Developing new VR possibilities for the Sports and Fitness Sector in Finland

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Abstract

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Virtual reality is here and ready to change our current understanding of reality. In a world already possessing artificial intelligence, self-driving cars and robotics, virtual reality is finally able to do what it has promised to for some time now: create a fully immersive virtual environment that a person can enter from the real world. Many companies, even those outside of technological fields, have recognized the impact that virtual reality has on business, and have adopted it as a part of their operations.

The health and wellbeing industry has been changing enormously in Finland for the past decade; innovation and digitalization are the driving factors for its growth. However, operators in the sports and fitness sector often seem to have not kept up with technological improvements, despite the ongoing fitness trend and the revolution in digital health tracking devices.

This thesis investigates the following areas: digital services used in the health and wellbeing industry, exergaming as a phenomenon, the history of virtual reality and the opportunities that virtual reality has to offer today for operators in the sports and fitness sector. Based on a literature review and interviews with VR experts in the fall of 2019, can better ascertain whether virtual reality could be integrated into effective exercise methods, when bringing a new and disruptive product onto the market in this highly competitive field. Results showed that challenges that come with virtual reality include the requirements of high speed and data, virtual reality sickness and the expensive, heavy and heated virtual reality gear. In the area of exercise, these challenges need to be addressed, in order to keep the experience enjoyable for customers and investment in VR worthwhile for the companies involved. Virtual reality offers a competitive advantage in the sport and fitness sector. Upcoming 5G technologies support the development of virtual reality in terms of faster speed and less latency, which can decrease virtual reality sickness, along with smaller, standalone virtual reality gear, which allows free movement for the user to exercise in versatile and previously impossible ways.

Keywords
virtual reality, exercise, health, fitness, exergaming, service design.

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1   Introduction

Wellbeing in Finland has been a huge trend for the past years and there is no end for the trend in sight. People swear by fitness applications and activity tracking devices, which are dominating the Finnish health technology market. Health and wellbeing industry has gone through drastic changes and the industry is clustered to smaller sectors, where digitalization is playing a huge role in all sectors. One of the sectors being sports and fitness sector that is highly affected by social media and digital platforms.

Digitalization brings new services and products but also reforms the current ways of doing. Virtual reality is one of the interesting technologies that has risen in the digital era but is nowhere near to reaching its fullest potential. This thesis tries to find answers to whether virtual reality could bring new opportunities for the sports and fitness sector in Finland.

1.1   Background

Inspiration for the thesis topic came from a gym called Fitness Village located in Helsinki, Finland. Noticing that the people were bored and frustrated of doing cardio exercises for over 30 minutes straight made me think about possible development ideas and the idea of gamification came into play from Fitness Village's own mobile application "Fitness Village – the game".

The main idea of this game was to work like Pokémon Go, the game that took everyone by storm a few years ago and where you catch and fight these little Pókemon species to level up in the game. The game makes the user walk to different places called "battle arenas" in the map, which are located in the user's neighborhood area (or more than 10 kilometers away, if you are willing to walk that far) and fight the creatures in those battle arenas. Developers of "Fitness Village – the game" had realized the exercising aspect of Pokémon Go and then created a new game to act as a reward system for the walking or other exercise the user had done.

The game also had minigames which were intended for users to play while exercising on a cardio machine to pass the time. The game sounded great, but it was poorly marketed and therefore not many gym members knew about its existence.

Although this particular mobile application did not transform the way we see exercise, it got me interested enough to investigate the possibilities of digitalization and technology

when it comes to health and wellbeing. Technology is supposed to make services more efficient and enjoyable, and there is room for technological improvement in the exercise products and services in the sports and fitness sector of health and wellbeing industry.

1.2   Objective and limitations

This thesis is limited to one area of technology, which is Virtual Reality. Virtual Reality (VR) is especially interesting since it has only been around for about 5 years (the concept was created already in the late 60s) and has not yet reached its peak. It is considered to transform the whole way we connect and interact in our personal and professional lives in the upcoming years, so we better prepare for it as early as we can.

The sports and fitness sector is the main focus area of health and wellbeing industry because the objective of this thesis is to look for ways and possibilities to use virtual reality as part of the services provided in that sector.

1.3   Purpose of the research

The results of the research can be used as a useful information by different health companies and operators in the sports and fitness field who are interested in implementing VR into their business. For instance, thesis data can be used in the planning process of creating a new fitness application or equipment or in the development process of the current ones.

Understanding how virtual reality and digital and virtual services are developing further and transforming ways of working can be useful for the companies' strategic planning process. Based on the thesis findings companies can decide whether virtual reality is suitable tool to use in their business or not. Many Finnish companies have found their ways to utilize VR as a part of their business processes through co-operation with virtual reality companies in different projects. Not only technology companies, but also companies from the fields of healthcare, education and entertainment find virtual reality to be a great competitive advantage in the business world and want to use it as their advantage as well.

2 Health and wellbeing industry in Finland

Health and wellbeing are a very widespread phenomenon and often called as a welfare industry cluster as it consists of many small health related sectors. Companies in the health and wellbeing industry are categorized as belonging to health and social sector, health and social services or the sports and fitness sector (Tevameri 2018, 3). Social and health sector consists of social services and healthcare in the public sector that take care of the health and wellbeing of the population. In this thesis we review the industry from limited perspectives and themes to what are meaningful for the research, which is extensively the sport and fitness sector.

2.1 Overview of the industry

The health and wellbeing industry as a whole is the world's biggest industry with 5 % annual growth (Business Finland 2019). Growth has been a key driver in wellbeing and health innovation in Finland, and the economic growth is supported by private consumption, productive investments of companies, as well as the long-term investments in education, innovation, and research infrastructures (Teknologiateollisuus ry 2017, 3).

According to The Finnish Health Startup Industry Report 2017 by Upgraded, most of the 62 startups participated in the survey believe that Finland provides a good platform for the development of health technology (Upgraded 2018, 25). Health technology companies act as providers of solutions and service innovation for the health and social sector. Health technology as a concept includes not only medical devices but also health technology information systems, software and other health-related devices, supplies or instruments used in sports and leisure for instance exercise bikes, heart rate monitors and activity trackers that are not directly related to medical health. Sport devices can be considered to fall within the social and health sector, particularly for aspect of maintaining and improving health (Hyvärinen 2011, 14).

In 2017 and the previous year, funding was listed as one of the biggest challenges for health startups (Upgraded 2018, 15-16). Funding, the act of outside sources to provide financial resources to startups, is still an existing challenge but the operators in the public sector are willing to invest on health startups more than before. Traditionally the public sector has provided most of the country's welfare services, especially in the social and health sector, but nowadays the aging population, overweight issues, growing child protection needs and other challenges have increased the need and demand for services.

Public sector is relying on solutions and innovation coming from the private sector to reform its current operating methods. Two ways to bring reform to public services are the use of private-public partnerships and experimentation in the development process (Martikainen 2016). Not only does the co-operation between these sectors bring different areas of expertise together and create new solutions and services, but it also narrows the gap between the two sectors.

Top field of operations within the participated health startups in the study were Medical field with 35 companies or 56% of the respondents and Wellness field that came in second with 29 companies or 47% of respondents (Upgraded 2018, 18-19). Wellness is still going strong as a trend since many companies nowadays aim their health services to not only treat illnesses but to prevent them. These top field results might seem self-explanatory since the study concerns only health startups, but there are also health startups working in the field of VR/AR, gaming and robotics, which tells that there are already companies that use gamification and new technologies in order to create innovations for the health and wellbeing industry. Some of these companies might even work on new disruptive innovations that can change the whole market.
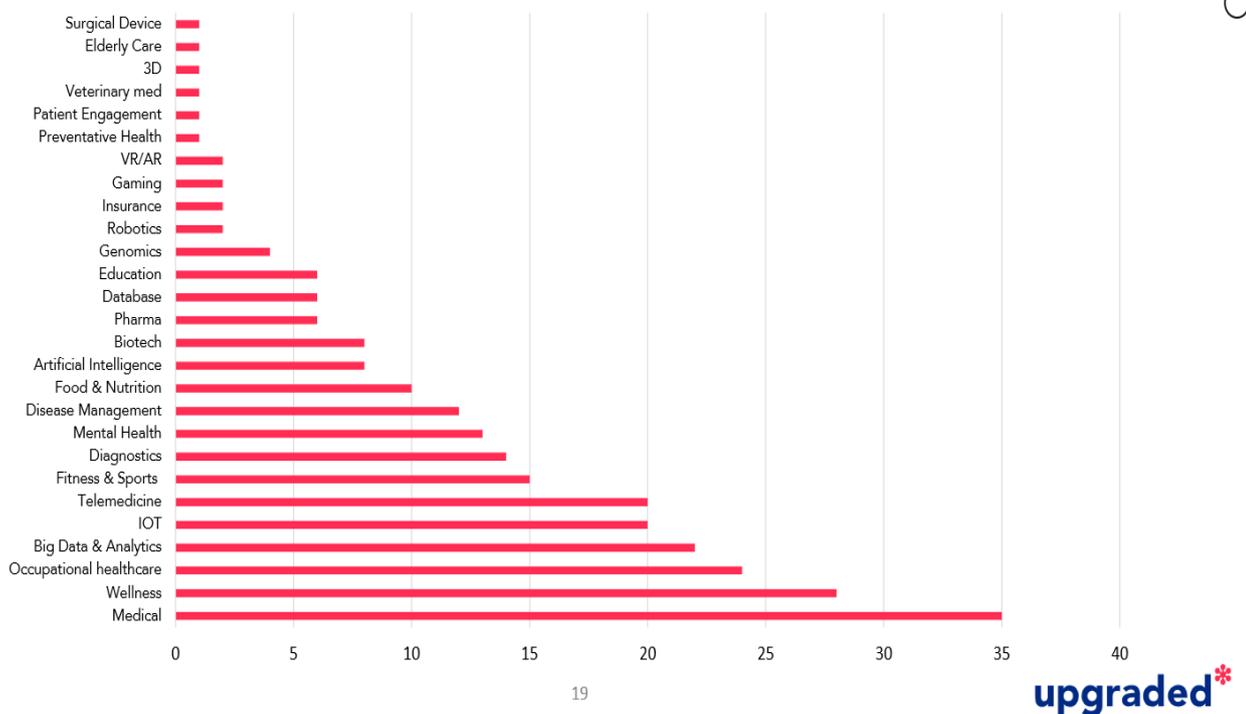

Figure 1. Health Startup Fields of Operations (Upgraded 2018, 19)

2.2   Sports and Fitness sector

Because the public sector no longer has the resources to meet the consumer needs for services, the number of private welfare companies has increased. This has also resulted as new gyms and wellness centers in the sports and fitness sector of health and wellbeing industry. The 2009 report of registered gyms and wellness centers in Finland shows that there were 450 private, commercial gyms and wellness centers and 300 public, government owned gyms in 2009 (Palmu 2009, 35). After 10 years these numbers have most likely increased with the increase in the number of gym users.

In 2009-2010 National Exercise Survey by TNS Gallup Oy, gym training was listed as a top three exercise method amongst Finnish people after cycling and walking (TNS Gallup Oy 2010, 32). Compared to the previous 2005-2006 survey, the number of gym users increased from 524 000 to 713 000, resulting in growth of 36% in three years (TNS Gallup Oy 2006, 24). From these results can tell that the number of gym users is only increasing, and by taking the same percentage of growth (36%) adding it to the following years, the number would have already doubled in 2009, being over a million in 2015 and almost two million in 2019. According to the 2019 IHRSA Health Club Consumer Report by The International Health, Racquet & Sportsclub Association (IHRSA), Finland had the third largest percentage growth of 25% in gym members worldwide in 2018 (IHRSA 2019). Finland is listed as one of the top three emerging markets for the fitness industry.

The dominant fitness trend of the 2010s has been a great influence for the growth of the gym empire. Fitness as a trend means that the desire of being physically in good shape or in other words, "fit", and having a healthy diet have become popular amongst people across the world. Globally, the fitness industry is growing massively each year and building a market share of billions of dollars in the US, Germany and the United Kingdom. One of the current global fitness industry trends that can also be seen in Finland is the market consolidation, meaning that a low number of companies control a large market share, which can be achieved by merging two or more separate companies into one. Merging is a way for companies to not only cut costs but also to gain productivity and greater investment returns (Kocic, 2017). Merging sounds like a perfect deal, but it also limits the decision making and freedom of these companies and forces them to operate under certain limits.

In Finland a good example of two merging companies in the sports and fitness sector is SATS and ELIXIA, two previously competing gym chains in the Nordics that merged into one in 2014 after realizing that they could be ruling the whole market together instead of

competing each other. Management consultant Jussi Järvinen in his Finnish Fitness Club Market Analysis of 2017 mentions these types of mergers and acquisitions (M&A) as a primary way to grow, gain footprint and play the competitors out (Järvinen 2017, 4).

There is still room for M&A consolidation in Finland, however further consolidation can destroy market value due to the increased price competition of remaining gym chains (Järvinen 2017, 3). The current gym membership prices are already high, around 60-80 euros per month for premium gyms that offer a variety of services and land on the mid-market. Gym operators like Fressi, SATS ELIXIA and Fitness Village in Helsinki region fall into the mid-market based on the high member prices and service diversification, meaning that they sell other services and products like retail or digital services as a part of their membership. On the other hand, the low market consists of cheap, "basic" gyms like Fitness24Seven, EasyFit and UniSport that only offer the essential gym services for 20-30 euros per month.

This thesis focuses more on the mid-market, which is full of gym operators that try to stand out from the big crowd with new service concepts and at the same time try to compete with the low market gyms that tempt the consumers with their prices and discount plans. The mid-market companies need to decide if they want to utilize new technologies and innovate new services to stay in the competition within the mid-market or attract the customers in the low market. Following the first option they risk losing the potential customers for the low market due to even higher prices. Some companies offer discounted services to their members as a one-time fee, in addition to the recurring membership fees. For instance, the members of a gym chain Forever in Finland can reserve a badminton court for less price or go swimming in a public swimming pool for free (Forever 2019).

Some companies even launch pop-up events in partnership with other companies inside their premises. One example is Fitness Village, who recently had a cryotherapy pop-up in their gym that was done in a partnership with CryoTech Nordic (Fitness Village Kaisaniemi 2019). Pop-ups are only available for a limited time and within that time members can either try them for free or get a good discount of the regular price. If these type of services were offered as a one-time fee with a discount for non-members, the gym could attract more potential customers and if they are left with a good customer experience, they might even return to the gym and register as a new member.

When the competition is as high as in the fitness sector, companies need to create a good customer experience in order to attract more potential customers. A customer experience (CX) is an image and a feeling that is formed by the customer from all encounters with the

company representative, channels and services (Ahvenainen, Gylling & Leino 2017, 9). A comprehensive customer experience is formed from three core elements: physical, digital and unconscious encounters (Ahvenainen & et al. 2017, 34).
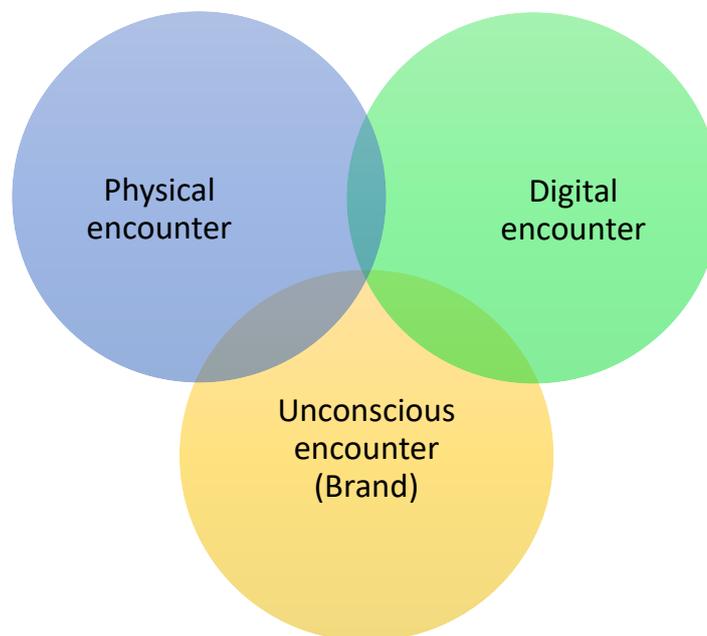
Figure 2. Elements of a comprehensive customer experience (Ahvenainen & et al. 2017, 33)

Physical encounter is the most known, traditional f2f encounter happening between the representative of a company and a customer. In addition to the physical encounter the digital encounter has become especially important in the digitalized business world. In the digital encounter the customer tries to find solutions to their problems by using a digital platform. Customers can look for services that answer to their needs through an online search. It is important for the company to be visible and on top of the search so that the customers know that their services exist and go to their website to see what they have to offer. These digital services need to be easy to use and effortless for the customer in order to create a good customer experience.

Unconscious encounter is what the customer creates unconsciously from all of their previous feelings, assumptions, views and thoughts of the company that then together form a brand experience (Ahvenainen & et al. 2017, 34). Greatest companies have built their own brand through a successful marketing strategy in order to raise awareness of the company and get recognized by customers. Customers attach feelings towards companies, and the customer's brand experience can be affected by their transaction history, cus-

tomer reviews, marketing and the previous experiences of the products and services (Ah-venainen & et al. 2017, 34). Customer experiences form the brand of the company, which can define the whole identity of the company and how customers see them.

A unique and memorable customer experience allows the company to stand out in this competitive field. For customers to see value in companies' services and to keep using them, companies use value proposition canvas as a tool to find out what are the pains and gains that customers feel about jobs or tasks they have to perform. In the value map (square) are products and services, meaning what products and services the company's value proposition is built around and what they are currently offering to help the customers get their functional, social or emotional jobs done. There are also gain creators, what positive outcomes the services have that the customers would appreciate and would be surprised by and pain relievers, services that reduce the customers' negative emotions in getting the jobs done. By identifying the pains, gains and jobs of customers, the customer map (circle) can be used to design services that the customers really care about (Oster-walder, Pigneur, Bernarda & Smith 2014, 57). With the customer map the company can try to find solutions to customer's pains and see if their current services act as gain creators for the customers.
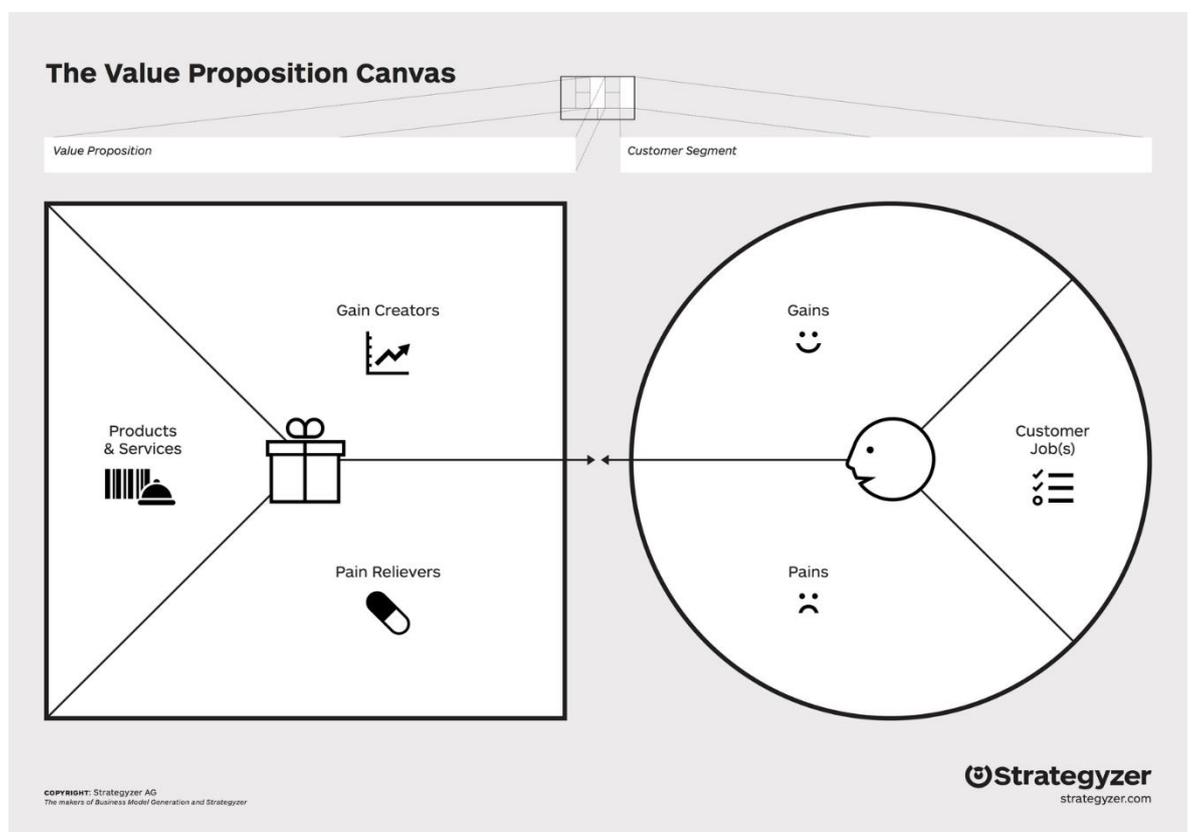

Figure 3. Value Proposition Canvas (Strategyzer.com 2019)

Companies' customer experience can be measured with different metrics, and the most used by all sorts of companies and especially by gyms is the Net Promoter Score (NPS), which is a survey that measures the satisfaction of customers based on replies on the scale of 0-10 to a single question: "How likely is it that you would recommend our company/product/service to a friend or colleague?" (Reichheld 2011, 52). NPS is calculated by subtracting the percentage of unsatisfied customers from the percentage of satisfied customers. The NPS score recommendations differ across industries, but in the fitness sector NPS over 50 is considered a healthy business (IHRSA 2016).

2.3   Digital economy

An economy based on the digitization of information and the respective information and communication infrastructure is called a digital economy (Zimmermann 2000,1). The rise of digital economy has forced businesses to reform their business models, and the main characteristics of digital economy are the changing industry structures, value creation processes, new types of products and digital platforms/services. Although Zimmermann's model was created almost 20 years ago, the structure of the model is still relevant to businesses today.
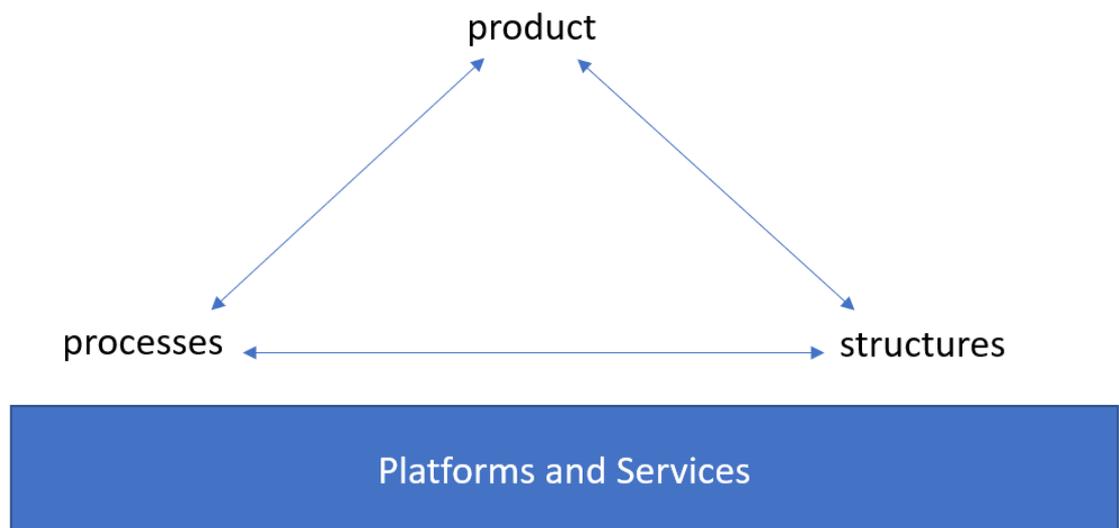

Figure 4. New Business Model (Zimmermann, 2000)

The new business model by Zimmermann shows that the newly constructed business model is built on a digital platform or a service, also called the ICT infrastructure (Zimmermann 2000,1). Companies create their own digital platform to serve as a service provider for not only the existing customers but the whole business community and to support the current marketing desires within that community. The way companies interact with their

customers have changed from treating customers as a part of a market segment to treating them as individuals (Zimmermann 2000, 3). Value creation process of businesses is more and more led by customers and their needs. Personalization, individualization and customization are popular concepts used by companies in their value creation processes but also in product development processes and goals.

A product is the main product or a service of the company that they build their business on and offer to potential customers. In the new business model, a product can offer multiple products at once as a "package deal". Example of this is the previous diversification of premium gym membership service where the customer of a gym can get access to various services like virtual exercise classes, retail or digital community platforms through one membership. Nowadays existing products can be reconfigured and integrated to new contexts, for instance bring all the features of a newspaper from its traditional infrastructure to a new context via ICT infrastructure, a digital platform (Zimmermann 2000, 3). Within the digital platform the news of the newspaper can be accessed from almost unlimited number of web pages that are linked to the news, making the product removable from its original context.

Industry structures are more versatile than before and even doing business solely as an online company can be profitable if using great digital tools. These online companies are called E-Commerce companies, and in 2017 most E-Commerce companies in Finland were working in the fields of travel, physical goods and services and streaming media (PayTrail E-Commerce Report 2017, 6). Most of the population in Finland buy their digital media and telecom services, games, tickets and memberships online (PayTrail E-Commerce Report 2017, 17). Based on how many people in Finland buy memberships online, the gym operators should create better digital platforms or services that make it easier for potential customers to buy memberships through a few clicks. Importance of personification in the service could show as a possibility for the customer to tailor the membership online to respond to their needs.

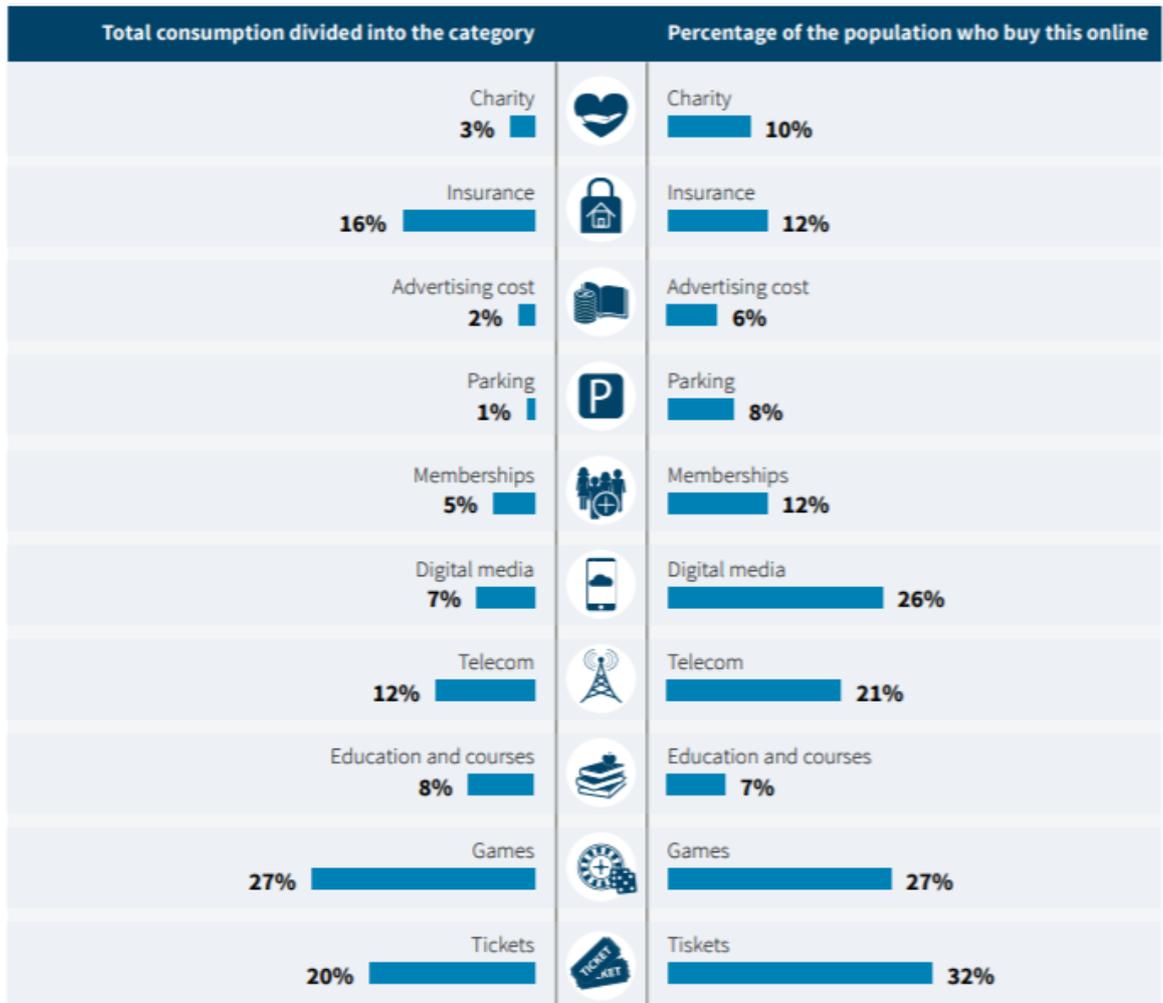| Total consumption divided into the category		Percentage of the population who buy this online
Charity 3%		Charity 10%
Insurance 16%		Insurance 12%
Advertising cost 2%		Advertising cost 6%
Parking 1%		Parking 8%
Memberships 5%		Memberships 12%
Digital media 7%		Digital media 26%
Telecom 12%		Telecom 21%
Education and courses 8%		Education and courses 7%
Games 27%		Games 27%
Tickets 20%		Tiskets 32%

Figure 5. Total consumption of services in Finland (PayTrail Finnish E-Commerce Report, 2017, 17)

IMD World Digital Competitiveness Ranking (WDCR) measures the capacity and readiness of economies to adopt and explore digital technologies as a key driver for economic transformation in business, government and society (Bris, Caballero, Cabolis & Pistis 2019, 1). WDCR is based on three factors: knowledge, which refers to adoption of ICT infrastructure and understanding the digital transformation processes, technology, how well are the new technologies enabled and future readiness, which examines the level of preparedness of an economy to digital transformation (Bris & et al. 2019, 1).

In the IMD World Digital Competitiveness Ranking for 2019, Finland ranked top 7 compared to 63 countries and had the second strongest knowledge in digital and technology skills. In the technology area Finland's strengths were in the development and application of technologies, communication technology and intellectual property rights (Bris & et al. 2019, 75). Placing first in E-Participation in the future readiness section means that Finland responds well to digitalizing public sector processes and services in the future. With

great results in technology innovation and E-Commerce market share worth 8,5 billion euros (PayTrail 2017, 6) can be seen that Finland is a big supporter of the digital economy.

2.4   Digital services today

Digitalization can give companies incredibly powerful tools to deliver unique customer experiences that allow them to create a lasting competitive advantage. The experience is then provided by a human or by a combination of human and technology, where the service path seamlessly combines the traditional analog and digital world into a customer experience world (Ahvenainen & et al. 2017, 11). Internet has made developing digital services and products possible, and digitalization has changed the consumer buying behavior strongly over time: consumers want to have more efficient and personalized service than ever, while the traditional f2f customer service is decreasing and moving towards digital service methods.

The reason why people move towards digital services is that it takes away time, place and participation restrictions, which is needed in today's busy world. And the reason why companies switch to digital services is that their services are easier to access and they can engage their customers to the services regardless of the place or time. The changing need for services have also transformed the way of designing health and wellbeing services: nowadays technology is used as a core element to build the service rather than having it only as a part of the service (Tevameri 2018, 14). A modern, digitalized service design concept by value co-creation researcher Kati Clements is based on three core elements: customer needs, innovation and technology (Clements 2017, 16). In this service design concept all the elements are equal and interact with each other.
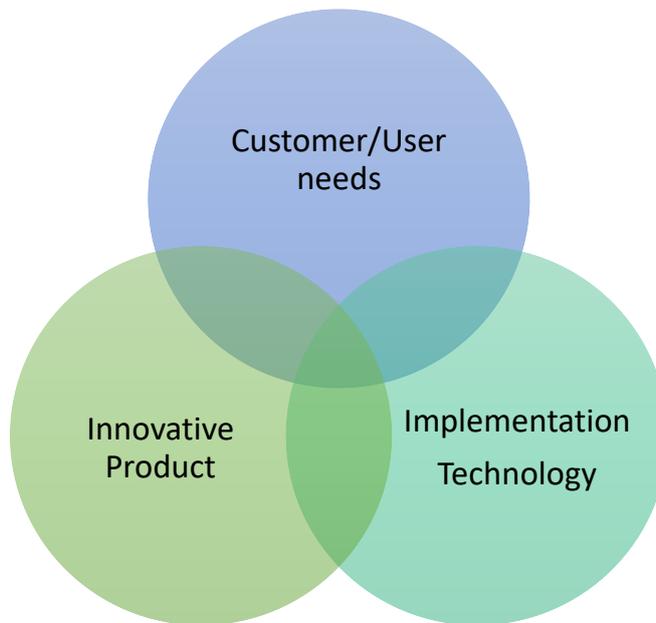
Figure 6. Modern service design (Clements 2017, 16)

When trying to match a service to the customers' needs, the service provider needs to listen and interact with the customer to get inside the mind of the customer and find out what their preferences are and what they value the most in a service. Listening to feedback and monitoring performance shows the company if they are doing something wrong or if they are on the right track. With knowing what their customers are like, they can design services that are tailored to them.

After the service provider has identified the needs and preferences of the customer, they can start designing and innovating products that match those needs or think of development ideas to the current services. With digitalization, it is possible to create something that was impossible before and solve problems of the current services to make them more efficient and up to date. It is the matter of question what technology is best to use for that service or product. After finding out a way to create that service with technology, the next and final step is the implementation (Clements 2017, 16).
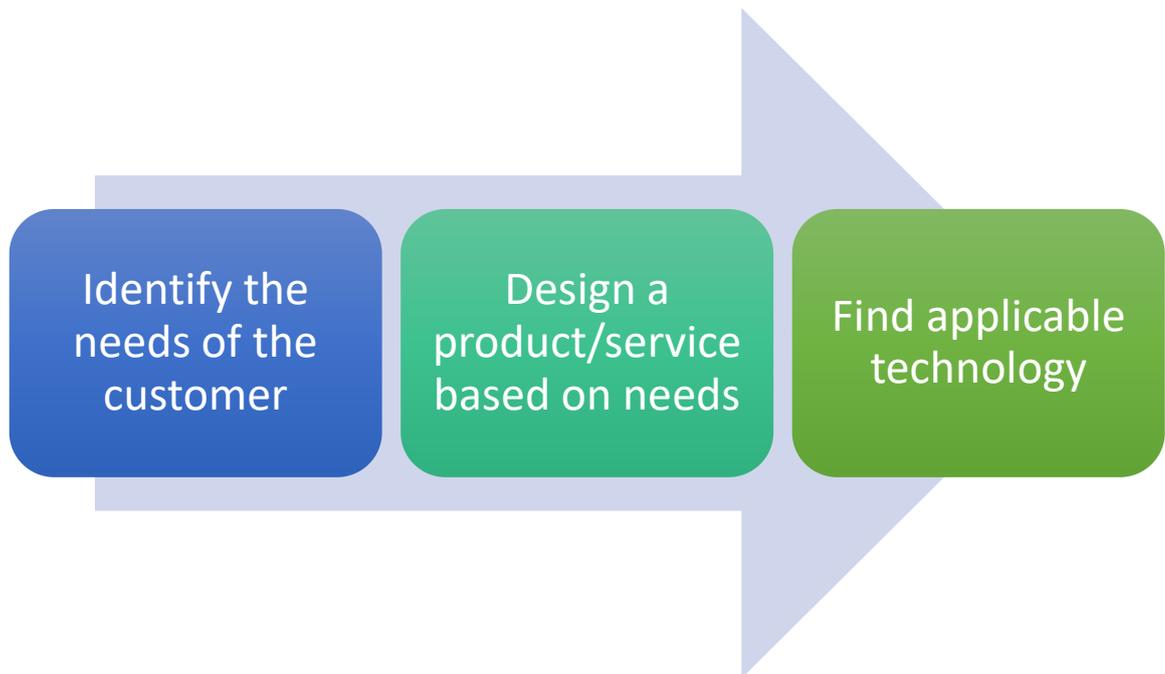
Figure 7. Basic steps in digitalized service design (Clements 2017, 15)

The modern, digitalized service design process can also be explained in three steps: identifying the needs and preferences of the customer, designing products and services that respond to those needs and finding which technologies can provide equivalent services (Clemens 2017, 15).

Example: a small gym has received feedback from customers that they wish the gym to have additional exercise methods beside the cardio machines and weightlifting. The size of the gym is too small to organize group exercise classes, so they need to come up with a service that doesn't require a lot of space. They decide to create a virtual exercise method, using a digital platform that offers virtual group exercise classes that the gym members can access from their homes or anywhere at any time.

2.4.1 Artificial intelligence

Many companies use an online chat on their website with a responding chat robot or a virtual assistant that guides the customer through the buying process. Chat robots are a popular communication tool which are developed by artificial intelligence (AI), a computer program that learns to make intelligent decisions. Chat robot uses machine learning, one type of AI to learn from every client interaction and this way improve its service methods and give the best possible answers. Some gym operators use the chat robots on their websites as a part of a buying process by recommending current membership discount plans to potential customers and answering their questions about the membership.

Other machine learning applications have also been seen in the sports and fitness sector. For instance, mobile applications that use personification to tailor fitness and health programs to the user. These can be weight loss programs, personal training or other health programs that use and track personal data (Nike+, MyFitnessPal, Polar Loop).

2.4.2 Self-tracking

People are curious about their health and find the information they need through online searches. It is simply faster and easier to access Internet nowadays than to wait a couple of weeks to get the results from the doctor or other medical professionals. It is also easier to keep track on one's own health data nowadays because of digital services.

To track one's health is possible with personal health monitoring, or in other words, self-tracking. Self-tracking is a way of finding out quantified data about yourself and using the data to track one's progress to reach a personal goal. Because some people are more interested in other aspects of health than others, like sleep or heartbeat monitoring, there have been developed customized health services like different apps or devices to match the person's needs. This tracking mindset has grown on so many people, that we now have a name for it, The Quantified Self. It refers to the cultural phenomenon of self-tracking with technology and to a community of users and makers of self-tracking tools who share an interest in self -knowledge through numbers (Wolf 2012).

2.4.3 Wearable technologies

The digital health field has experienced what seems to be an explosion of self-tracking devices and the markets for wearable technologies are expected to even double before 2021 (Sethumadhavan 2018, 29). Apps calculate quantified data of the user through a smart phone, watch or some other smart digital gadget.

FitBit, Apple, Suunto and Polar have been extremely popular digital health device providers in Finland for the past few years, from which Suunto and Polar are from Finland and have received a great recognition for their products. Usually activity trackers and other self-tracking devices come with their own mobile app that is connected to the device and from the app the user can read more detailed information about their health status. They are designed and built around different apps to control different aspects of health and wellbeing.

The device itself has simpler functions in order to be small enough to wear on the wrist or arm, but because it is usually worn throughout the day, it is the best way to self-track to

this date. The popularity of wearable technologies has increased in the recent years due to the wider range and the better quality of products. These activity trackers price range from 100 to 200 euros, Apple Watch being the most expensive one of them all with 270 euros the lowest.

Picture 1. FitBit Inspire HR (Fitbit 2019)

Although these devices seem like an easy way towards more healthy lifestyle, they are criticized to make the user care too much about numbers so that it becomes an addiction and results as worse health conditions. Numbers are supposed to lead to a healthy life-style, but they can also become a trigger to mental issues like eating disorders. In the worst case, the user's life is only based on algorithmic evaluation.

Lupton points out that expectations of normality and health are implanted in the self-tracking devices as target numbers, risk scores and gamified incentives (Pantzar & Ruckenstein 2017, 2). Tracking personal progress with numbers can become an addictive in similar ways than regular games and exercise games can. But the question on whether gaming addiction truly is unhealthy if it drives the user towards healthier habits, remains unanswered.

2.4.4   Virtual platforms

Different virtual services are available at gyms and health centers, for instance many workouts can be done at home virtually through a digital platform. As a gym member, you probably have an application or an online portal where to schedule your next gym class or massage from. Gyms and wellness centers offer all sorts of digital services for group exercise classes, cardio machines and personal training.

Companies like Pulse Fitness, which is an UK-based manufacturer that makes cardio machines and other gym equipment and CSE Entertainment, a Finnish virtual exercise game developer, have joined their forces to bring modern gym products and services that utilize digital platforms to the market (CSE Entertainment 2017).

They have created the first virtual reality platform equipment, and that was the first technological change in cardio machines after 40 years (The Pulse Group 2017). What makes the technology virtual reality is that they have built a software that views 360-video to be compatible with the cardio machine. They also mention that these machines are compatible with a VR headset, that can make the experience more immersive. While a person is running on a treadmill, a moving 360 video of different surroundings like a forest, beach or a city is displayed on the screen, making the illusion of the person actually running in those surroundings.


Picture 2. Treadmill VR (CSE Entertainment 2017)

Fitness Village has these type of treadmill VR machines as their gym equipment. Compared to traditional cardio machines, treadmill VR can offer the user something interesting to look at while doing cardio. Pulse Fitness and CSE Entertainment are planning to resume with the virtual reality platform by bringing more features to it in the future. One feature they mention is having the possibility to race against other gym users or globally in the web (CSE Entertainment 2017).

One of CSE Entertainment's most recent products is called iWall, a screen wall with a virtual gaming platform that uses the movement tracking technology, which have been used

before in Xbox Kinect and Virtual Reality. What is great about iWall is that it has multi-player games and two people can play the game from one screen at the same time, both interacting with the screen. iWall has different games for different exercise needs, for instance "Parkour" for interval training, coordination skills and strength training and "Shadow Master" for mobility, balance, acrobatics and strength training (CSE Entertainment 2017). iWall has already been introduced to schools (for children to play during a recess), gyms, activity parks, rehabilitation centers, shopping centers and other public spaces.

In a study conducted by activity park SuperPark (SuperPark Finland 2019) was found that exercising with iWall increases maximum performance, anaerobic endurance and muscle strength. The muscle activity increased 58% from the normal walking pace, and the exercise intensity reached 85% from maximum heart rate. These results indicate that training with iWall can lead to positive effects in health.
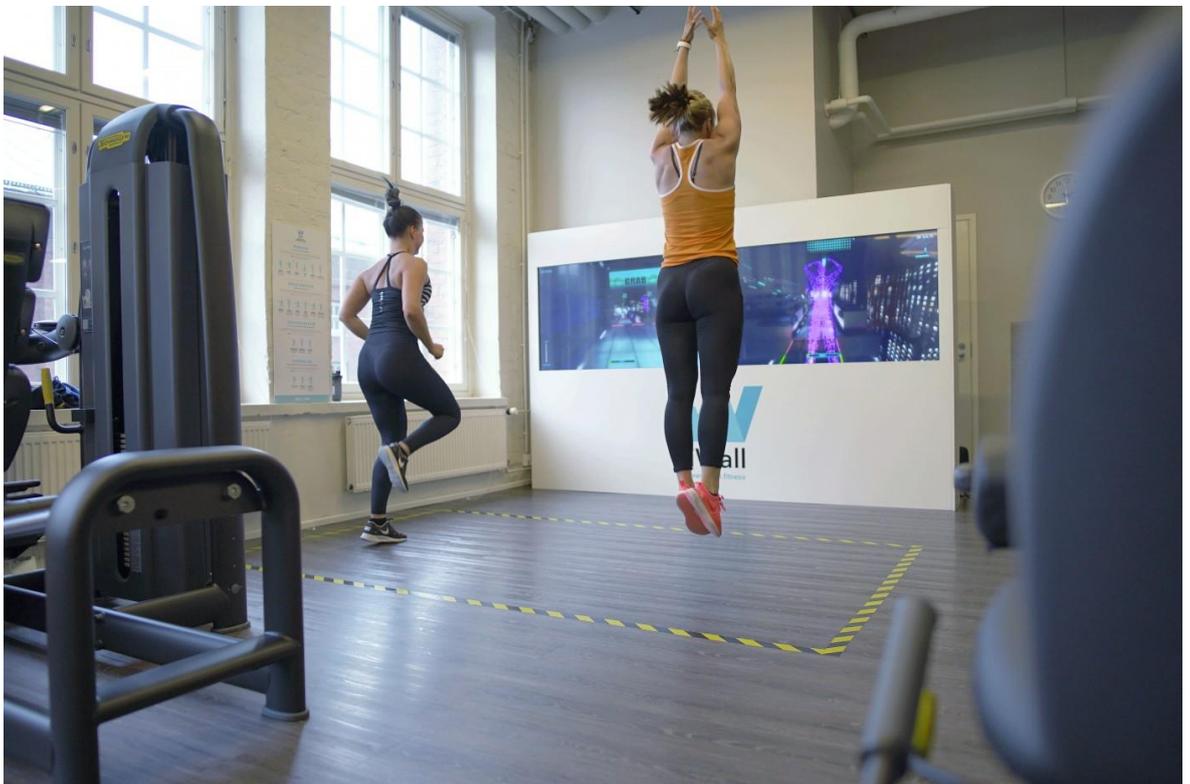
Picture 3. iWall (iWall Fitness 2019)

2.4.5 Exergaming

In order to make exercising more fun and addictive, there has been efforts to gamify existing exercise methods since the 90s. A memorable game series of that decade is Japanese gaming company Konami's Dance Dance Revolution (DDR), an arcade dance game released in 1998. The game bases on arrows that appear from the bottom of the screen

and move with the music and the player needs to press their feet on an arrow on the dance mat at the right time. The dance mat worked as a remote pad, from which the game was controlled from.

Picture 4. Dance Dance Revolution by Konami (Konami Digital Entertainment 2016)

DDR inspired many innovations to come. Janne Lähdekorpi, Development Director at Exerium used an exercise ball as a chair to help with his back pain which then gave him an idea to make the exercise ball controllable by having the dance mat remote placed in a wooden cup underneath the ball. He discovered that this way he could also control other non-complex games, which led him to realize that he could be onto something big.

In 2006, Nintendo released Nintendo Wii, a gaming console that detects movement and which brought the exergaming term to the global knowledge. At that time Lähdekorpi decided to resign from his job to study to become a programming designer. Now he works at Exerium, also known as Suomen Kuntoutusvälineet Oy, a Finnish startup company founded in 2015 that aims to create ergonomic products with the help of gamification for abdominal muscle activation and rehabilitation purposes. When designing their products, the company uses a method of combining digital technologies, gamification, physical devices and data in a unique way:
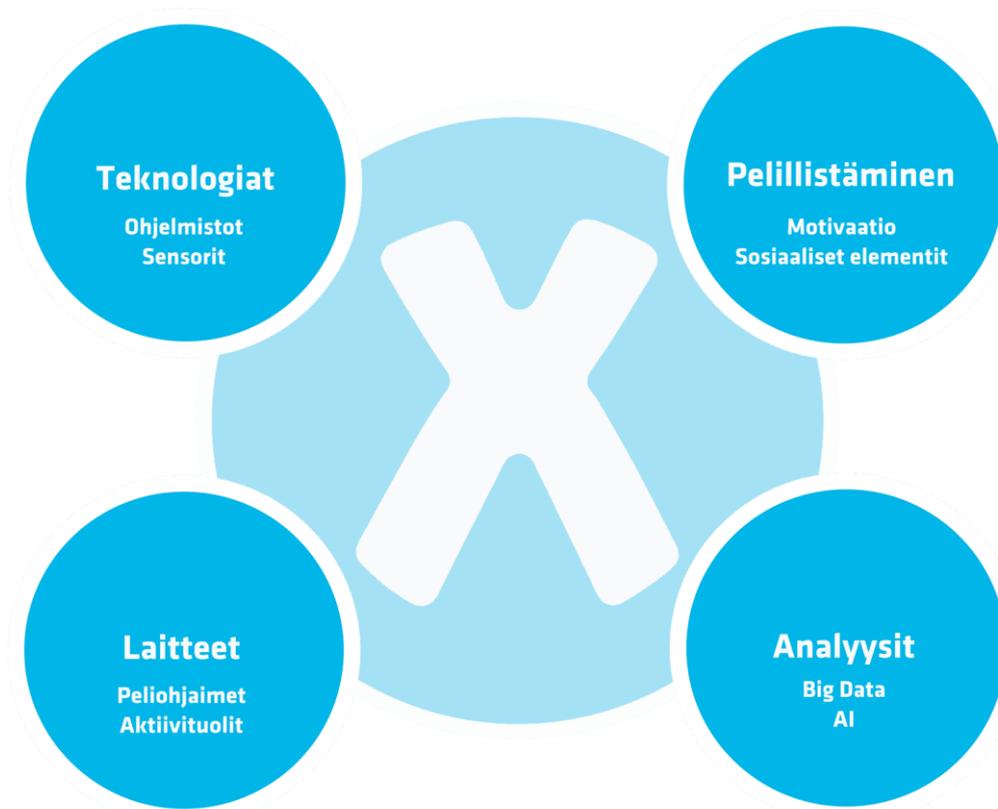
Figure 8. Exerium Product design (Exerium / Suomen Kuntoutusvälineet Oy 2019)

There are four contributing factors to Exerium's product development. Different technologies are used for the program creation and sensors to detect the movement. Gamification of the product is used to create excitement and motivation to exercise. Gamification also works as a social element as the user can share the experience with others. Physical devices like the active chairs are designed with the natural needs and instincts of people in mind, to create a product that is suitable for everyone (Lähdekorpi 18 September 2019).

With artificial intelligence and big data technologies, the company stores and analyzes data of their products to learn more about the users and deliver even better products to match their needs. Lähdekorpi says that the game-based analysis is a great research method as games can create a variety of research settings. Authentic information can be gathered from the subject because usually the user is doing their best to "beat" the game and doesn't perceive the situation as an analysis that could otherwise affect the research results (Lähdekorpi 18 September 2019).

Picture 5. Game XR (Exerium 2019)

So far Exerium has created their own ergonomic chairs. Active Chair, a saddle chair that can be adjusted to the user's best comfort and Game XR Chair, that has a gaming screen and remote handles. The game is playable with body movement and the movement's main focus is on the abdominal muscles.

In the future Lähdekorpi sees their licensed products to be produced by also other manu-factures and they intend to provide their sensors and wellbeing digital services for other manufacturers' active chairs (Lähdekorpi 18 September 2019). For instance, they have partnered up with Polar, a Finnish digital health company to have their sensor technology used in Polar products. As a small company Exerium has not reached out for the fitness sector yet as they try to focus on their main business that is wellbeing and rehabilitation, but they do have future plans for also the gyms and wellness centers.

3   Virtual Reality

Immersive technologies augmented reality (AR) and virtual reality (VR) usually go hand in hand but where AR really bases its focus on reality and the virtual information presented over the reality, VR bases virtual data as its main focus, having the user immerse into the middle of the synthetic reality virtual environment (Bastug, Bennis, Médard & Debbah, 2017, 1).

Virtual reality is a real or imagined environment that has been captured or created for either interactive or passive consumption on a wearable headset (Stuart 2019, 22). Through a headset, or a head-mounted device (HDM) you can access a virtual reality environment. Up to this date, the most seamless and realistic VR experience is provided with headsets as they close the user completely into the virtual world. There are other virtual reality technologies that don't need a headset to provide a virtual reality experience like projection walls and regular screens with virtual platforms, but they don't achieve that similar feeling of presence as the VR headset would.

3.1   Hype Cycle

Looking at the Gartner Hype Cycle for Emerging Technologies for 2017 (Panetta 2017), Virtual Reality has passed the innovation trigger and the peak of the hype phase, meaning that it has already been adopted and is reaching its way to become a mainstream product. At the peak of the hype cycle are the currently potential and interesting technologies that are predicted to take over in the next few years.
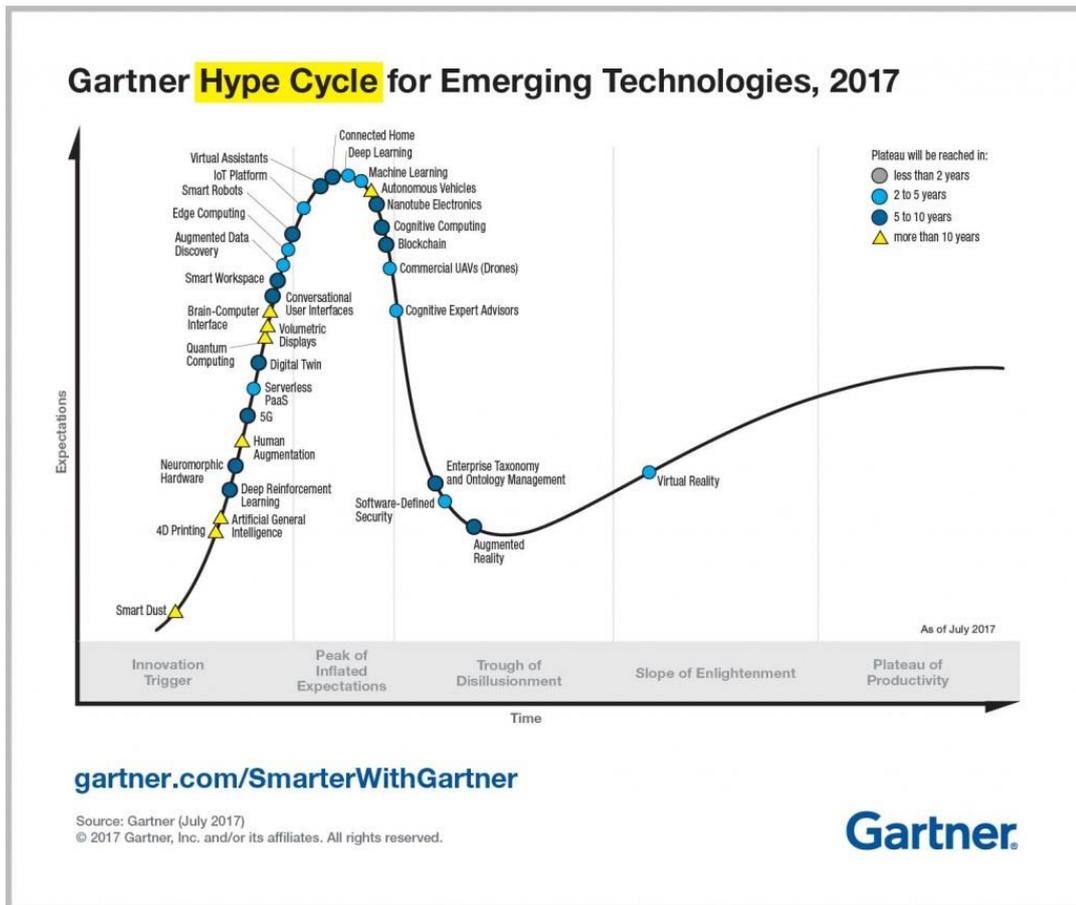
Figure 9. Gartner Hype Cycle for Emerging Technologies 2017 (Panetta 2017)

After the 2017 hype cycle there have been released the next hype cycles for 2018 and 2019, and the latter shows that different Artificial Intelligence (AI) technologies and 5G networks are listed as the current trends for 2019. In the 2019 Hype Cycle Virtual Reality is no longer visible as it has reached the plateau of productivity; it has become a relevant product for the broad market and therefore has graduated from the hype cycle. 5G on the other hand is on top of the Hype Cycle in 2019, the year when it was released to the world as an existing technology.

Figure 10. Gartner Hype Cycle for Emerging Technologies 2019 (Panetta 2019)

3.2   History of VR

Despite the quick development of virtual reality in the 21st century, virtual reality was not invented in that time era. If we think further back as to creating an illusion of being present in somewhere else than were not, then the earliest attempt at virtual reality is from the 19th century in panoramic paintings.

Panoramic paintings were intended to fill the viewer's entire vision with the painting, to feel present in the actual scene that the painting illustrates (Virtual Reality Society 2017). In Europe, panoramas were created of historical events and battles, and one of the most notable panoramic painting artists in the 19th century was a Russian painter Franz Roubaud.

Picture 6. a fragment of "Battle of Borodino" by Roubaud in 1812 (Virtual Reality Society 2017)

In 1929 Edward Link invented the "link trainer", the first commercial flight simulator that was a motor-driven device that mimicked turbulence and disturbances (Virtual Reality Society, 2016). Link trainers were used by over 500,000 pilots for initial training purposes to prepare for World War II (Virtual Reality Society 2017).

Picture 7. Blue box Link trainer G-BSFS (Marcel Van Leeuwen)

One of the first times VR was actually mentioned was back in 1935, when an idea of spectacles that show a view to another world was introduced in a comic book called Pygmalion's Spectacles by Stanley G Weinbaum. It is crazy to think how Stanley G Weinbaum had already imagined a pair of glasses which were very similar to the concept of what Virtual Reality is like today. One could say that he had predicted the future of VR.

PYGMALION'S SPECTACLES

By STANLEY G. WEINBAUM

Author of "The Black Flame," "A Martian Odyssey," etc.

© 1935 by Continental Publications, Inc.

Unbelieving, still gripping the arms of that unseen chair, Dan was staring at a forest

Picture 8. Pygmalion's Spectacles by Weinbaum in 1935 (Virtual Reality Society 2017)

Morton L. Heilig has been called the true Father of Virtual Reality, thanks to his remarkable work on Sensorama Machine in the mid of 1950s. It is a simulator for one to four people that provides the illusion of reality using a 3-D motion picture with smell, stereo sound, vibrations of the seat, and wind in the hair to create the illusion (Morton Heilig 2019).

Picture 9. Sensorama Machine 1962 (Virtual Reality Society 2017)

What made his work even more impressive was that Morton Heilig made a total of six films for his invention Sensorama by himself all the way from scratch. The titles of these films were the Motorcycle, Belly Dancer, Dune Buggy, helicopter, A date with Sabina and I'm a coca cola bottle! (Morton Heilig 2019).

Later in 1960 Heilig invented the first head-mounted display (HMD) called the Telesphere Mask, which has a wide, 3D display and stereo sound. Telesphere Mask may have started the progression of the current virtual reality headsets which look alarmingly similar, but Heilig never gained the recognition he deserved for his technological innovation. If only he knew that 55 years later his vision of virtual reality glasses would become true.

Picture 10. Telesphere Mask (Virtual Reality Society 2017)

After Morton Heilig's invention of head-mounted display there has been remarkably large development in HMDs throughout the 1960s. Worth to mention is Headsight by engineers Comeon and Bryan in 1961, which was the first motion tracking HMD that would allow the user to move their head to look around the environment.

In 1968 Ivan Sutherland and his student Bob Sproull created The Sword of Damocles, the first AR/VR head-mounted display that was connected to the computer instead of camera.
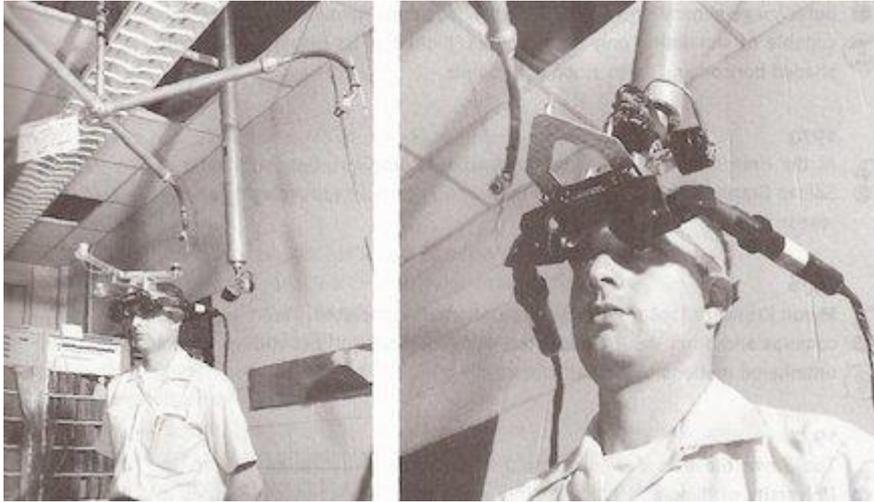
Picture 11. The Sword of Damocles by Sutherland & Sproull in 1968 (Virtual Reality Society 2017)

In 1987, the term virtual reality was finally created by Janor Lanier, the founder of VPL visual programming lab who also developed virtual reality goggles named "EyePhone" that year (Virtual Reality Society 2017).

After 1980s the virtual reality world was very silent and not any major milestones were reached until the 2010s, what we call the new wave of VR. Many people, me included, started hearing the term 'Virtual Reality' the first time around year 2013 when VR was first introduced to the gaming world in the form of Oculus Rift. The first video I saw of the topic was from Youtube's biggest gaming sensation, PewDiePie in September 2013 (YouTube, 2013).

Back then VR Glasses were very limited and there was no proper interaction from the user. The user would watch moving animations happening in front of their eyes and react to them physically and emotionally but not interactively. Bad visuals and imprecise controls of VR were reasons why gamers were not fully convinced with VR and would only try it occasionally as a fun experiment. Nowadays the visuals and the content of virtual reality games are significantly better in terms of quality and the technology allows the user to interact with the game more and become part of the gameplay.

Picture 12. "Oculus Rift: The Future is Here…" video by PewDiePie (YouTube, 2013)

2016 was a big year for VR, when HTC Vive and Oculus Rift were released to the public. Oculus VR was a division of Facebook Inc, and two weeks after declaring as an independent company they started a Kickstarter funding campaign in 2012 for Oculus Rift and the campaign raised 2,5 million dollars (2,26 million euros) from 9,500 donators (Kickstarter 2015). The project was so successful that the first consumer VR headset by Oculus was published in 2016 for 599 dollars (543 euros).


Picture 13. CV1, First consumer model of Oculus Rift (Wikipedia 2019)

For a regular household they were still too big of an investment at the time, without knowing where they would put their money into. Although the price has gone down since, the cheapest Virtual Reality gear still costs over 200 euros and is still too strange of a product for many to buy for the home use. But Pikseli Arcade might have solved that problem with their concept of a virtual park.

Pikseli Arcade allows people to come and enjoy the features of VR for less money and less commitment. Maija Ignatius, who is Store Manager at Pikseli Arcade, tells that the first time Jan Hursti, the CEO of Pikseli Arcade discovered the world of VR was in the

summer of 2016 when he tried the VR Glasses with his friends in the United States. Hursti realized that there could be ingredients for a business idea and decided to invest on virtual reality in Finland. Virva VR Oy, the parent company of Pikseli Arcade was then shortly founded at the end of 2016.

Ignatius invited me to visit one of Pikseli Arcade's locations and to try their Virtual Reality games for the first time. Pikseli Arcade says on their website that the pricing is based on the gaming time: 30 minutes of gaming time for one person costs 20 euros and one hour of gaming time costs 38 euros. Every customer gets a virtual reality headset and a gaming room in their use for the selected gaming time. They also offer series tickets and group packages for families, companies' recreations and parties. I got to try their virtual reality experience for free and bring a friend with me to their premises on 31st of August 2019 in Kalasatama, Helsinki Finland. At first you had to watch a tutorial video from a screen on the general rules and instructions. The arcade had a hallway with 15 gaming rooms, and the employee helped me and my friend to put the headsets on and choose what game to play using two hand remotes.
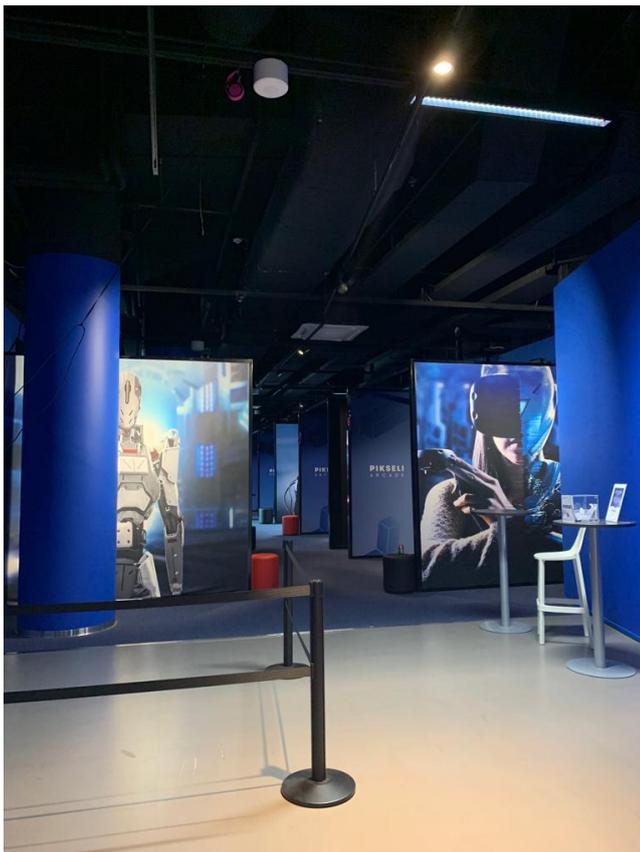
Picture 14. Pikseli Redi premises (view to the gaming rooms)

Picture 15. The author playing a VR game at Pikseli Redi

They offer a large variety of games all the way from light to medium to high intensity, and one of the most popular games they have is called 'Beat Saber", where the player is slashing beats of music that move towards the player (Ignatius 13 August 2019). Beat Saber is one of the high intensity games at Pikseli because the player is moving around constantly when trying to slash the beats as fast as they can. Another active game to play is virtual badminton, which is like playing regular badminton but the game also counts how many calories you burn as you play it. The badminton game was surprisingly addictive because it only lasted a few minutes and you could immediately start the game again. Having more options for virtual real-life sports could be a fun way to try out and play real-life sports, and it could even be an easier way for people to learn new sports. In addition to virtual reality games, Pikseli Arcade also offers cinematic VR experiences (360 video) for instance Google Earth VR and short movies.

3.3 VR types

There are different types of virtual reality and ways how to implement virtual reality. It is constantly being developed and researched to find more ways to explore the world through VR. As in 2019, virtual reality has found its way to be either in the form of being

interactive, meaning that it is a dynamic experience and it runs on game/real-time engines, or cinematic, as in the form of 360 videos, which is more of a passive approach to virtual reality.

3.3.1 Interactive VR

Interactive virtual reality, also known as immersive virtual reality, is a smooth and dynamic experience that allows the user to influence the virtual environment that is reached through a headset and delivered by a computer (Henry Stuart 2019, 2). Interactive VR is the type of VR to produce games with, as the user actually can influence the virtual environment with their actions.

The virtual experience can also be reached by a mobile-based headset like a budget VR device Google Cardboard that is sold for three euros, but because mobile devices are not as powerful as computers yet, they have a risk that the experience does not run as smoothly as it should. However, the upcoming 5G mobile networks can improve the VR mobile experience and bring better VR content to mobile applications in the future.

3.3.2 Cinematic VR

Cinematic VR, often in the form of 360-video, is inherently noninteractive, a passive experience, like watching a film (Henry Stuart 2019, 21). It differs from other types of VR by not being computer-generated nor interactive, and because of that it is even debated whether cinematic VR is truly a virtual reality experience. Although 360-video argues with the definition of virtual reality, 360-video can be viewed through a headset, that transfers the user into another world, whether that based on a real or imagined world. The world can be viewed all around the user with 3D video and full-sphere audio to reach the fullest form of the realistic feel.

360-video is a great tool for storytelling with its power to disconnect the user from everything else and make the user feel present in the story itself. Cinematic VR just might be the next big thing in cinematography that changes the way we watch movies – considering that we already have stepped into 3D and 4D movies. As an example, Pikseli Arcade and Elisa worked together in 2017 to create a 360-video film experience called "Unknown Soldier – VR experience" which was based on the Finnish cult film "Tuntematon Sotilas" (Ignatius 13 August 2019). The film experience was filmed with Nokia OZO camera and the film was viewed at selected Elisa stores for a limited period of time.

In 2014, Cinematic VR was still a struggle to produce (Bailenson 2018, 31). Jeremy Bailenson, the founding director of Stanford's Virtual Human Interaction Lab explains the filming process in his book Experience on Demand: "Coordinating the position and timing of 6 GoPro cameras simultaneously and mounting the system on a tripod sized for a football field was an endeavor full of pitfalls". Cinematic VR is not as complex to make anymore and nowadays it is comparable to regular film-making where there are actors, directors, producers, cameramen and programmers involved in the process. Cinematic VR has found its way to be the most used virtual reality technology and it is used as a tool in virtual travelling and designing architectural spaces and more.

While visiting Pikseli Arcade, I stumbled upon Google Earth VR, which is a virtual reality experience made by Google in 2016. It is based on the original digital Google Earth application that launched in 2005 and can be viewed through HTC Vive VR glasses. It virtually represents the world surroundings and it allows you to travel around the world by dragging a map with a controller and zooming in on places. You can go anywhere from the busy streets of Tokyo to the mountains of the Alps or even visit your own house. I can now say that I have been to The Grand Canyon, Antarctica and even space.
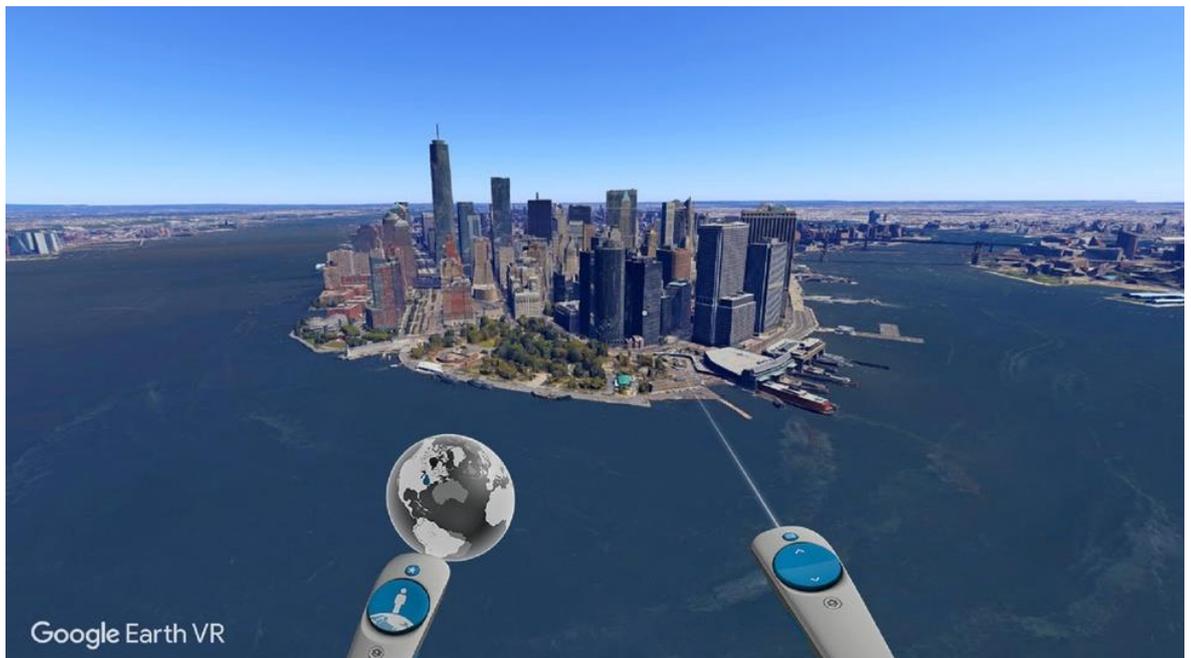
Picture 16. Google Earth VR (Google, 2019)

Floating and looking at the Earth from space can make anyone feeling sick and dizzy but if that happens whilst moving in a virtual environment, you are experiencing something called the virtual reality sickness. It happens because the brain is fooled to believe that the user is physically moving when they are only moving in the virtual environment, making a

confusion to the brain. Similar to common motion sickness, virtual reality sickness can induce a lot of physical symptoms such as general discomfort, headache, stomach awareness, nausea, vomiting, fatigue, and disorientation (Kim, Baddar, Jeong, Ro & Lim 2017, 1-4).

Virtual reality sickness is rooted from motion and simulator sickness, and the latter was reportedly experienced by U.S army pilots during and after flight simulator training and it would negatively affect their training (Crowley 1987, 355-357). Negative effects due to the simulator sickness were discouragement to use flight simulators, less efficiency to training through distraction, adaptive behaviors that were harmful for performance and safety risks when leaving the simulator. Although these were effects of the flying simulator, they also apply to virtual reality systems, which tend to be the barrier to using virtual reality.

Theories and assumptions have been made about what causes the virtual reality sickness, but it is still not completely understood. One logical explanation for the sickness experienced through VR is that the refresh rate of on-screen images (how fast the images are shown) is not as fast as the brain processes, which then creates a discord between the refresh rate and the process rate. Discord is seen as glitches, sudden malfunctions on the screen that make the user feel sick. VR would need the time between actions and the response to be less than 20 milliseconds to trick the brain and avoid latency (New Gen Apps 2018). This theory is based on the idea of sensory conflict, meaning the information your eyes receive in VR doesn't always match with your body movement.

Some technical details have also been associated with virtual reality sickness, for instance the mismatched motion, field of view and viewing angle can cause the sickness. Despite feeling sick from high places in VR, the experience was still breathtaking and surreal, looking at all the different places in the world.

3.4   5G Technology

Ever since the beginning of Internet, people have been trying to find better ways to have more effective electronic communication and faster network. Because the amount of data has grown so rapidly, the demand for faster network has increased even more in the past few years.

According to a 2018 industry analysis on mobile data usage by Tefficient, Finnish people use the most mobile data in the world (Tefficient 2018, 2-3). Finland's mobile data speed in the GSM era, between 2000 and 2001 was as low as 9,6 kbit/s (kilobits per second),

but nowadays in the 5G era the speed is up to 100 Mbit/s (Megabits per second), which is over 10 000 times faster than before. In the future the speed is only getting faster, and we can expect it to be over 500 Mbit/s by 2025 (Elisa Oyj 2018)
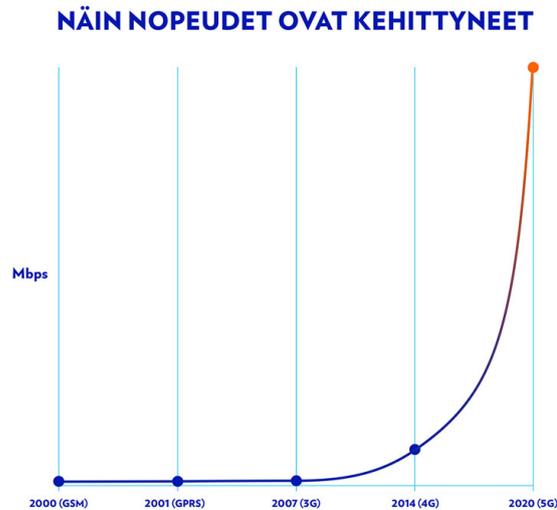
NÄIN NOPEUDET OVAT KEHITTYNEET

Figure 11. Network speed growth (Elisa Oyj 2018)

Elisa Oyj was the first mobile operator to bring 5G networks to Finland in June 2019 and at the same time presumably the first to bring commercial 5G networks to the entire world (Elisa Oyj 2018). 5G is said to be ten times faster than its predecessor 4G and allows everything to become faster that is to do with mobile and other connected devices. This brings more possibilities to having real-time interaction, which is good news to the virtual reality world.

5G helps virtual reality technologies to adapt to the demands of virtual reality applications, which include telepresence, streaming media, haptics, education and healthcare applications (Orlosky, Kiyokawa & Takemura 2017, 133). Telepresence, also referred as Telexistence is a concept of the ability to be present at a remote location in some way or form (Orlosky, Kiyokawa & Takemura 2017, 135). We are used to having conference calls that happen through a video call that creates a 2D replicated representation of the person. Soon we can expect more, as the 3D reconstruction of objects and humans is made possible with 5G network.

Haptics or haptic technology refers to a technology that can create an experience of touch by applying some sort of motion or vibration to the user (Robles-De-La-Torre 2010). For example in video games the gaming controller vibrates when the user gets hit or collides with something in the game. In Virtual Reality, haptics add sense of touch to interfaces

and virtual objects and even to textures in some extent. Thanks to 5G, a tactile Internet can be achieved which allows the sense of touch to be transmitted over long distances with or without visual feedback. Tactile Internet has been impossible before due to the amount of data required and latency issues, but soon it could also be paired with virtual reality.
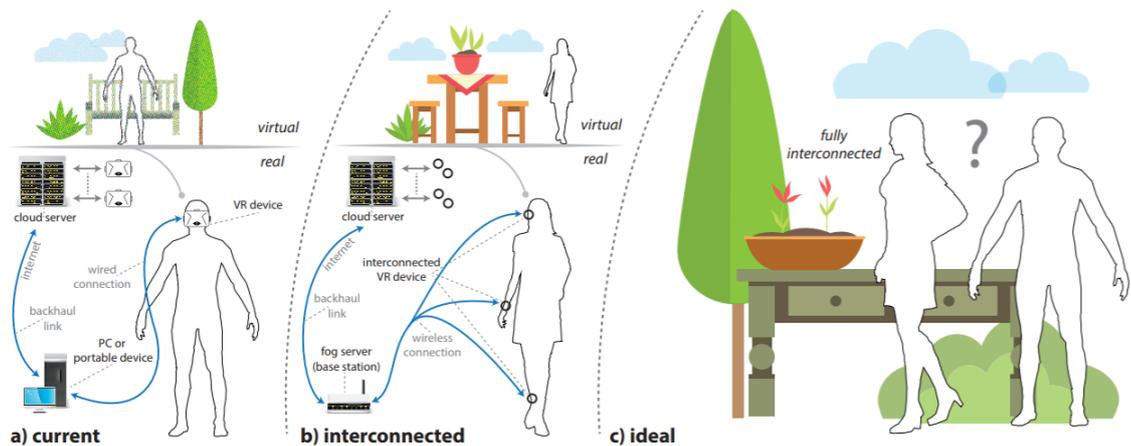

Figure 12. The current, interconnected and ideal virtual reality systems (Bastug & et al. 2017, 2)

What has prevented VR of becoming real immersive experience is that the most powerful VR products are wired with cables because the 4G wireless systems can't cope with VR's amount of transmitted HD resolution video at high frame rates (Bastug, Bennis, Médard & Debbah 2017, 1-2). The production of current VR system consists of the VR device (headset) connected with a cable to the PC or other portable device that generates the image or scene and then connected via Internet to the cloud server that streams the virtual reality software to the headset.

Next step would be the interconnected virtual reality system, a completely wireless connection between components. In this scenario the PC with a powerful CPU (Central Processing Unit) needed for current virtual reality technologies would be replaced with Cloud computing. Headsets or other VR devices would be cable-free and light to wear, as they would not need to store as much data because it would be stored in the cloud instead. This virtual reality system is what many companies are already working towards, since it is now possible to meet the virtual reality's requirements of fast data transfer and short delay with 5G networks.

The ideal scenario represents a fully immersive real-time experience combining real and virtual worlds together. The full-resolution experience that imitates human perception is the ultimate goal of virtual reality but it can't be achieved and only works as a guide for virtual reality systems. However, Cloud VR is a huge step from the computer-generated, local VR. Big technology companies like Huawei have acknowledged it as a huge trend and Huawei has already demonstrated their five major Cloud VR application scenarios to be VR video streaming, VR gaming, VR live broadcast, VR live sports and games, and VR home fitness (Huawei Technologies 2017a).

Figure 13. Transition from Local VR to Cloud VR (Huawei Technologies 2017a)

Attempts of using 5G networks with virtual reality to create an immersive experience have already been made in Finland. A Finnish teleoperator company Elisa Oyj, VR company 360Mediatalo and City of Turku joined forces to put together a virtual stroll along the River Aura for the elderly as a part of the city's development project about the possibilities of 5G in transportation, movement and preventing exclusion.

Elders who might not be able to move on their own outside got a chance to experience Turku's River Aura with the help of VR and 5G network all the way from wellness center Ruusukortteli in Turku. The VR experience was created by transmitting a real-time image of the river to the VR glasses using a 360 camera and 360Editor publishing platform by 360Mediatalo and Elisa's 5G mobile network.

Prior Konsultointi Oy recently published a study commissioned by Elisa Oyj to find out what Finnish companies think about the new 5G technology. 249 people representing 233 companies took part in the study and 75% of the already 5G invested companies believe that 5G gives a significant competitive edge to Finnish companies. Out of all the companies 50% believe in 5G's competitive edge (Prior Konsultointi Oy 2019, 12).
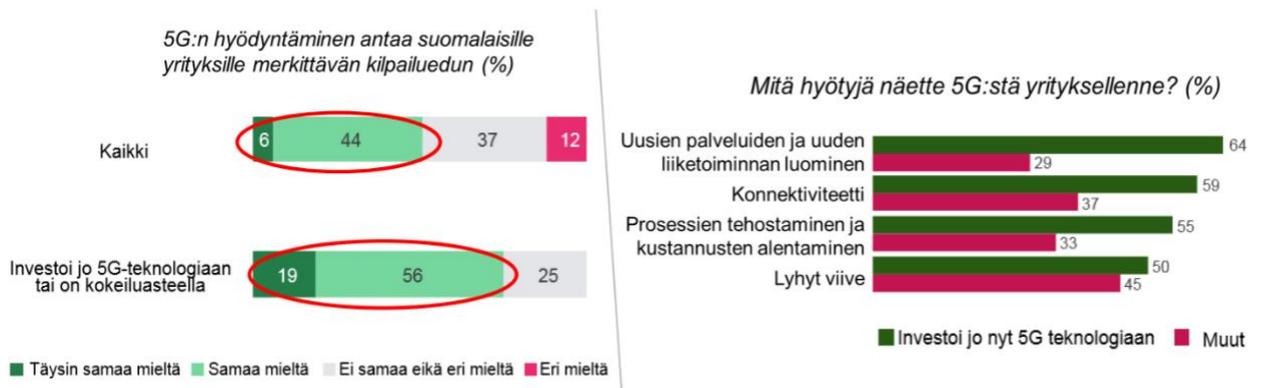
Figure 14. Elisa 5G study 1/2 (Prior Konsultointi Oy 2019, 9-12)

Among the benefits of 5G, its importance in streamlining business processes, reducing costs and creating new services and businesses were highlighted the most (Prior Konsultointi Oy 2019, 9). The most useful 5G features are high capacity (amount of data), short latency and better connectivity, which identified just under half of the respondents. Companies are particularly interested in connecting more devices to the network.
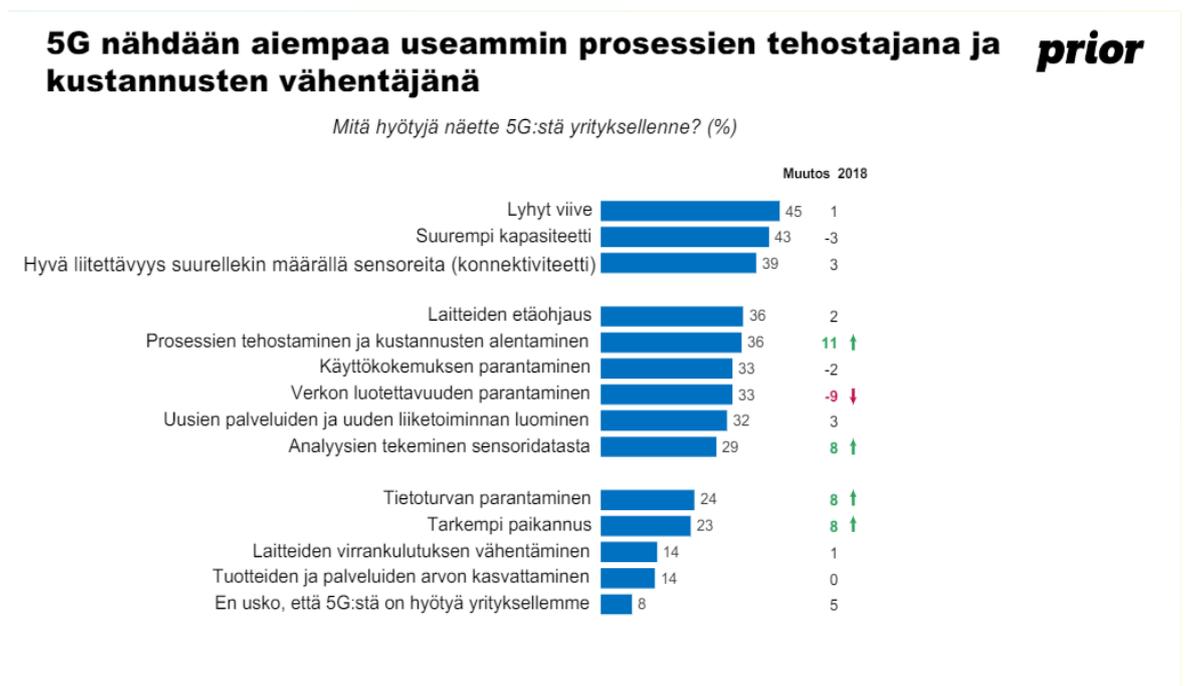

Figure 15. Elisa 5G study 2/2 (Prior Konsultointi Oy 2019, 8)

3.5   VR Markets in Finland

According to a 2017 report conducted by FIVR, Finnish Virtual Reality Association and Tekes, Finnish Funding Agency for Innovation, there were over 100 virtual reality companies in Finland. Most of the companies are located in the Southern parts of Finland. The newly found companies had their peak in 2016, when 40% of the companies in the study

were founded. In 2017 there was a decrease in founded companies despite the hype virtual reality received that year.
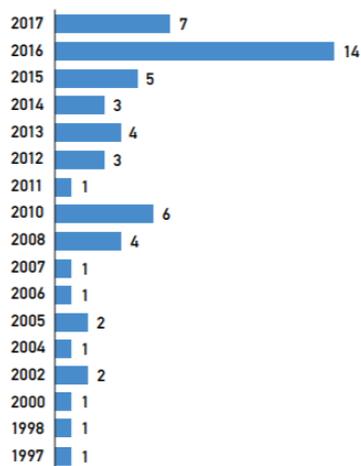

Figure 16. Company founding years (FIVR 2017, 8)

Since 2017 the number of VR companies and interest in virtual reality have increased from 2014. According to Google Trends, virtual reality was the highest searched in Finland when entering 2017 and has achieved the same heights in 2018 and 2019. There is a visible pattern of peaks at the end of each year, during Christmas time. From this one can assume that people most often search for VR games and devices right before Christmas to buy them as Christmas gifts. At other times virtual reality reaches around 50 searches per week.
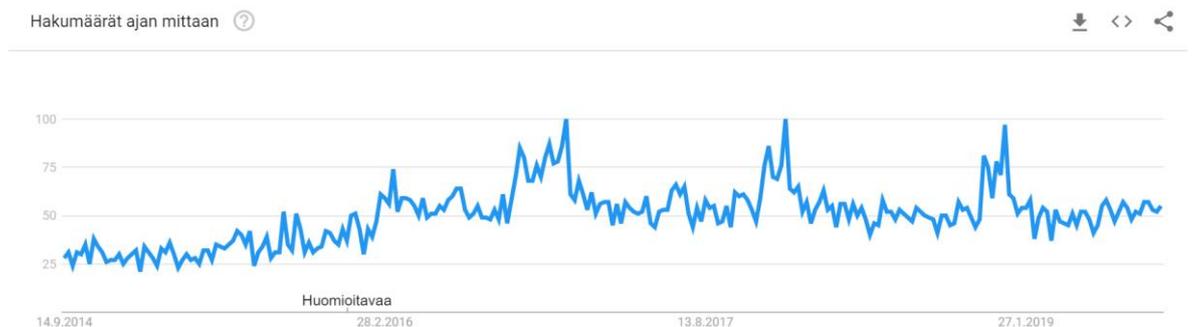

Figure 17. Number of searches for word "virtuaalitodellisuus"(virtual reality in Finnish) in 2014-2019 (Google Trends 2019)

Virtual reality is most often associated with gaming the industry, but it has also been utilized in other businesses especially from fields of construction, marketing, education and training. Finland is one of the most advanced countries in the gaming field, and many of the Finnish gaming companies have switched into fully making virtual reality games. The

reason for turning towards virtual reality is that the developers deeply believe in VR's potential to revolutionize design, healthcare, learning, marketing and training (Business Finland 2017). Other factors are the freedom when it comes to creativity and that they are able to create never seen before -content with the existing expertise and experience they have and utilize those with the greatest technology available.

In addition to creating virtual reality technologies, companies have invested in the development of virtual reality gear. The famous Finnish technology company Nokia released The Nokia OZO in 2016 and received a lot of attention for being the first professional 360 video camera that can capture live footage. It is exactly what the name claims it to be: 360-video camera, that combines pictures from eight image sensors with dynamic rendering into the camera. In 2016 Nokia OZO cost whopping 40 000 euros, but nowadays it is worth 23 500 euros. Nokia OZO is only compatible with a Mac Pro 6 Core Dual GPU computer that is worth 3 000 euros, increasing the cost and limiting its usage even more.

Picture 17. Nokia OZO cameras (virtuaalimaailma.fi, 2016)

Nokia OZO is mostly used by professionals due to the massive costs, but it can also be rented by the co-operation companies and networks of Nokia. In 2017 it was reported that Nokia has put the development of OZO in halt after their research found that virtual reality market was developing at a slower rate than expected (Allard 2017). On the bright side,

Nokia OZO was a path leader to better VR technologies and Nokia OZO technology still continues to live on with other projects although the device itself has been discontinued.

Other mentionable Finnish VR company is Varjo, founded in 2016 and specialized in high resolution VR screen technologies. They have reaped the glory overseas with their VR-1 glasses which claim to be the only VR device with a human-eye resolution and the most advanced eye tracking technology in the world. VR-1 glasses are used in training simulators, architectural and 3D design and more. Varjo VR-1 was launched to the market in early 2019, and it is already shipping to 35 countries from Europe to North America and Japan. VR-1 glasses were awarded Product of the Year at the 2019 Helsinki Design Awards (Varjo 2019).

Picture 18. VR-1 Glasses by Varjo (Varjo 2019)

4   Conducting the research

The companies involved in the research were found from the websites of Virtual Reality
Finland Ry (vrfinland.fi) and Finnish Virtual Reality Association (fivr.fi), both non-profit vir-
tual reality organizations that aim to support the development of virtual reality in Finland.
They had listed all the registered virtual reality companies in Finland on their websites.

4.1   Research methods

The research was conducted by using a qualitative research method as the main research
method, in this case in the form of an interview. The reason why this method was chosen
is that the answers from the interviews could not be measured as they are personal views
and opinions made by the interviewees. The interview questions had to be personalized
for each interview as the VR technology companies were focused on different fields, for
instance healthcare and entertainment.

The interview with Maija Ignatius from Pikseli was scheduled a week before without send-
ing the questions beforehand and executed through a 20 minute long phone call, whereas
Janne Lähdekorpi from Exerium and Olli Sinerma from FIVR sent their answers and com-
ments via e-mail, Sinerma responding almost immediately and Lähdekorpi with very de-
tailed answers a couple of weeks after sending the questions. With the research data the
aim is to understand the general fears and opportunities that virtual reality may have in the
eyes of the experts on the field. Interview questions were formed in a way that the re-
search would tell us whether virtual reality is a good exercise platform or not and why it
should or should not be implemented in the sports and fitness sector in Finland.

Literature review was used as a secondary method of the research, meaning that the ex-
isting findings and data on virtual reality and the health and wellbeing sector in Finland
were used to find answers to the research. My current workplace, Finnish mobile operator
company Elisa Oyj and their study findings were used as one of the sources to the re-
search. Elisa working with their new 5G launches and co-operating with startups and com-
panies to innovate more 5G applications from the field of virtual reality have also given
more value and insights to the writer for this research topic. Observing and taking part in
Elisa's internal events have expanded my understanding of the new technological im-
provements and plans for the mobile network market in Finland.

4.2   Interviewees

Pikseli Arcade is a company that has a concept of a virtual park that offers virtual reality games and VR escape rooms for entertainment purposes. They are the first virtual park in the world that is managed by only one employee and where all gaming rooms have the same games and there is no need for switching rooms. Currently they have 5 virtual parks in Finland, three of them located in the metropolitan area (Helsinki, Espoo, Vantaa) and the rest are in Lempäälä and Seinäjoki. I interviewed Maija Ignatius, Store Manager at Pikseli Arcade Flamingo in Vantaa, to ask her about the story behind Pikseli Arcade and what she thinks about the future of virtual reality and virtual exercise in Finland. Pikseli Arcade as a company was chosen for the research because of the entertainment and exergaming aspect of virtual reality, which would then be linked to the sports and fitness sector as well.

Exerium / Suomen Kuntoutusvälineet Oy, company located in Tampere in Western Finland, innovates new health products that focus on rehabilitation and core strengthening using gamified methods. This was an interesting concept to include in the research and learn more about from their Development Director Janne Lähdekorpi. Lähdekorpi's long history with games and exercise is fascinating and helpful to this research since combining exercise and technology (virtual reality in this case) is what the research is about.

The founder of FIVR (Finnish Virtual Reality Association) Olli Sinerma also gave his quick opinion on whether he believes that virtual reality is worth to combine with exercise. As a person who is deeply involved with the VR world and who used to own a virtual reality gaming company (Mindfield Games), his opinion on the topic is highly valued for this research and based on great experience and knowledge on VR.

4.3   Interviews

When asked about using VR as a form of exercise, Sinerma thinks that it is not comfortable for long-wear as headsets are currently sweaty due to many factors, including the screen heating, lack of air conditioning and material that touches the skin (Sinerma 10 September 2019). Heating is a common problem with any digital device and virtual reality headset is no exception. If a user spends a long time in VR, the device heats up and if the user spends the time exercising in VR, the body produces even more heat, making the situation uncomfortable. Heavy weight of the VR headset gives a hard time for the user to exercise for more than two hours (Ignatius 13 August 2019). The size and weight of virtual reality headsets is expected to become smaller, as the data stored in headsets is moving

towards cloud (Huawei Technologies 2017a). Reducing size and data processing of the headset can also help with overheating of the gear.

30 minutes of working out is usually enough to break a sweat, especially if there are workout equipment included in the workout. Beat Saber is an extremely active game to play and it only takes two rounds of Beat Saber to get sweaty from the workout (Ignatius 13 August 2019). Sinerma tells that he enjoys to play Beat Saber as a form of exercise while using sand weights on his legs and arms (Sinerma 10 September 2019).

Sinerma sees more potential in projection walls and regular screens that create a game as a motivator for exercise. Regular screens with virtual platforms are used in Exerium's Game XR Chair and in CSE Entertainment and Pulse Fitness' treadmills. These treadmills have virtual reality and gaming aspects to them, as the user can run in a virtual environment and maybe even race against others in the future (CSE Entertainment 2017). Projection wall on the other hand can be seen in CSE Entertainment's iWall, that has variety of games based on different exercise needs from practicing stability and breathing techniques to HIIT (High Intensity Interval Training). These types of workouts have been proven to lead to health benefits (SuperPark Finland 2019).

Answer to whether there are time restrictions to virtual reality is that most virtual reality games are not time restricted and the user can play the game as long as they want or are capable of (Ignatius 13 August 2019). Although there are no time restrictions in virtual reality, it is recommended by the virtual reality headset manufacturer Oculus to take a 10 to 15 minute break every 30 minutes to avoid discomfort, such as eyestrain, disorientation and nausea (Oculus 2019, 2).

As for the reasons of gamifying exercise, Lähdekorpi mentions that games bring motivation to exercise, that then leads to increasing number of repetitions. Playing games like Virtual Badminton in Pikseli Arcade changed the feeling of exercising into enjoying a fun game that could be played for hours. Time also flies fast when concentrating fully on "beating" the game, therefore gamification could act as a solution to the boring cardio machines that gyms offer today. As for the gym customers that are unmotivated and have negative feelings towards exercise, gamification could excite them about exercise and also work as gain creator, what customers would appreciate and be surprised by in their gym services (Osterwalder, Pigneur, Bernarda & Smith 2014, 56).

I asked whether they see future for virtual reality and gamification in the sports and fitness sector, and Ignatius believed that in order to bring virtual reality games to the sports and

fitness sector, there needs to be a co-operation between specialists from both virtual reality industry and health and wellbeing industry in order to fully understand the product development process (Ignatius 13 August 2019). In Finland many companies from the public sector offer partnerships to smaller start-up companies to create new innovative products and services (Martikainen 2016). This could be one way to introduce virtual reality to the sports and fitness sector, as there are already existing health startups working in VR (Upgraded 2018, 19).

Exergaming will certainly bring great opportunities to the fitness industry, as they are constantly looking for new exciting products and methods in the gym business due to the tight customer competition (Lähdekorpi 18 September 2019). In this competitive field the companies work hard to stand out, therefore having a unique service that is well marketed could bring more visibility and potential customers to the company. Existing customers could appreciate the variety of services and the social element of virtual reality, as customers would share the new gaming experiences with each other (Lähdekorpi 18 September 2019).

Virtual reality will come to the gyms and wellness centers eventually, but it may still take a while for it to happen (Ignatius 13 August). As of the current situation of VR, the virtual reality systems are moving towards a new wireless generation and transitioning from local to cloud VR (Huawei Technologies 2017a). These changes will make the movement and exercise in VR easier, but it is still unsure when that happens.

5   Analyzing the results

SWOT analysis was developed by Albert Humphrey in the 1960s to act as a tool for strategic business planning. SWOT defines all the strengths, weaknesses, opportunities and threats of the assessed matter. The analysis results can be used as a basis for drawing conclusions on how to exploit strengths and opportunities and to transform weaknesses into strengths and avoid threats.

The analyzed matter for SWOT Analysis was virtual reality as an exercise method or a service to use in the health and fitness sectors. The points in all categories are formed based on the research and the literature review. Results indicate that there are almost equal amount of threats and possibilities and more strengths than weaknesses of using virtual reality as a technology in the sports and fitness sector.
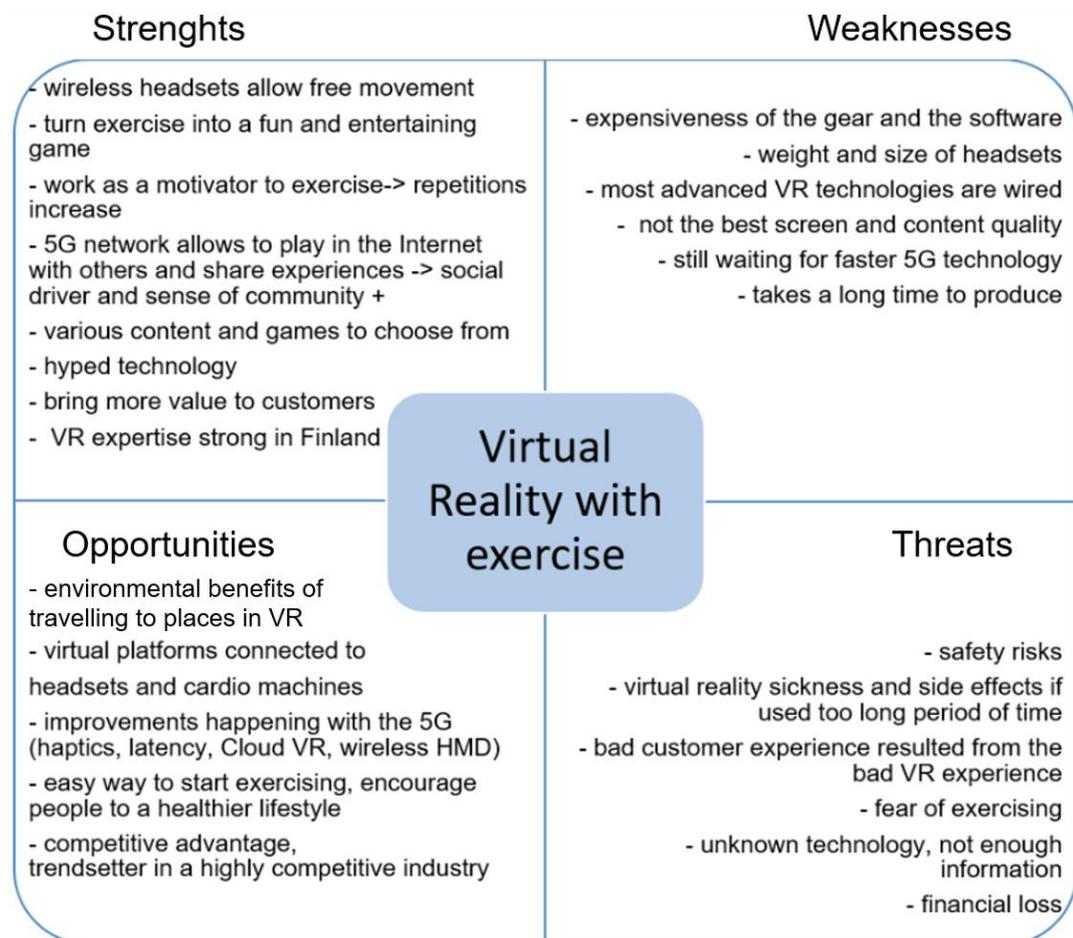

Figure 18. SWOT analysis on Virtual Reality as an exercise method

Today's virtual reality is at its best when using virtual reality glasses (headsets) but they are heavy, large and hot to wear at the moment, which takes away the functionality of ex-

ercising in VR (Sinerma 10 September 2019). The most advanced virtual reality technologies require wires because the large amount of data they process cannot cope with the current 4G wireless systems (Bastug, Bennis, Médard & Debbah 2017, 1-2). Wires tend to decrease the user's sense of reality in virtual environment because they prevent the user from moving freely. Headsets also tend to look and feel clumsy, so they are needed to be wireless and sized down to a size of sunglasses or even to a size of contact lenses to be able to move or exercise in them. However, since 2018 and 2019 a few VR device manufacturing companies like HTC Vive and Oculus Rift have managed to create wireless VR headsets, meaning that the headsets are already moving towards a wireless generation.

The expensive price is still an issue, as the cheapest wireless headsets are currently around 500 euros. And for the local VR system, which the current virtual technologies are produced with, a wired headset is around 300 euros, not forgetting that a powerful PC is needed and that usually costs 1000 euros or more. If virtual reality systems switch from local VR to Cloud VR, the PC is no longer needed (Huawei Technologies 2017b, 7). Not only does Cloud VR take a lot of the expenses off, but it also removes the cables that are otherwise plugged from the PC to the headset. The cost of local rendering PC per user is around 1270 euros whereas Cloud rendering is roughly 400 euros (Huawei Technologies 2017a).

Exercising and sickness don't go well together, so the issue of motion sickness in VR needs to be minimized to be able to add virtual reality to exercise games. With contemporary commercially available VR systems, the incidence of motion sickness after only 15 minutes is anywhere from 40 to 70 percent (Stoffregen 2019). If the user experiences virtual reality sickness, there is a threat for forming a fear or adapting a certain behavior towards exercise (Crowley 1987, 355-357). The user's negative feelings from a bad VR experience provided as a service by a company can link to a bad customer experience or even up to a bad brand experience (Ahvenainen & et al. 2017, 34). Another threat in implementating virtual reality is that the company may suffer financial losses if virtual reality fails to bring value to the customers. If virtual reality does not improve the current situation it is also not worth the investment.

A big opportunity created by virtual reality is that the user can go and exercise anywhere in the world without travelling to the place in real life. This way the user can decrease their carbon footprint if they otherwise would travel using an emission-generating way of transport, like drive with a car to a gym class. The development of Telepresence and holograms that 5G technologies boost forward is also going to make a difference in remotely attending places and events (Orlosky, Kiyokawa & Takemura 2017, 138). This could also

be bringing new options for the exercise department by fixing transportation issues that burden the environment. More and more companies have taken their sustainability actions into account lately due to the ongoing climate change crisis, and introducing telepresence and virtual reality systems would be a great way to show that they care about the environment.

6   Conclusions and recommendations

This chapter summarizes the findings of the research and literature review and presents development ideas that were created based on these findings. Findings are divided to three main themes of the thesis, which are the health effects of virtual reality, exergaming in virtual reality and the future of virtual reality in the sports and fitness sector.

6.1   Health effects of virtual reality

Based on the current situation of VR, there are more health risks than health benefits involved with virtual reality, as virtual reality sickness can happen to over 50% of the users due to technological issues (Stoffregen 2019). There are also various side effects of spending time in VR for too long which can stray people away from using virtual reality. Therefore, the workouts should be short and intensive. Using extra weights can convert even a short session into a heavier workout (Sinerma 10 September 2019). Risks in VR could be minimized with further developed 5G technologies that decrease the latency and bandwidth issues, but they take at least a couple of years to develop since 5G only launched in May 2019 in Finland (Elisa Oyj 2019). Due to this reason the issues with latency continue to live on. When the 5G is introduced to virtual reality systems, it becomes a smaller chance to experience virtual reality sickness in the virtual environment.

On the other hand, exercising with a projection wall that uses sensor and motion tracking technologies (iWall by CSE Entertainment) has been proven to lead to health benefits (SuperPark Finland 2019). IWall has games like Shadow Master and Street racing that could be fun to try out as a pair exercise at the gym, or even as a group exercise if the projection wall was bigger and could identify more than two players on the screen.

6.2   Exergaming in virtual reality

As for the current VR content, there should be more exciting and motivating exercise applications on the market so that the users felt the constant urge of using virtual reality glasses. Exercise games like Virtual Badminton and Beat Saber in Pikseli Arcade could be brought to gym chains and wellness centers as a "pop-up" experiment similar to the cryotherapy pop-up organized by CryoTech Nordic and Fitness Village (Fitness Village Kaisaniemi 2019). The experiment would be organized by a gym operator in co-operation with Pikseli Arcade, showcasing VR for a limited period of time. This type of gaming experiment could excite the customers about exercise and act as a social driver for the gym members (Lähdekorpi 18 September 2019). It is only the matter of time when virtual real-

ity games like Beat Saber become wireless, since there are already some wireless headsets on the market (Oculus 2019). Wireless headset enables free movement for the user without being attached to a computer with cables, making VR a better platform for exercise.

If the virtual reality headsets were smaller, wireless and had little latency to prevent virtual reality sickness, they could be used as a part of the virtual platform of a cardio machine by displaying a 360 video of moving environment and creating a fully immersive experience. For instance, Google Earth VR's street view feature could be integrated to the virtual platform and the user could choose where they want to run by pointing at the map. Imagine being able to walk anywhere you choose: take a trip down the memory lane and run on the roads of your childhood neighborhood or on the beach where the birds sing in the background and you can feel the ocean breeze on your face. Imagine feeling all that while running in VR.

These virtual platforms in cardio machines could include gamification as a motivator for exercise. For instance when running in the virtual environment for a certain amount of time (maximum of 30 minutes), the user could receive points and get ranked in a score billboard that listed scores of other gym members. The gym could reward the highest ranked user every month with a membership discount, health product or a gift card. The virtual platform could also be turned into a worldwide internet game with a fast speed of 5G network, where the user can compete against or run with others in a mutual virtual environment, similar to CSE Entertainment's virtual platform idea (CSE Entertainment 2019).

6.3 Future of virtual reality in the sports and fitness sector

Finland is a country known for technological innovations, meaning that improvements in virtual reality applications can also be expected because of Finland's great response to new technologies and the amount of VR companies working in the fields of healthcare and wellness. The competitiveness of the sports and fitness sector forces companies to be innovative and develop new services. Exergaming has already been adopted in the sector, meaning that the door has been opened for virtual reality as well. I can't find a reason why companies would not use virtual reality, as it is constantly developing to become more accessible and rich in content. Companies like Elisa, Pikseli Arcade and Exerium show that doing something first in the industry is not something to be avoided or scared of, as new and uncommon technologies can help companies to achieve major milestones and create unique, never-before-seen experiences.

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Appendices

Appendix 1 Questions for Maija Ignatius

1. When was Pikseli founded and when did you start working there?

2. Where did the idea for a virtual park come from?

3. What kind of reception have you gotten as a virtual park in Finland?

4. How was the "Tuntematon Sotilas" film experience created?

5. What is the recommended time for playing a game?

6. Could you turn a high intensity game that requires a lot of movement into a workout?

7. In addition to virtual badminton, do you think you will get more sports games in the future?

8. Do you think there are risks involved with bringing virtual reality sports games to gyms or wellness centers?

Appendix 2 Questions for Janne Lähdekorpi

1. What are some of the biggest reasons you wanted to start gamifying rehabilitation? Where did the idea come from?

2. What type of companies use your products?

3. What is your target group?

4. What is the recommended time to play on the gaming chair?

5. What are the benefits of gamification? What about the disadvantages?

6. For example, could wellness centers benefit from your products in the future? (People who like taking care of their health could be interested in the products.)

7. Do you think gamification could open up new opportunities for the fitness sector?

–

8. What are the goals and objectives of your company?

Appendix 3 Questions for Olli Sinerma

1. What is your opinion on digitalizing and gamifying health and fitness services?

2. Do you think it is a good idea to combine exercise with virtual reality?