlayStation Eye[14] in 2007, followed by the Sony PlayStation Move in 2010[15] and Microsoft's Kinetic[16] in 2010. Furthermore, it should be remembered that in addition to tracking devices like Kinetic or Wii Remote, dance pads have also played a vital role in exploring the possibilities of motion tracking in gameplay.

All main new generation consoles continue the support for motion tracking: PlayStation 4 comes with an updated PlayStation Eye camera, and the Xbox One comes with an updated version of Kinect together with expanded voice controls[17]. However, besides their high price for end users and a very limited mobility, the current console based motion tracking solutions also have other specific limitations. For example, Kinect works poorly in small Asian apartments[18]. From the perspective of end users however, the clear strength of video game consoles is their highly accessible user interface: All you need to do is place the game in the console and it starts. Especially with PC's, but also with mobile, starting a game requires a bit more extra effort, which might be a challenge for certain user groups.

Recommendation:

- Due to their highly accessible user interface and highly developed *motion-as-an-input* solutions, the console might provide a highly interesting platform for game developers targeting certain motion-based rehabilitation market segments

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14 http://en.wikipedia.org/wiki/PlayStation_Eye
15 http://en.wikipedia.org/wiki/PlayStation_Move
16 http://en.wikipedia.org/wiki/Kinect
17 http://en.wikipedia.org/wiki/History_of_video_game_consoles_(Eighth_generation)#Wii_U
18 http://kotaku.com/5716740/how-to-play-kinect-in-a-tiny-japanese-apartment

3.1.3 PC

Although there are a vast variety of niche input devices for PC's, in the end, only the keyboard can be considered to be genuinely universal. Additionally, as laptops with touchpads are becoming more and more popular, even the mouse is starting to become a non-universal input device. Although there are some health game developers building their games on niche input devices (e.g. Leapmotion[19]), this is always a huge commercial risk in B2C markets, if the market penetration of the input device is not already established. However, in B2B markets, the leading medical devices are often operated through a PC and thus games developed based on the input signals from these devices should be also developed for the PC.

Recommendation:

- Due to the wide variety of third party medical devices available, PC offers on interesting technological platform for medical games. On the other hand this also makes PC markets extremely fragmented and challenging.

3.1.4 Third party devices

Due to limited input possibilities, many health games rely on third party gadgets to collect required data (heart rate, body temperature, SpO2, respiratory rate, blood pressure, EEG, emotional stress etc.). However, this approach has two main problems. Firstly, the market penetration of these devices is not as big as the core gaming platforms, and secondly, these devices are not usually developed from the outset as input devices for games.

For example, when it comes to the EEG devices capable of providing relevant input data for the indication of emotional stress, their prices are still around 30,000 euros per device and they are not really mobile devices. Consequently, they currently have very limited markets and it will take some time before sensors of this kind will be available for mainstream mobile devices. However, even highly popular third party devices like heart rate monitors for exercising still have a much more limited user base than the leading smart phones.

Furthermore, as third party devices are not currently developed from the perspective of using them as input devices in gaming, the more complex the data collected by the devices gets, the greater becomes the need for specific software by which to analyse the data and create input signals out of it. This is especially the case with collecting your brain signals using EEG devices: if the EEG signals are used, for example, as input signals for a game used to treat ADHD syndrome, a specific software is needed to analyse the signals collected in the context of ADHD syndrome and then transform that information to input signals creating desired brain effects.

At the moment this software is often included in the game itself. However, as the developers of analysing software are often awful game developers and vice-versa game developers generally have no expertise in analysing brain signals, from a market perspective it would be better to treat these softwares as separate products. A company developing analysing software could even become **a** platform holder for those games targeting certain diseases and disabilities that the software is able to generate input data for. However, this would require significant investments to be realised.

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[19] https://www.leapmotion.com

In order for this kind of platform to emerge, it is crucial that the device manufacturers open the data that their devices are tracking for third party developers, for example by streaming it via a Bluetooth connection to a smartphone or to a video game console. Especially in the area of medical games, the markets around certain diseases are so small, that it does not make sense for device manufacturers to start building separate platforms for each disease segment by themselves. Furthermore, it still to be debated, as to whether or not major sport equipment manufacturers (for example Suunto, a manufacturer of heart rate monitors and outdoor sports instruments) should start building their own gaming platforms, or if it would make more sense for them to simply integrate their devices with the leading smart phones.

Recommendations:

- Software used to analyse the raw data from an input device and a health game using that data as an input signal should be treated as separate services, with different roles in the value chain.
- Third party health device manufacturers should be strongly encouraged to open the data their devices are tracking for application developers.
- Health game developers should carefully map the possibilities for co-operation with existing medical device manufacturers

3.2 Trends and challenges of main gaming platforms

3.2.1 Mobile

In addition to smart phones, tablets with their larger screen sizes offer interesting opportunities for game developers. Currently, Android run by Google and iOS run by Apple dominate these platforms. Due to their far developed monetization solutions, these platforms usually provide the best tools for monetizing the health games in B2C markets.

Although it is in principle true that a mobile game developed for these platforms is immediately available for global markets through Apple's Appstore or Google's GooglePlay distribution channels, the reality is not so simple. First of all, there are hundreds of games released for both platforms every day. For this reason, the discoverability of all games (including health games) is a challenge for developers. Secondly, the Android platform is especially fragmented. Consequently, if the features of the game based on device orientation work on one device and operating system version, it does not necessarily mean they would work on another one. Thirdly, in different market areas different smart phones are dominant. Therefore, if a health game developer is targeting emerging markets, they have to develop the game for devices that are dominant in the countries targeted.

Recommendation:

- Smart phones and tablets are likely to soon become the leading gaming platforms within the biggest gaming markets, thus they offer a high potential platform for everyone trying to maximise their revenue stream.

3.2.2 Console

A sport game called Wii Sports[20] was introduced as a pack-in game with the Wii console and it quickly became the best-selling video game of all time, outselling even Super Mario Bros. Due to its success, many health game developers have based their game on benchmarking the ideas introduced with it (see for example Limps Alive[21]). However, the progress of the console market is dependent on console manufacturers and the console publishers who act as gatekeepers in these markets. As a result, if they don't see enough economic value in the e-health games market, then introducing e-health games to those platforms is virtually impossible. A further challenge of console platforms for medical games is the fact that they rarely pre-exist in the offices of health care service providers.

Although the main console games are still released through retail markets, most console platforms also offer online stores. As self-publishing is extremely challenging to retail markets, the alternative of digital distribution channels has made limited self-publishing possible in regard to console use. The specific challenge for Xbox is the fact that Microsoft forces all game developers (including health game developers) to use an external publisher for their games, if it is released on Xbox. Unfortunately there are not many publishers who focus on health games at the moment. Additionally and by example of regional variation, any developer targeting emerging markets should remember that video game consoles are banned in China and consequently any health game published on a console platform would not have access to Chinese markets.

Recommendations:

- There are already commercial genre traditions exploring the possibilities of motion as an input solution and these should be taken in the account while developing the games for consoles.
- B2C success in the console platform usually requires support from platform holders who are currently hesitant to invest in health games.

3.2.3 PC

The traditional retail markets are currently getting smaller, as they are being replaced by online distribution platforms like Steam. Although the market size of these platforms is small, they are usually good at reaching different kinds of niche audiences. However, the challenge of these platforms is that in countries where operator billing is not accessible, they offer only limited possibilities for the mobile billing that would be a crucial requirement for making micropayments more accessible in these platforms. Furthermore, as PCs are usually the hardware that pre-exists in the offices of health care service providers, they might subsequently be the easiest platform by which to target health care professionals.

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[20] http://en.wikipedia.org/wiki/Wii_Sports
[21] http://www.limbsalive.com/

Recommendation:

- The online distribution platforms for PC are the most suitable for health games targeting niche audiences or health care service providers.

3.2.4 Online/browser

Due to fact that an increasingly large part of the human population has an internet access, browser based health games offer the best way to reach the largest possible audience. Consequently, it is an especially interesting platform for games focusing on preventive health measures such as those informing and educating the public on a healthy diet.

Due to the limitations of mobile browsers (e.g. no support for Flash, and limited support for HTML5), browser games are often built on the platform of PC browsers. With many games however, this means that they are unusable on tablet and mobile devices.

Beside the challenges related to user input devices on PCs, these types of games are also the hardest to monetize. As there are no 'ready-made' payment solutions in the online environment, one has to choose the right payment solution based on the targeted market. Furthermore, and similar to mobile games, the discoverability of games also presents a huge challenge.

The clear advantage of the online environment though, is the fact that the leading social gaming platforms (most notably Facebook), operate in an online PC browser environment. This makes it an attractive environment for games based on sharing your gaming results with your friends (e.g. social diet games). On a negative note however, although Facebook games can be played on laptops, they are still not particularly mobile when compared to smart phones and tablets.

Recommendation:

- In addition to multi-platform solutions, the online platform is the best option for those health games trying to reach as large an audience as possible.

3.3. The development of business models

3.3.1 B2C Retail

It can be asked, if health games are competing in the retail markets against the core games or other health products such as fitness equipment. Unfortunately however, all too often the retail health games are both bad games and clumsy health products.

From the games industry perspective, there is currently a clear industry trend that retail driven business models are becoming slowly obsolete, as digital distribution channels are conquering the field. This is clearly demonstrated by the financial problems major game retailers have faced during recent years. It is also clear that it is almost impossible for health games to compete in traditional retail games markets against the leading multimillion-euro AAA-games, whose biggest budgets are tens of millions of euros.

On the health product side, there might be some very limited opportunities left for health games as retail products, if supplied through the normal retail chains of other health or medical products. In this case, and especially when it comes to fitness equipment; game developers should find ways to integrate their games with leading retail products, in a way that they provide clear added value for the end consumer.

Recommendation:

- A health care developer should carefully map how medical devices in the area of health issues his or her game is addressing, are usually provided for end-users.

3.3.2 B2C Premium

The premium business models of digital distribution are based on consumers paying a fee for having access to a digital product. These business models include for example, pay-per-download and subscription. Although premium prices are in general low, consumers are still ready to pay considerable sums for specific niche products like nautical maps or specific dictionaries. This might also be the case for medical services (especially in the area of medical games), if insurance companies are ready to cover part of the costs. Furthermore, a business model based on different licenses for private and business use might be worth considering.

It will take some time however before B2C markets for medical games truly emerge. Currently there are some medical games that work as preventive self-medication, but these are not yet really competing with the drugs industry.

Recommendation:

- The health game developers should carefully benchmark the existing licensing models from the software industry providing different licenses for personal and business use.

3.3.3 B2C Freemium

The freemium business models of digital distribution are based on offering consumers free access to a digital service, where the consumer is either asked to pay for advanced features (microtransactions) or the consumer is targeted with advertising (traditional free-to-play).

The advertisement based models are especially popular in emerging markets (e.g. Africa and Latin America), where consumers have extremely limited amounts of money available for microtransactions. In many cases this approach is challenging for health games, as they are rarely able to reach a large enough audience (usually in the millions) to become a relevant advertisement channel. However, games able to reach smaller audiences with specific consuming patterns which are shaped by their health problems (e.g. diabetes), might offer interesting opportunities for an advertiser targeting these specific groups.

When it comes to games based on microtransactions, it is vital to integrate the monetization and payment models within the gameplay itself. If the health approach does not place major constraints on the gameplay, this can be done by following best practices drawn from the core games industry. However, the more constrains there are, the harder this approach becomes and thus it might present much more of a challenge for medical games.

Currently, freemium business models are becoming dominant, at least in the mobile games industry. Consequently the great promise of health games (their potential ability to decrease health care costs), is becoming easier to reach. For those health games targeting a clear major segment of the mass markets (e.g. jogging trackers, sleep monitors, training tools etc.), this might be the business model to choose. However, on the side of medical games, the use of freemium based business models is much more problematic due to the sensitive nature of health information. Often the marketing of many free-to-play games relies on viral marketing, customer acquisition, and building up and managing gamer communities. As personal health information is in many cultures considered highly sensitive, consumers might be hesitant to share for example in Facebook the fact that they are playing games which are targeted at aiding the depressed. Thus it is very important to give end consumers clear control over what health data they are willing or not willing to share.

Recommendations:

- While exploiting the possibilities of freemium business models, game developers should take carefully into account the highly sensitive nature of personal health information.
- Although the means and channels of marketing are different than traditional models, the direct and indirect costs of customer acquisition and community management can be significant. This should be taken into consideration while planning marketing strategy.
- A connection to social platforms (e.g. Facebook) is an essential element in marketing games.

3.3.4 B2B

As more and more game developers are now self-publishing, game development is becoming more and more a B2C business. However, especially in the area of medical games, B2B business models such as subcontracting and licensing might be more suitable.

In the B2B markets however, it is not enough to build individual health related products. Instead, companies should be able to provide a full service for their targeted market segment. Unfortunately at the moment, many Finnish companies operating in the B2B markets start their game development process as a part of a scientific research project targeting a specific disease, and thus face major challenges in developing a full service from the outcomes of the project.

Building up a very detailed health game focusing on one single and very narrowly defined health issue might be enough to acquire research project funding. However, from the perspective of the potential actors investing in the game, it rarely brings enough added value. For example, a physical therapist is unlikely to be interested in having a game which helps them in the rehabilitation of certain knee related injuries, but will preferably want a game helping them with other rehabilitation activities as well.

The 'Full service dilemma' could be approached by building value networks consisting of several companies, who together have the possibility to a create full service to a targeted customer market. However, even then it should be remembered that the games themselves have to be developed as being engaging as possible for the actual patient, and not interesting only to the other actors in the value chain.

The scalability of the business models behind project-based health games is a key challenge in developing sustainable business in B2B health game markets. Often, research projects focus strictly on the medical effects of the game itself. From the perspective of the end users (therapists for example), it is as important to have access to services which help them to build up a strong customer relationship with their patients and also limit their administrative burden. Due to the strict regulation of medical data however, building up the additional features of this kind is a very delicate undertaking.

From the perspective of game developers, the main challenge in entering the medical game markets are the requirements to undertake burdensome clinical trials. Often it would be enough to conduct such trials for the technology platform itself (for example, a software analysing EEG signals or tracking rehabilitation movements), and not for each game which is published that follows the guidelines of the platform. Furthermore, if this platform would be offered by a third party developer, then developing games for these platforms would not necessarily be a more expensive or slower process than developing games for any other mainstream gaming platform.
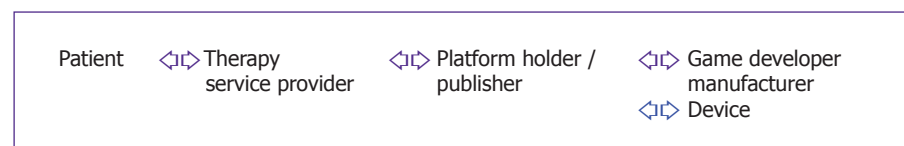
| Patient | ⇄ Therapy service provider | ⇄ Platform holder / publisher | ⇄ Game developer manufacturer |
| | | | ⇄ Device |

Figure 3: The B2B value chain

However as shown above, the B2B value chain of medical game markets is long and unfortunately for many developers, it is currently often the only way by which to access public health care markets. In addition, at the moment there really are not many publishers who focus solely on health games.

Any actor wishing to act as a medium between therapists and game developers should understand that in order to keep their platform interesting, they need to finance the games developed for their platform but let the game developers keep their Intellectual Property Rights (IPR), in order to encourage them to bring core-game IPR's to the platform. The other solution is to give game developers a significant share of the profits generated by the platform.

In current mobile platforms, game developers receive 70% of the turnover of the game and thus many developers are waiting for similar returns from other gaming platforms, if they are required to finance the games entirely by themselves. However, as it is unlikely that the therapists would be willing to reduce their share, it will be challenging to make these platforms interesting for all of the actors in the value chain. Thus the platform holders should also look for the ways to monetize the medical data they collect, exploit the advertisement potential of these platforms, and consider starting to finance the game development for these platforms themselves.

Consequently, it looks like there is a clear need for a health game related publisher or platform holder, who would facilitate the access of game developers to the health care markets. However, this demand germinates clearly from the perspective of the service provider, developer and platform, but not necessarily from the customer or end user, to whom the issue does not matter that much. At the moment this kind of publisher exists only for geographically fragmented and limited market segments. This kind of publisher does not though necessarily have to be a traditional game developer, and already there are well established national and global actors who exist in the health care markets selling traditional retail based health products, and they might be interested to co-operate in broadening their markets to include digital solutions as well.

Ultimately however, one of the main challenges to establishing well-functioning B2B health game markets is the fact that many health care professionals still have strong prejudices towards the games industry. So, it will take some time before those generations that have grown up playing video games will reach the decision making roles in this field.

Recommendations:

- Publicly funded research projects should pay more attention to ensuring that their end products take account of the requirements of both the therapists and the patients.
- At the current stage of health game markets, health game developers should focus on either co-operating with or at least carefully benchmarking already existing market platforms that provide rehabilitation services, although their business models might differ from those typical of the digital markets.

- Under the current market climate, pioneering health game developers should target becoming health game publishers or platform holders, so paving the way for the next generation of more content-focused game developers.
- When supporting the development of health games through public funding, the sustainability of their business model should be carefully evaluated.

4 Public support for health games

4.1 Financial support for research

The health game ecosystem is only currently emerging both in Finland as well as globally. As such, there are only a very limited number of private investors investing in this field and even they are sceptical, as it is not yet clear if health care markets are accessible at all for the introduction of health games, and there are only a very limited amount of success stories similar to Wii Fit to benchmark. Furthermore, it is very unclear how much consumers are willing to pay for these kinds of games, how many paying consumers actually exist, who exactly is going to pay (the end consumer or an insurance company), and how the monetization and payment methods needed can be integrated into the gameplay of health games. Consequently (and especially in Finland where acquiring private funding for your company is challenging even for those companies operating in the booming core game markets), the importance of public funding is vital.

As the development of the health game markets is in its infancy, public actors should not place any high expectations on the success of an individual health game. Hundreds of unsuccessful or only moderately successful games were developed in the Finnish mobile game ecosystem before any great success was achieved, so there will likely be many failed projects in the field of health games. However, this does not mean that the risk of failure in projects could not be decreased, for example by ensuring that in addition to funding the research, public actors would also invest in the outcomes of the research (we will discuss this in detail in the next section).

In general, there are currently plenty of research funding instruments existing for health games related research on both European and national levels. However, quite often such funding is only theoretically available, as public bodies have a very limited competence in evaluating innovative projects that unite the best practices from both the field of gaming and the field of health care. In addition, it is a clear challenge that public funding is fragmented and often more focused on current health effects, rather than the future of developed solutions in the markets. Thus funding is often for example, more focused on creating rehabilitation solutions than in securing that such services will be ultimately used by therapists. Consequently, instead of focusing on basic research in this field, given the current market position it would perhaps be more important to focus on activities which bridge the gap between health game developers and those actors providing rehabilitation services, e.g. by supporting the development of health games based on currently funded research.

The other problem with the strict health focus of health games is that they are likely to be bad games, as little effort is made to ensure that the games are developed to be primarily entertaining and only secondarily to including components that generate actual health effects. Consequently, any publicly funded project developing a health game should always have a real game developer in the consortium, ensuring that the game developed will be successful.

Furthermore, a problem with public funding is that it is often targeted at the most innovative project applications (albeit with totally unrealistic business plans and market projections), instead of more innovative projects with limited but actually existing market potential. Consequently, the innovation funding agencies should become more competent in recognising the most innovative overall solutions which lie behind the formal quality elements of the applications.

Another problem associated with public funding in Finland is the fact that each actor implements the state aid regulations in a very strict, but different way. This has lead to a situation where each organisation has their own way of regulating projects, which causes a significant amount of extra red tape for health game developers. For example, public bids are organised for even small public procurements, despite this process being unnecessary and seriously hindering the long-term co-operation between a subcontractor developing health games and the organisation providing health and welfare services. The current practice is of first hiring a consultant to map those areas of investment a public health or welfare service provider should make public funding available for, and then find a suitable subcontractor for each project. Instead, a public service provider should publish a call for interested parties for a Public-Private Partnership and build up their development projects based on the joint needs between them and selected partners. At present however, health game developers have very limited opportunities to influence the kinds of projects key health and welfare service providers are ordering from them, which considerably hinders the further development of their new innovative ideas and concepts.

Although there have been many projects trying to mainstream the best practices in the field of eHealth services, they are not widely used by Finnish health and welfare service providers. Part of the problem is that most of the funding of such projects goes towards tackling the administrative challenges involved, instead of tackling the objective itself.

4.1.1 European funding

- **Horizon2020:** under the planned programme, about 9 billion euros are allocated for health, demographic change and wellbeing. Furthermore, under this program there will be specific instruments supporting SMEs in general in terms of loans and grants.

4.1.2 National funding

At the moment many institutions in Finland are providing funding for research focusing on health games:

– **TEKES**[22], the Finnish Funding Agency for Technology and Innovation, runs a programme providing grants and loans based on innovation in social and healthcare services. The programme started in 2008 and ends in 2015. The goals of the Innovations in Social and Healthcare Services programme are: effective, customer-oriented health and social services, more extensive preventive actions, and diversified partnership and cooperation. Companies operating in Finland can apply for funding at any time. Research organisations may apply for funding during specific application periods.

– **RAY**[23], the Finnish Slot Machine Association. Having the state monopoly on slot machines and casinos in Finland, RAY targets all its profits to supporting health and welfare organisations. As subcontractors for the projects funded by RAY have to be selected through a public competition, there are rarely opportunities for long-term co-operation between an organisation providing health or welfare services and a health game developer.

– **KASTE**, the National, Development Programme for Social Welfare and Health Care is a programme funded by the Ministry of Social Affairs and Health. It focuses on developing local health and welfare services. The problem with this funding is that it is very challenging for municipalities to use, as it cannot be used for hiring subcontractors or investing in new health care solutions. Instead, any funding can normally only be used for improving internal practices. Thus this funding cannot be used to fund a health game, but only be used only for its integration within the organisation.

– **Kuntoutussäätiö**[24] is a Finnish rehabilitation fund, focusing on running projects for innovative rehabilitation services.

– **INKA**, the Innovative Cities programme funded by the Ministry of Employment and Economy, provides specific funding for the Health of the Future project[25], in the Oulu region of Finland.

At the moment there is a clear market failure in the funding of those projects which may be seen as 'risky', which effectively closes the market. As most public funding is based on research, there is often a lot of research available on the topic concerned, but nobody is currently funding actors who are willing to run small-scale tests or build prototypes to show how these research outcomes could be exploited in the markets. Consequently, a public body similar to the Finnish Film Foundation (funding commercially extremely risky projects with relatively small grants) would be of great benefit to the emerging health games market.

Recommendations:

• Public funding should focus more on bridging the market gaps instead of strictly focusing on rehabilitation solutions.

• Innovation funding agencies should become more competent in recognising the most innovative solutions that lie behind the aspects of the formal quality of applications.

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[22] http://www.tekes.fi/programmes/sosiaalijaterveyspalvelut
[23] https://www.ray.fi/en/ray/aboutray
[24] http://www.kuntoutussaatio.fi/t
[25] http://www.tem.fi/files/37119/Oulu.pdf

- Publicly funded health games projects should always have a real game developer involved, so as to ensure that the games developed are successful.
- An innovation fund should be established for supporting potential projects in risky market environments.

4.2 Public procurement

If the Finnish government and municipalities want to see a sustainable health game ecosystem emerge in Finland, they have to invest in the games themselves, in addition to the research which surrounds them. It is the only way to ensure that the companies developing health games have well structured business plans and market projections behind them instead of simply vague promises of great market potential in non-existing markets. One way of doing this would be to ask municipalities to take a more active role in investing in health games, for example by making them to target one to two per cent of their annual investment in health care on new and innovative health services and tools. This would strongly help them build up the required competence to implement new and more effective health care products more quickly. However, there is no point in investing in new and innovative services, if the developers of these services are unable to offer them because of prohibitive public procurement practices.

In 2011 alone, Finnish municipalities and insurance companies spent approximately 17,1 billion euros on providing health care services[26]. However, due to administrative barriers, it will take a long time before public procurement in this field will have any clear focus which considers health games. For example, only recently have Finnish health and welfare actors started to provide simple web-based health consultation services instead of relying on solely on the physical presence of health centres, although the technology to achieve this has existed for years. Such solutions are usually ordered from big IT-consulting companies, as the implementation of public procurement rules in Finland often leads to a situation where it is easier to order health care solutions from big companies who are adept at mastering the regulation and administrative procedures, rather than from small actors offering highly innovative and revolutionary solutions.

The current threshold for the mandatory requirement for tenders in public procurement are 100,000 euros for health and welfare services and 30,000 euros for other services. However it is unclear what kind of services are actually included in health and welfare services. Consequently there needs to be a clear decision on the part of the Finnish government that health games are indeed acknowledged to be included within the portfolio of health and welfare services.

Furthermore, NGOs and private companies should be given equal treatment in the public procurement process, if public actors want to see real markets to exist.

Additionally, when purchasing medical systems for hospitals from medical device provider giants, public actors should clearly require them to provide access to the data their systems provide, to third party application developers.

[26] http://www.thl.fi/fi_FI/web/fi/tilastot/aiheittain/talous/terveysmenot

In the USA, the United States Armed Forces is one of the key actors both investing in and boosting the development of health games as well as the input devices for them. Consequently, although the Finnish Defence Forces have significantly less research funding available than their US counterpart, they should map possible areas of co-operation in this field with the Finnish health games industry in order to maximize the effect their research efforts have on the Finnish economy. Furthermore, if Finnish defence forces are to purchase American military technology, then it would significantly help the Finnish health game industry, if they were to be included in the defence offset agreement.

As the Finnish national health care markets are small (especially in the area of highly regulated medical games); Finnish public actors should help Finnish health game developers export their games to other markets in the field. Unfortunately however, the agencies which support such export activities rarely have any specific competence that relates to this emerging market sector.

Recommendations:

- Finnish municipalities should examine the idea of using one or two per cent of their annual investment in health care on the production of new and innovative services.
- There should be clear definition on under what circumstances may health games be considered to be health and welfare services under the auspices of Public Procurement Act.
- Public actors should ensure the equal treatment of NGOs and companies providing health care services, in areas where they want functional and representative markets to exist.
- When investing in health care systems, public actors should ensure that the data provided by medical devices is made accessible to third party developers.
- The Finnish Defence Forces should deepen their co-operation with the Finnish games industry in order to identify potential projects of mutual benefit.
- Finnish agencies supporting the Finnish companies in entering global markets should build up specific competence related to eHealth markets.

4.3 Opening regulation

At the moment, the European Union in general (and Finland as part of it) have a clear competitive advantage over the USA and Japan in the area of health games due to more flexible regulation regarding the certification of medical equipment. For example, due to the complex, long and expensive authorisation mechanisms run by the FDA (the US Food and Drug Administration[27]), Europe currently offers a much more interesting development environment for innovative eHealth applications due to quicker and cheaper access to markets. Furthermore, the FDA requires a much stricter certification of medical games than do its European counterparts:

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[27] http://www.fda.gov/default.htm

How to get a FDA approval:

– A company has to closely follow an ISO certification for developing health care services. In practice, this roughly doubles the overheads associated with the development process compared to core games.
– When the health application is ready, the company has to hire a consultant to help it run clinical trials in an American research hospital. The consultant creates a trial protocol that has to be accepted by the FDA before the trial can start.
– The whole clinical trial process takes from 2-2.5 years and may easily cost millions of euros.

Valvira is the National Supervisory Authority for Welfare and Health, the Finnish counter part of the FDA. It grants licenses for professional

practice rights and medical devices. Under the European legal framework, health games are consider to be medical devices, if they are used for the diagnosis, prevention, monitoring, treatment or alleviation of disease, injury or handicap or a compensation for injury or handicap. Furthermore, medical devices are also devices developed for the investigation, replacement or modification of the anatomy or of a physiological process or a control of conception.[28]

According to FiHTA, the Finnish Health Technology Association[29], as long as a game developer does not intend a health game to be used for the medical purposes mentioned above it does not fall under the Medical Device Directive (MDD) [30] or In Vitro Diagnostic Medical Device Directive (IVD)[31] and thus CE marking is not required. If the intended use of a medical game is within the definition of a medical device or in vitro diagnostics, CE marking is needed. In such case, most likely the classification would be Class I for medical devices or General for in vitro diagnostics, and a self-declarance of conformity to the corresponding Directive would be sufficient followed by registration at Valvira.

In the end, in a specific case, the Notified Body or the National Competent Authority (Valvira in Finland) will decide whether the medical game is a medical device or not and define the risk class. If this is not possible, which may happen, as these medical games may be borderline cases, the Borderline committee under the EU Commission will make the decision. If a medical game was intended to be used as a part of a medical device or as an accessory to a medical device, it would most likely follow the same classification as the parent medical device.

[28] MEDDEV 2.1/6 Guidelines on the classification of stand alone software used in healthcare within the regulatory framework of medical devices, http://ec.europa.eu/health/medical-devices/files/meddev/2_1_6_ol_en.pdf
[29] The Finnish Health Technology Association, FiHTA, is the association for all Finnish companies in the health technology business. The purpose of FiHTA is to represent the growing Finnish health technology sector and monitor the common interests of its member companies in order to improve their business environment. FiHTA forms a substantial forum for communication, cooperation and networking. It maintains firm contacts with its interest groups and customers in the health service sector: http://www.finnishhealthtech.fi
[30] For further details see directive 93/42/EEC of 14 June 1993 (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31993L0042:EN:HTML) or
[31] See directive 98/79/EEC http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31998L0079:en:NOT

Due to the strict regulation of health information privacy, health game developer studios avoid collecting data from their users that could be used to identify them. As long as games themselves are not an integrated part of the health and welfare services provided by health care professionals, they are not developed in a site that provides health care services, and they do not identify their gamers, health games are not subject to the regulations of health information privacy. Of course, this does not mean that game developers would and should not take good care of their consumer privacy in general.

Consequent to these issues, Europe has a clear competitive advantage over the USA in the medical games markets. Inside Europe, some countries have a competitive advantage over other European countries, as their respective authorities in charge of medical devices are perhaps more receptive to innovation than others. These market advantages are however at risk as the European Union is discussing regulating the European markets of medical devices as strictly as the current system in the USA[32]. If such regulation is enforced, health game developers are likely to move their R&D efforts to less regulated regions such as Australia, in a similar manner in which the USA based developers are testing their games in Europe at the moment.

Recommendations:

- The European Union should secure its competitive advantage created by its innovation-friendly environment by not making its regulation as strict as that of the USA.

- Especially, regulators should ensure that content providers (whilst working under strict limitations set in accordance with already certified medical devices and therapy methods), will have under clearly defined circumstances, the possibility to develop immersive and engaging health games without becoming the subjects of strict regulations on medical devices and patient data.

- Due to the complex nature of the regulation targeting medical devices, medical game developers should consult external legal experts on fulfilling legal requirements in different market areas.

- Medical game developers should carefully map legal obstacles related to the use of personal health information.

4.4. Standardisation

In the area of standardisation a solid application programming interface (API) is needed to import and export information from health games to patient databases. This would help health game developers to avoid building their own patient databases and subsequently transforming their game data into heavily regulated health data. Furthermore, it increases the privacy and security of the patients when their personal information is not accessible through such games.

In addition, a standard or a certificate would be needed to indicate what kind of third party devices can be used in providing input data for medical games. There is also a need for a standard API such devices use to transform the signal from a device, to an input command in a game.

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[32] http://www.euractiv.com/special-report-medical-devices-r/us-doctors-look-envy-europe-medi-news-529026

A standard would be needed for accepted biofeedback methods in neuroplastic therapy and the ways these kinds of therapies are reimbursed by public authorities.

Recommendations:

Standardisation efforts should focus on the following areas:

- An API for importing and exporting information between health games and patient data bases.
- A standard for providing input data for medical games (transforming the signal from a device to an input command).
- A standard is needed for accepted biofeedback methods for neuroplastic therapy.

4.5 Education

The way game developers see health games is significantly different from the way doctors and other medical experts see them. While game developers in general, focus on making good games that will make a profit, medical experts focus solely on their patient's health and are far less concerned about the level of enjoyment the patients feel while undergoing a treatment. Consequently, there is not much common ground on which to base co-operation.

However, this situation is similar to the problems game developer studios face when they have to force art-oriented graphic designers, business-oriented game developers and technologically-oriented coders to co-operate with each other inside the game developer studio. As has been demonstrated by the success stories in the area of games education however, the best way to overcome these kinds of barriers is to make the actors co-operate with each other from the earliest stages of when they start their studies. Consequently, the Finnish universities focusing on medical technology (University of Oulu, University of Eastern Finland, Aalto University, Tampere University of Technology and University of Turku) should seriously consider introducing health game development into their curricula and ensure that medical, art, technical and business students are strongly encouraged to co-operate from the beginning of their studies, preferably by realizing joint projects. In Finland, due to the funding available through the Inka programme (as previously mentioned), the University of Oulu is well placed to exploit these opportunities.

Recommendations:

- Universities offering bachelor or master degrees in medical technology should introduce health games into their curricula.
- Medical students and students focusing on game development should run joint projects from the beginning of their studies.

5 Conclusions

At the moment global health game markets are just emerging. They are still at an early stage, where the terminology used to describe the market phenomena is vague, the roles in the value chain are unclear, and public and private investment in the sector is low. This makes the health games market extremely challenging, however the competition is just starting and the Microsoft, Facebook and Google type entities of the health games market are yet to be founded.

At the beginning of this paper, access to the markets, reaching talent and access to funding were identified as being the main challenges faced by a health games developer. Firstly, it is important that health game developers make a clear choice between targeting more entertainment oriented B2C wellness games markets or the more health care oriented B2B medical game markets. However, in both cases the games developed have to be good enough to be able to compete with the leading games from the traditional games industry.

As with more entertainment focused games, health games have to take carefully into account the technological and business related strengths and limitations of their gaming platforms. Whilst mobile devices are excellent for location based solutions, their limited battery life and the risks of breaking the device set obvious limitations for their use in an outdoor environment. Sophisticated motion-as-an-input solutions make consoles a highly interesting platform for some motion based rehabilitation services, but they already have fixed genre traditions on how to use the devices and the market is dominated by platform holders and publishers. For the PC there are a great number of third party devices available that make it a great platform for niche games based on niche devices. In addition, there are also lots of opportunities in the area of multiplatform gaming.

Developers should however join forces to overcome the challenges related to a lack of technological standardisation in this field. Especially, the possibilities of building an API for importing and exporting information between health games and patient databases, a standard for providing input data for medical games and a certificate of accepted biofeedback methods for neuroplastic therapy use should be exploited.

On the business side, for games targeting B2C markets, a connection to social platforms enabling viral marketing is essential. However, developers should find a sustainable balance between viral marketing and the highly sensitive nature of personal health information. Furthermore, consumer acquisition and community management might entail new health related challenges. Likewise, the developers should carefully benchmark the existing licensing models from the software industry, providing different licenses for personal and business use.

In the area of medical games, game developers have to pay specific attention to the way they take care of public relations in securing access to the lists of health services covered by public actors and medical insurance companies. Especially, pioneering companies in their respective fields might focus on benchmarking the already existing retail market platforms which provide services for the actors in the health care ecosystem and map ways with which to co-operate with them, or perhaps consider becoming health game publishers or platform holders in their own right.

Third party device developers should open access to the raw data from their devices for software developers. This would enable the raw data from the input device to be analysed and transformed into an input signal for health games targeting specific diseases. Furthermore, the health game developers should carefully map the possibilities for co-operation with existing medical device manufacturers.

Public government should take a wide range of actions at different levels. All actors funding research in this area should ensure that the prototypes developed take into account the requirements of health care actors, in addition to the needs of patients. Furthermore, the sustainability of the business model behind the health game should be evaluated as closely as the games potential health benefits.

On a European level: the European Union should secure its competitive advantage which is currently created by its innovation-friendly regulation environment in relation to health games, by not making its regulation as strict as that currently in place in the USA. Especially, regulators should ensure that content providers (whilst working under strict limitations set in accordance with certified medical devices and therapy methods), will have under clearly defined circumstances, the possibility to develop immersive and engaging health games without becoming the subjects of strict regulations on medical devices and patient data. Furthermore, the European Commission should provide updated information on how the health care markets work in each member state, from the perspective of the health game developer.

On a national level, the Finnish government should make it clear under what circumstances health games are considered to be classed as health and welfare services under Public Procurement Act. Additionally, the Finnish Defence Forces should deepen their co-operation with the Finnish games industry in order to identify potential projects with mutual benefit, and those Finnish agencies supporting Finnish companies in entering global markets should build up specific competencies related to eHealth markets.

At a local level, medical universities or hospital districts should produce guidelines which take into account the specific issues related to game development, to assist in running clinical trials. In addition, when investing in medical equipment these actors should ensure that the data provided by the equipment is made available to third party developers. Furthermore, Finnish municipalities should consider the idea of using one or two percent of their annual investment in health care on new and innovative services. In areas where they would wish actual health care markets to exist, they should also secure the equal treatment of NGOs and companies when funding services.

Higher education institutions focusing on medical technology should address the challenges related to accessing talent by including health games in their curricula. In these programmes it would be important that medical students and students focusing on game development should run joint projects from the beginning of their studies in order to increase the potential for co-operation between these two groups.

ANNEX 1: Summary of Recommendations

For Game Developers

- Developing health games in general

  - In order to be successful, like all other games health games have to be developed to be as entertaining as possible. Furthermore, in order to be easily accessible they should follow the conventions of the core games industry.
  - Although many health game solutions are theoretically possible, in reality, gameplay might be seriously hindered by technological limitations (e.g. battery life or the risk of breaking the device).
  - The technological platform the game is developed for should be carefully selected based on the technological possibilities of producing the desired health effects (for example some third party devices work only on PC, or some consoles are excellent for motion as an input). It should also be consider the means it offers to distribute the game to the desired audience (e.g. PC's are usually available in health care institutions, most end-consumers have mobile phones etc.).
  - A connection to social media platforms is vital for enabling viral marketing possibilities and targeted advertising based on health data is an interesting way to offer the game for free, however the highly sensitive nature of personal health information should be carefully respected.
  - Due to the limited target group, the direct and indirect costs of customer acquisition and community management can be significant for health games.
  - Health game developers should carefully map the possibilities for co-operation with existing medical device manufacturers

- Developing medical games

  - The developers of medical games have to pay careful attention to their public relations with public bodies and medical insurance companies.
  - These developers should carefully benchmark the existing licensing models from the software industry which provide different licenses for personal and business use.
  - Medical game developers should map existing market platforms that provide medical services and exploit the possibilities for co-operation or become health game publishers or platforms in their own right.
  - The developers should map legal obstacles related to the use of personal health information.
  - Due to the complex nature of the regulation targeting medical devices, medical game developers should consult external legal experts on fulfilling legal requirements in different market areas.

- A game-as-a-service approach is especially relevant for medical games, where as wellbeing games can be more easily developed based on more retail-focused business models.

■ Required standards

- An API for importing and exporting information between health games and patient data bases.
- A standard for providing input data for medical games (transforming the signal from a device to an input command).
- A certificate is needed for accepted biofeedback methods in neuroplastic therapy.

For Third Party Device Developers

■ Third party device developers should open the raw data available from their devices to software developers analysing the raw data from the input device and transforming it to an input signal for health games targeting specific diseases.

For Public Government

■ General remarks

- Publicly funded research projects should pay more attention on ensuring that their end products take into account all the requirements of the health care actors themselves, in addition to the patient's needs.
- While supporting the development of health games through public funding, the sustainability of the applicants business model should be carefully evaluated.

■ On a European level

- The European Commission should provide updated information on how health care markets are work in each member state from the perspective of the health game developer.
- The European Union should secure its competitive advantage which is currently created by its innovation-friendly regulation environment in relation to health games, by not making its regulation as strict as that currently in place in the USA. Especially, regulators should ensure that content providers (whilst working under strict limitations set in accordance with certified medical devices and therapy methods), will have under clearly defined circumstances, the possibility to develop engaging health games without becoming the subjects of strict regulations on medical devices and patient data.

■ On a national level

   o There should be a clear definition of under what circumstances health
     games are considered to be health and welfare services, under Public
     Procurement Act.
   o The Finnish Defence Forces should deepen their co-operation with the
     Finnish games industry in order to identify potential projects of mutual
     benefit.
   o Finnish agencies supporting Finnish companies in entering global markets
     should attain competence in opening foreign health care markets to Finnish
     medical game developers.

■ On a local level

   o Municipalities

     • Finnish municipalities should examine the idea of using one or two
       percent of their annual investment in health care on new and
       innovative services.
     • Public actors should ensure the equal treatment of NGOs and
       companies when providing health care services

   o Hospitals

     • A medical university or hospital district should produce guidelines
       which take into account the specific issues related to game
       development for the purpose of conducting clinical trials.
     • When investing in health care systems, public actors should ensure
       that the data provided by medical devices is made accessible to third
       party developers.

   o Higher Education Institutions

     • Universities offering bachelor or master degrees in medical technology
       should introduce health games in their curricula.
     • Medical students and students focusing on game development should
       run joint projects from the beginning of their studies.

ANNEX 2: List of Industry Experts Interviewed

For the purposes of this study, following industry experts were interviewed:

- Mikko Honkakorpi, Culminatum Innovation, http://www.culminatum.fi
- Tiina Zilliacus, Gajatri Studios, http://gajatristudios.com
- Hannu Vuola, Serious Games Finland, http://www.seriousgamesfinland.com
- Timo Ahopelto, Lifeline Ventures, http://www.lifelineventures.com
- Ville Tapio, Mental Capital Care, http://www.mentalcapitalcare.fi