LAPIN AMK
Lapland University of Applied Sciences

WEARABLE SMART TECHNOLOGIES: NEW ERA OF TECHNOLOGY

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Thesis
Lapland University of Applied Sciences
Innovative Business Services

2015

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Lapland University of Applied Sciences

Abstract of Thesis

Lapland University of Applied Sciences
Degree Programme in Innovative Business Services

Author Tran Vu Anh Khoa **Year** 2015
Supervisor Eija Turunen
Tittle of thesis Wearable Smart Technologies: New Era of Technology

Number of pages 46+16

The aim of the thesis is to analyze the current wearable smart technology industry, point out achievements and obstacles and predict growth of the wearable smart technology in the future. In this paper, readers will have the overall information of four main wearable smart devices: smart wristband/fitness trackers, smart watches, wearable cameras and smart glasses. In addition, a case study is carried out to research and access how differently male and female people who took part in the research choose and use wearable technologies.

The research methods used are quantitative research along with information and figures collected from articles related to wearable smart technologies.

The outcomes of this thesis is realiable. However, there should be other research in order to understand deeper how men and women choose and use wearable technologies. Companies can reference this thesis or similar ones in order to understand customer behavior or create, develop and improve products to please customers.

Wearable technologies are taking closer steps into our lives. Achievements already created at the moment and in the future are limitless. Therefore, wearable industry should get more attention and investments from the community.

Key words: wearable technologies, smart technologies, smart devices, wearables

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ABBREVIATIONS

IoT = Internet of Things

OS = Operating System

OSs = Operating Systems

Techs = Technologies

1 INTRODUCTION

The rapid development of technology in recent years has given mankind new chances to experience what were dreams, what was impossible. Among revolutions of technology, “smart-industry” is the one that researchers, enterprises and manufacturers are aiming to and sooner or later it will become the incredible thing which changes the lifestyle of the human being.

Smart-industry is an industry focusing on researching and developing smart devices or smart technologies which have an ordinary look but possess special abilities or functions by having sensors, computer chips or ways to communicate to support users. (Saltzman 2014)

In the next few years, smart technologies will be found in daily life, from the beginning of the day when you will be woken up softly by a smart bed then have a healthy breakfast done by a robot with perfect calculated ration. Next, a smart mirror will recommend you a very nice suit for an important meeting you have that day. Then enjoy your free time by reading the newspaper or review files for the meeting while the smart car is automatically driving you to your workplace fast and safely. Later on, in the evening, you come back home and drink a cup of coffee which has been prepared a few minutes ago by the robot, have dinner and enjoy the rest of the night with your family.

However, due to a huge number of smart devices, this thesis cannot cover all of them. Therefore, this thesis only mentions about wearable smart technologies or wearable devices or wearable technologies.

Firstly, this thesis defines what wearable smart devices are and then classifies them. Then, the thesis shows the current situation of wearable industry as well as creates a SWOT analysis of it and predict further development that wearable technology can reach in the future. Moreover, a case study was implemented to study differences between male and female in choosing and using wearable technologies. Finally, the thesis contains predictions for the next three years of wearable industry.

Furthermore, the aim of the thesis is to describe the current status of wearable smart tech industry and to evaluate further its development in the next three years.

The methods used for this thesis are monographs, latest information and data from websites which specialize in technologies. Moreover, a primary quantitative was conducted as a case to study about customer behavior in choosing and using wearable smart devices. Differences between male and female were compared in this case study as well.

2 WEARABLE SMART DEVICES

Wearable smart devices are technological products that possess sensors or computing chips and let users wear, attach on his/her body or clothes.

2.1 Classification of wearable smart devices

Wearable devices can be divided into the following categories based on their appearances:

- Healthcare & fitness trackers
- Wearable cameras
- Smart glasses
- Smart watches
- Others (include: smart rings, smart helmet, smart headgear, etc.)

Healthcare & fitness

There are different kinds of wearable devices existing on the market currently such as fitness trackers, wristbands and smartwatches which have special functions for health tracking. These gadgets can measure our heartbeat, energy consumed, steps taken and distance travelled (Glatter 2014) or more especially some of them can be used for treatment. The typical case can be mentioned is Philips BlueControl which is built to use light to control symptoms of Psoriasis (Editors 2014).

There is no longer a period of time when people have to wear cumbersome devices for experiments in laboratories. Nowadays, wearable technologies come and open a new way in collecting, analyzing data in large-scale. Results measured not only can be checked by the end customers after work-out or shared worldwide as motivation (Nike + for iPod nano) but also can be analyzed by doctors, experts and involved in earlier diagnosis and treatment, research and development in the future.

Recently, more and more services called “online treatment” are found, it means more and more people are willing to pay money to receive advice and treatments online instead of having in-office appointments. This means somehow healthcare wearable devices are taking an important role by

providing self-collected data. The fact is that figure 1 and figure 2 below show a large number of healthcare and fitness trackers taken over all wearable devices either worldwide or in the U.K.

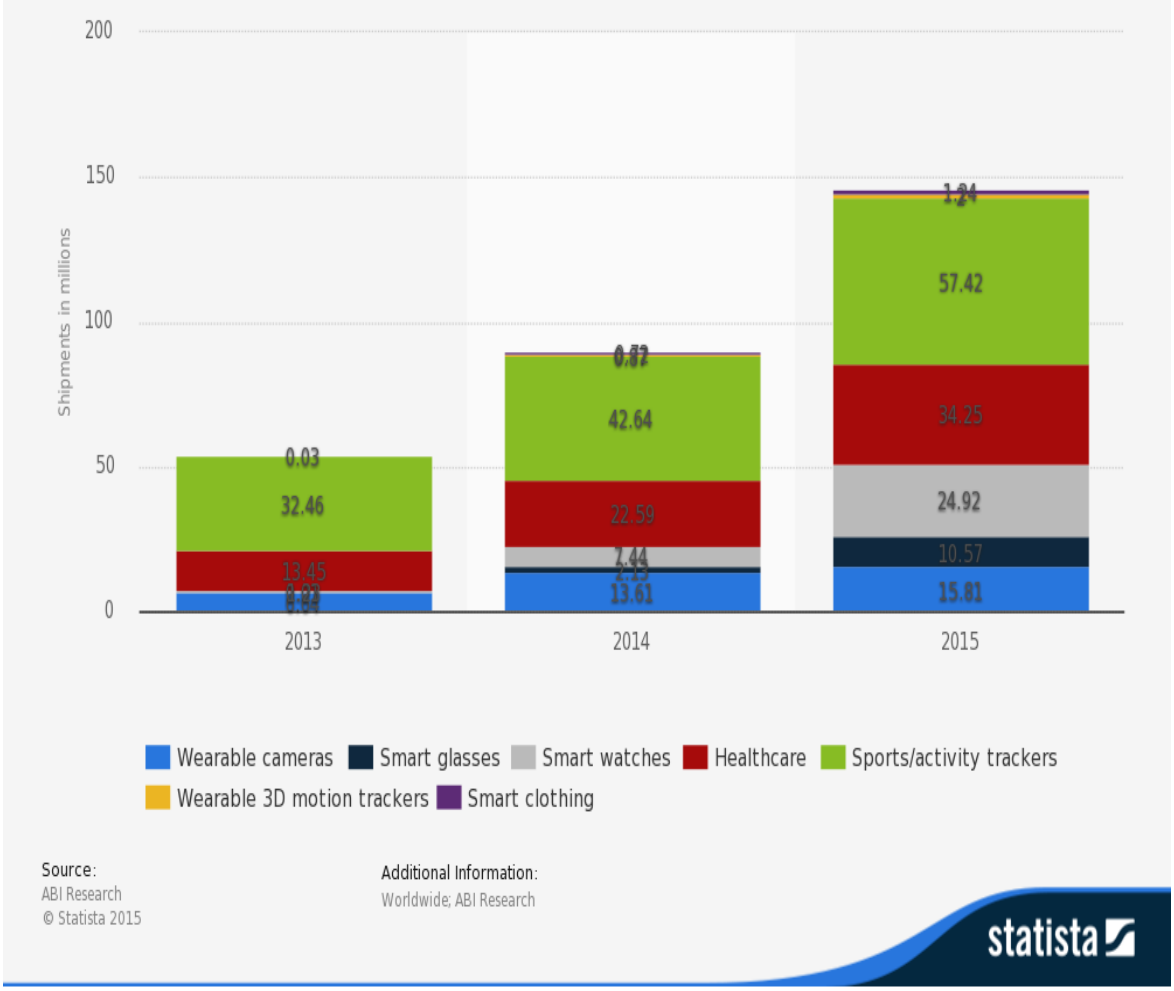


Figure 1. Shipments of wearable computing devices worldwide by category from 2013 to 2015 in millions (Statista 2015)

In figure 1, the big market share that healthcare and sport/activity trackers taken show importance and popularity of these products on the market from 2013 to 2015.

Although the percentages of these two factors in the market share have been decreasing through years, from over eighty percent (80%) in 2013 and over seventy percent (70%) in 2014 to over sixty percent (60%) in 2015 as prediction but the development potential is always on the top. It also means that in the future, products related to other segments of wearable technologies will attract and interest more consumers than they are doing at the moment.

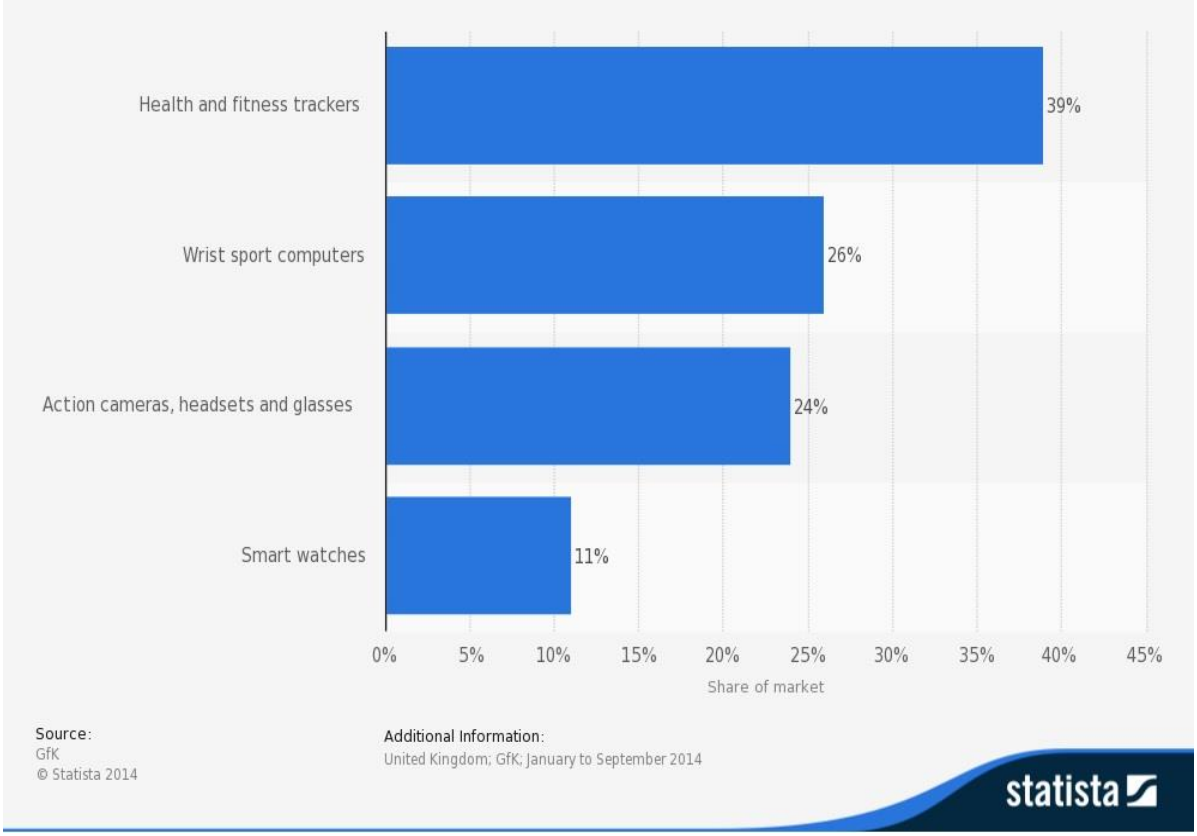


Figure 2. Product share of wearable technology market in the United Kingdom (UK) between January and September 2014 (Statista 2014)

There are not many differences compared to the world's figure, in the United Kingdom health and fitness trackers took the first place in market share of wearable devices in the first three quarters of 2014 with thirty-nine percent (39%).

Wearable cameras

The most important differences that make wearable cameras being more special than cameras existing on the markets are mobility and flexibility. These elements create more interesting ways for consumers to use the device to interact with the world. First-person videos are made and shared more frequently on the Internet. These can be undeniable proves for this new technology.

There are two types of wearable camera existing on market at the moment: the first ones are small cameras which can easily be attached on the users' bodies or clothes or can be worn on ears and the second type are bigger cameras which need sticker mounts to fix them on helmets.

Have you ever seen a super scary movie or a spectacular performance of sport then asked yourself how those actors/actresses or athletes really feel or see? That is not an impossible thing anymore. With wearable camera technologies which can be worn on your head, your arms or can be attached on your clothes, you can record anything, anywhere, anytime.

In addition, during the last decade, the explosion of social network has inspired everyone to share moment of their lives to the world through photos, videos or status of thoughts more regularly. And it is absolutely still a trend for at least the next decade when new technologies such as wearable cameras with streaming option can be the top choice on the market.

Smart glasses

Nowadays, glasses are no longer being used only for eye diseases or luxury fashion accessories but also can be turned into smart devices which can provide information, notifications, entertainment and a special point of view such as virtual reality space in three-dimension (3D) mode. Smart glasses on the market can be arranged into two types: with and without smart phones. In other words, dependent smart glasses (SamSung VR Gear) need to cooperate with smart phones to create virtual reality images or videos. Users have to use smart phones to play images or videos, then use smart glasses to look at them in order to see virtual things. In the opposite site, some other smart glasses, such as Oculus Rift, will have to connect wired to source devices (PCs or X-Box) to receive images then transfer and display on screens of the glasses.

Although the demand for smart glass has been rising, these wearable devices are still used mostly in industrial levels or in research laboratories due to high costs. However, companies producing smart glasses are doing their best to let more individual users possess this technology by reducing selling prices, increasing popularity and raise number of products used worldwide.

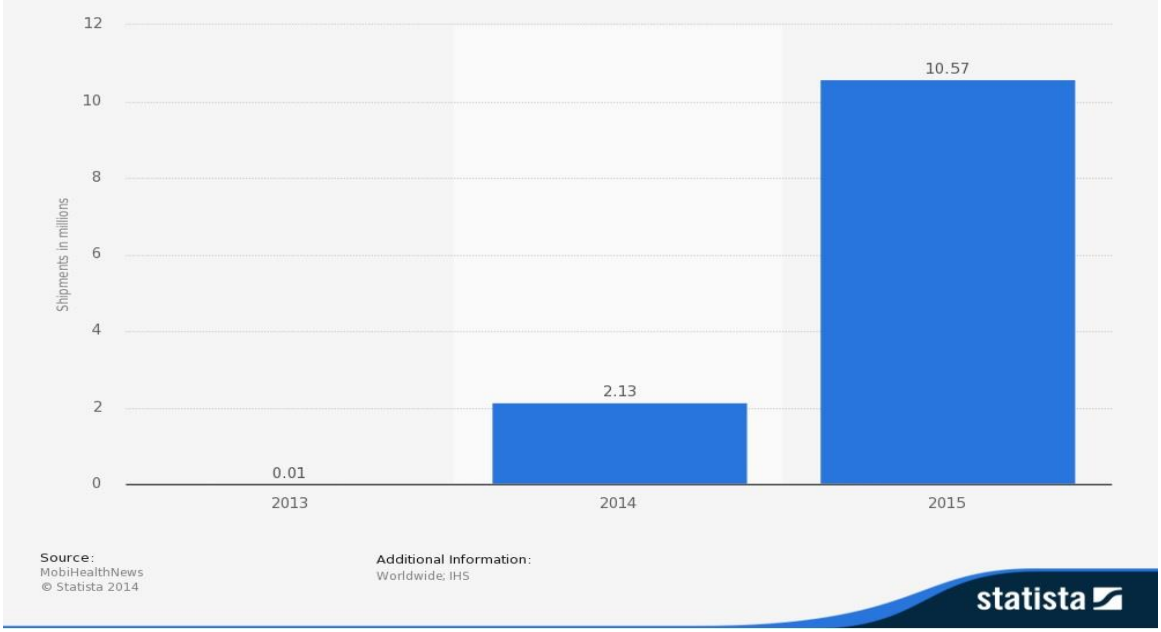


Figure 3. Shipments of smart glasses worldwide from 2013 to 2015 in millions (Statista 2014)

As an evidence of the developing market, figure 3 shows a leap in number of smart glasses shipped worldwide from 0.01 million units (year 2013) to 2.13 million units (year 2014) and 10.57 million units (year 2015).

Smart watches

Healthcare and fitness trackers are not the only wearable smart devices in glorious period, smartwatches are in a blooming decade as well. They are introduced and released more and more day by day through annual international electronics events such as: Consumer Electronics Show (CES) or IFA - Berlin Shows or manufacturers' shows.

About 40 companies have launched smartwatches in 2013 (Smartwatch group 2013) and the latest company doing so is Apple Inc. by releasing Apple Watch in March 2015.

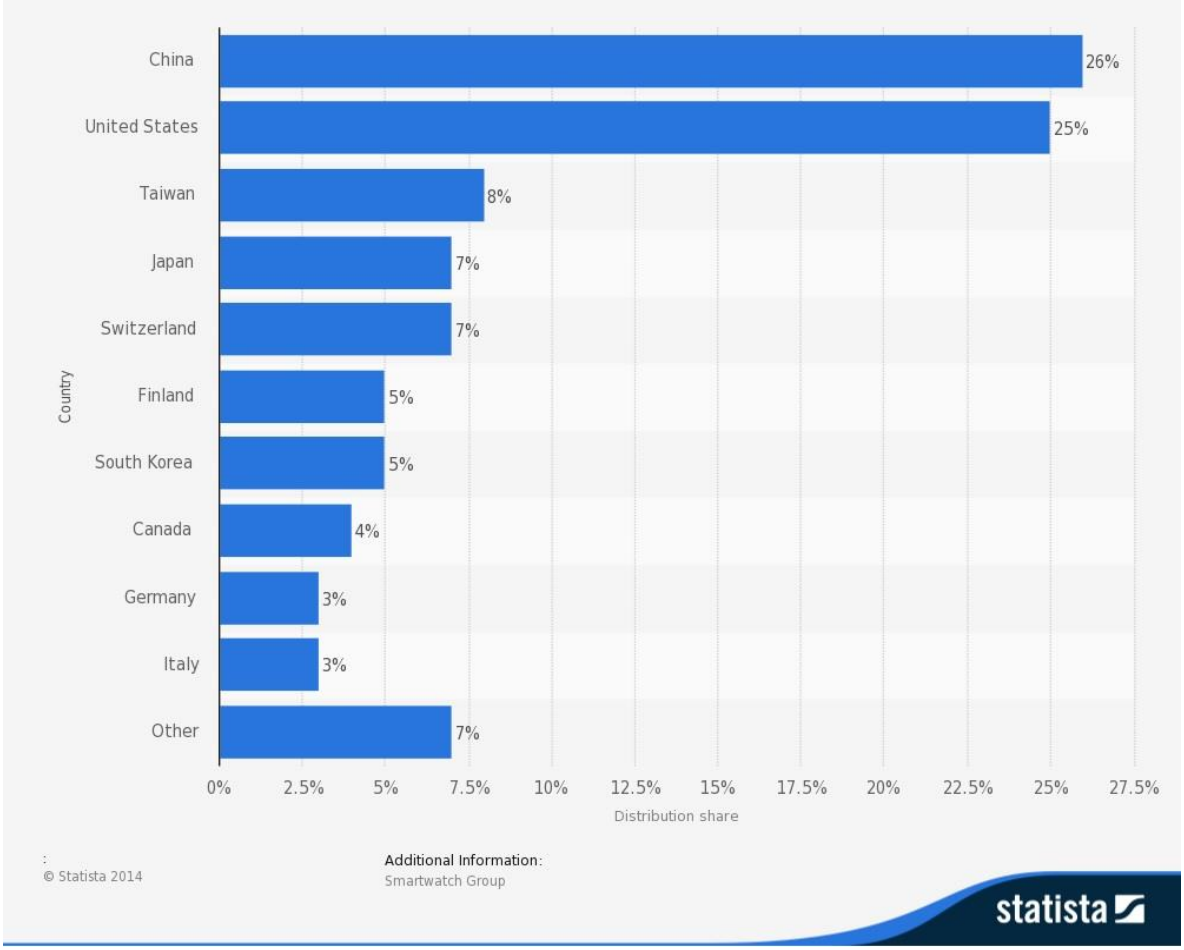


Figure 4. Geographical distribution of smartwatch companies in 2013, by country (Statista 2014)

According to figure 4, top markets of smartwatch industry are China and the United States, both countries take over a half of distribution of smartwatch worldwide. This is understandable because most companies producing smart watches locate their factories in the United States where power consumption is big and market is full of potential and China where has the largest population and cheap labor

Others

Besides top well-known products in wearable technology industry named above, there are other smart wearable devices existing on the market: smart rings, smart headphones, smart headgears and some products which have the ability to treat or diagnose diseases, etc. These devices take a tiny piece in the market share cake but still provide significant achievements.

One of the most amazing products, named as iTBra, is expected to become a "game changer" in wearable industry. This technology will help women to self-monitor easily at home in order to diagnose breast cancer. (Kosir 2015) What is great about this wearable device is that women can track their breast' health at home with a simple device so any unusual symptom will be detected very soon. The sooner breast cancer is diagnosed, the sooner it can be treated. It means more and more women worldwide can be saved from breast cancer.

Another great invention worth mentioning is Virtuix Omni - "a complete body experience approach". (Mischke 2015) In order to get the game played, the player should use different wearable devices such as headgear (to show virtual reality images) and footwear (to track movement of player in the game) beside other necessary hardware. (PC, Virtuix Omni platform + Pods + Harness, etc.) The interesting point of this technology is that the player has to walk or run in reality to make his character move in the game. Therefore, the player is not only playing game but also doing some exercise at the same time. The game now becomes a motivation for the player to exercise as well.

2.2 Wearable smart technology companies

According to some reports about top companies in wearable industry and recent updated information, the following table will show the top well-known wearable technology companies and their existing products on the market. (MarketWatch 2014; Russell 2013)

Table 1. Top well-known companies and their existing products on market

	Fitness/ Health trackers	Smart watches	Smart glasses	Headgears
Adidas	☑	☐	☐	☐
Apple	☐	☑	☐	☐
Fitbit	☑	☑	☐	☐
Google	☐	☐	☑	☐
Nike	☑	☐	☐	☐
Pebble	☐	☑	☐	☐
Samsung	☑	☑	☐	☑
Sony	☑	☑	☐	☑

Most big technology companies focus on fitness or health trackers and smart watches while only Google pays more attention to the smart glasses market. In the headgear category which includes devices worn on the head such as wearable cameras or virtual reality devices, these products are mainly researched and developed by two big electronic companies: Samsung and Sony.

Although there are too many wearable companies existing on the market at the moment, their products have a different look but similar function. They have not really made any important impact yet or have not solved new issues. (Whitefoot 2015) However any real revolution may occur in the next couples of years or even months. Any great ideas that either come from giant companies or start-up ones can become game changers which can lead the company to the top of its market and make new era of technology come sooner.

3 SWOT ANALYSIS FOR WEARABLE SMART DEVICES INDUSTRY

By analyzing existing products on the market, the following SWOT analysis shows strengths, weaknesses, opportunities and threats of wearable smart technology industry at the moment.

Table 2. SWOT analysis of smart wearable technologies

Strengths	**Weaknesses**
- Big supply resources for electronic components and devices - Technologies are developing rapidly	- Many different operating systems (OSs) - Low battery - Low popularity - Interaction between devices
Opportunities	**Threats**
- Products for multiple customer segments - Applications for the future - Creating new type of business	- Intense competition from existing companies. - New companies are joining the industry - Privacy - Affect human relations. - Decline in demand of some business

Strengths

A single electronic device is made of hundreds or thousands of hardware which is from different suppliers from around the world. From outside displays or glasses to inside tiny sensors, transistors or batteries, most of them are from famous branches such as Apple, Samsung, LG, Intel, Toshiba, AAC and Nidec. Factories of those suppliers are mainly located in Asia (China, Vietnam, India, etc.) due to cheap labor and they are always ready to supply millions of components to be assembled in every quarter. Therefore, the demand of consumers is always under control even for new companies who just join in the smart wearable technologies.

Moreover, rapid development of technologies is an important factor that promotes innovation and revolution of products. Sensors and transistors are getting smaller - a three-atom-thick transistor is just discovered and will be used to make ultra-thin electronics one day, chips are getting more powerful and displays, which can be bended, will be becoming very soon. (Brandom

2015; Kang & Xie 2015, OLED flexible 2015) Thanks to new technologies, devices will be smaller, thinner, lighter but more powerful, more flexible and become more useful in creating joy in daily life and success in work space.

Weaknesses

The Operating System (OS) is the heart of any electronic device. It is a program that allows communication between hardware and software; the device itself would be useless if OS does not exist or gets any error (ComputerHope). Several OSs are being used inside hundreds of wearable devices existing on the market. Among them, names of four (4) popular OSs at the moment are: Android, Android Wear, Tizen and Linux (Yamada 2014). Even though benefits of having many OSs are more options for consumers to choose and each OS has its own pros but at the moment, some obstacles of having too many different OSs are:

+ Each OS has different environments; it means each OS has a different way to program, to create applications and communication between software and hardware. This causes difficulties for programmers who want their applications to be known as much as possible so they have to re-create same idea in different languages. It is like translating a book in English into Chinese, French, Germany, etc. so everyone (applications) can understand to implement orders. Therefore, it does take much time and effort to get the work done.

+ Consequence of the above obstacle is some developers choose typical OSs to work with. These selected OSs then have a huge number of applications available on online markets while other OSs only have a paucity of applications. Some new OSs are treated the same so that the problem really impedes the development process of other OSs even if they are more simple and obtain more interaction between developers and OSs themselves.

At the moment, interaction between wearable techs is not possible. You cannot order a smart watch which possesses an interaction voice to take a photo by a smart glass. Most smart wearable devices work with smart phones or independently. It causes an inconvenience for users if they have many smart wearable devices and they have to remember where to trigger each one or

consider which device is better for different purposes. Example: a user has smart glasses and a smart watch, both of them have the same an application called MapNavigation but in different OSs. That user now wants to find a direction to a place where his meeting is going to start soon. This city is so new to him and he wants a fast and the best solution for this case. The smart watch has a better processor so it can find the place quite fast but he just can't keep his eyes on the watch all the time. On the other hand, the smart glasses track his location and updates slower but have a better way to communicate with him which is to display the direction to the meeting in front of his eyes clearly. The perfect solution to get his order completed is interaction between two devices. The smart watch will find the direction, track down his current location then send that information to the smart glasses which have a simple mission to show the user the shortest way to his meeting on time.

The division of work mentioned above does not only help users in saving time by giving an order one time only without consideration which devices will implement the work (devices will be self-assigned base on their sources) but also helps devices themselves to save power. While smart phones have thousands mAh, most wearable technologies especially smart watches only contain few-hundred-mAh-capacity batteries (Ramadass 2014) and with high power consumption, wearable devices now just can work for few days. According to information about average battery life of smart watches (Specout), most of them cannot last more than a week with one charge. However, some solutions have been researching and developing for the low battery capacity of wearable techs such as: generating power using body heat of user him/herself (Burgess 2014) or through daily normal movement of body (walking, climbing, running, etc.) (Coxworth 2012; American Chemical Society 2015). Another solution worth mentioning is innovation in decreasing energy consumption for Bluetooth radio intellectual property (ARM 2015). Battery life then will last sixty percent (60%) more thanks to this innovation.

Avoiding the mentioned issues, one weakness that still keeps consumers away from wearable smart technologies is its popularity. One solution to deal with this problem will be mentioned in chapter five*. A suitable plans should be implemented in order to increase awareness and experience of customers in

this new industry. Therefore, number of potential customers who are willing to spend their money on wearable techs can be risen.

Opportunities

Wearable techs are diverse and have many different range of price in order to reach different types of consumers. They can choose from cheap products with basic functions to higher segments which have added functions, special versions, higher memories or longer batteries. The price for wearable techs can be around a hundred euro to several thousands of euros. Therefore, the possibility for consumers to possess wearable techs nowadays is totally possible.

Getting smaller, lasting longer, being cheaper and having more wonderful interaction ways applications for wearable devices in particular and for smart techs in general are uncountable. They will be used soon as entertainment tools, supporting hardware for work or treatments for better health. Further potential of wearable techs will be discussed deeply in chapter five* below.

Wearing technologies which have the ability to record will be more popular. There are reported cases about racial bias and excessive force of police in America (Kaste 2015). This move is seen as a hope to avoid excessive or unnecessary action of the police.

It can be said that wearable technology industry is changing the world we are living in today. Its development involves new type of businesses formed and innovation for existing products or services. For example, Qantas has cooperated with Samsung in order to serve a new trial entertainment service on their planes for three months (Qantas 2015) or smart helmet which has possibilities to record the journey by a 1080p camera, to receive hands-free phone calls and to light your route up using a built-in OLED (Edwards 2015).

Threats

More and more companies are joining smart technology industry with diversities of businesses from wearable devices to smart houses, smart cars, etc. and products in each business are also plentiful and innovative in different

ways. These cause competition for the market share will become more intense and difficult for both new challengers and existing companies. Taking smart watches market as a typical case:

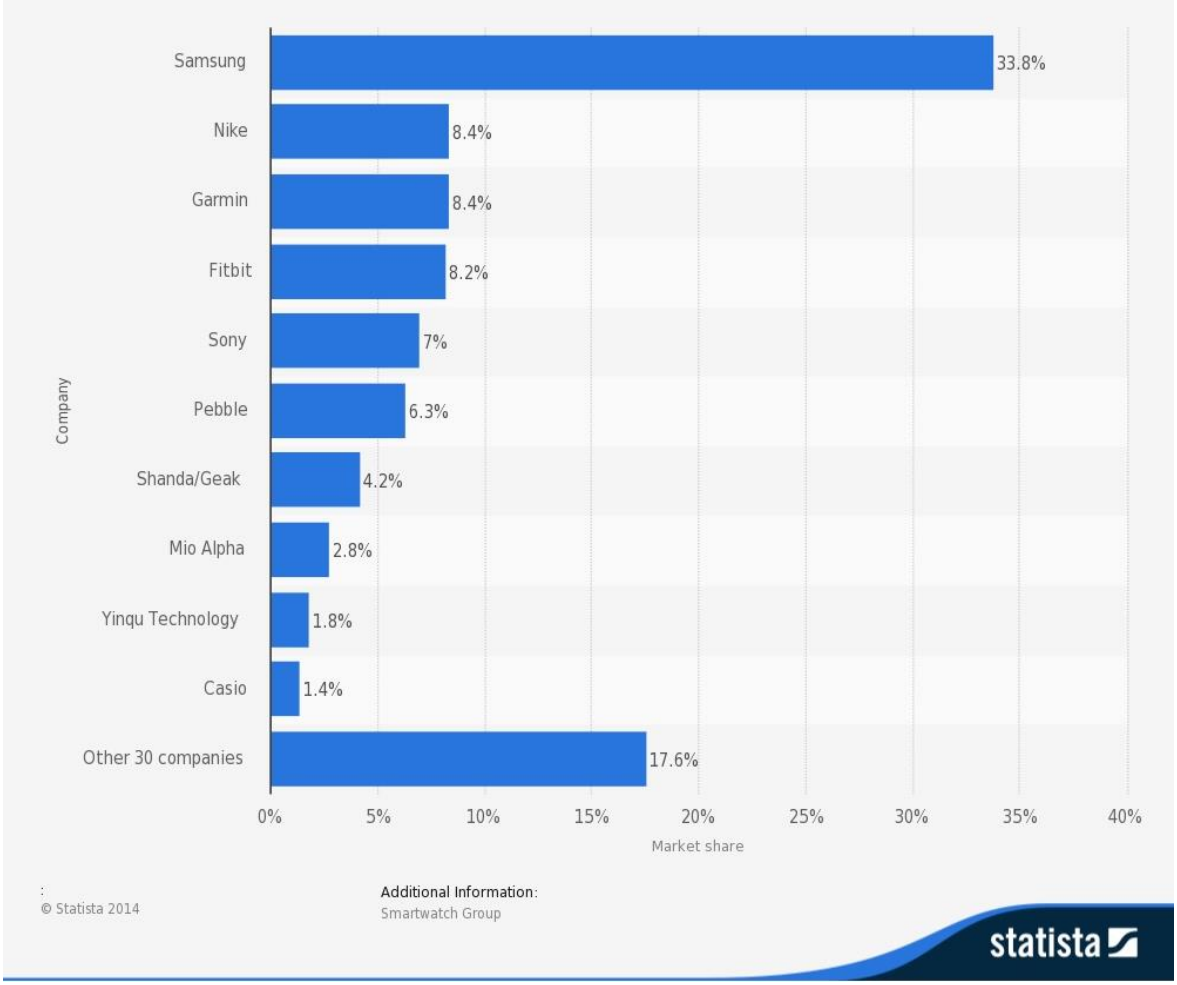


Figure 5. Market share of the leading smartwatch companies worldwide in 2013 (Statista 2014)

In 2013, Samsung Electronics Co., Ltd is leading with over one third of the market share of smartwatch industry. SamSung's market share was even higher four times than Nike's or Garmin's – these two companies share the second place with the same eight point four percent (8.4%) of the market share. In addition, the market share of other thirty (30) companies was only more than a half of Samsung's. Therefore, the influence of Samsung on the smartwatch market is very huge and becoming a big obstacle that new companies, which want to join the industry, need to overcome. However, as mentioned above, the participation of Apple Inc. in March 2015 by launching their new product Apple Watch can be seen as an exception. New products sold out in few hours (Barrie 2015; Rossignol 2015) is a good proof of how

important innovations mean besides existing big reputation and support from fans.

Wearable techs somehow are taking every step into peoples' lives, tracking any actions from breath, calories burned and blood pressure to sleep quality, favorite traveling routes of wearers. These then cause questions about information privacy collected by devices themselves and sent to their manufacturers or software creators; but how many users really consider this problem?

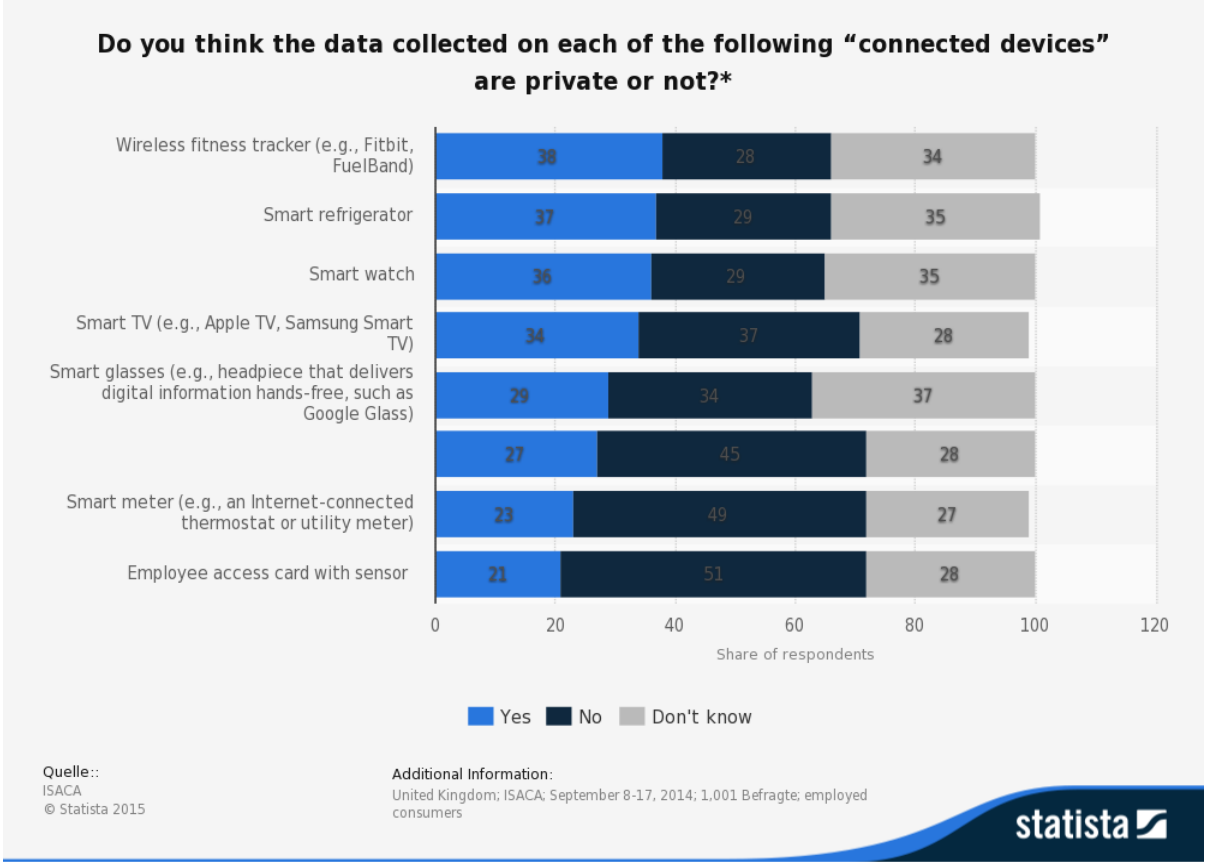


Figure 6. Perceived privacy of connected device data in the United Kingdom (UK) 2014 (Statista 2015)

According to figure 6, it seems not many people care about their personal information which can be found on the Internet nowadays. The fact is a large amount of users trust their product manufacturers or know nothing about what they have left in the Internet. Digging deeper into worries of users when using things connected to the internet, which concerns them the most?

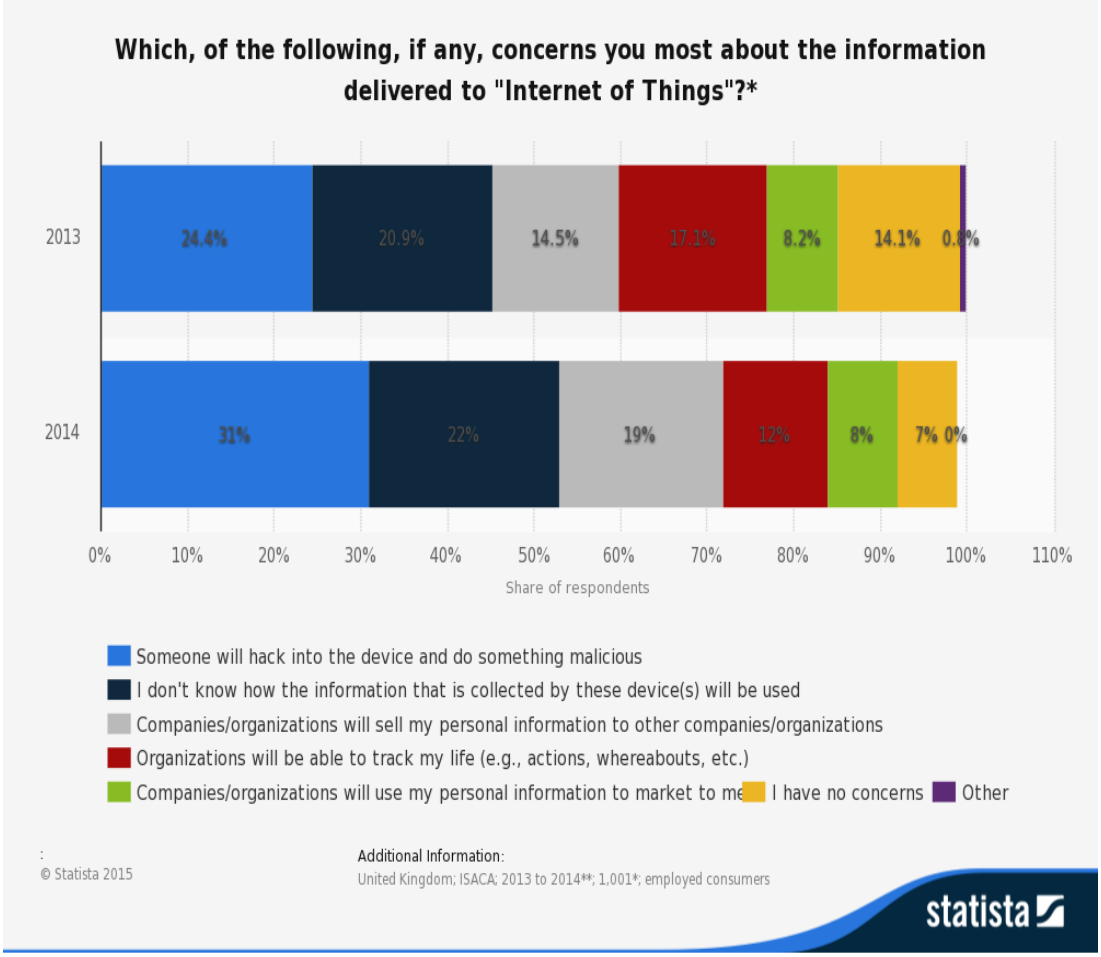


Figure 7. Concerns about how information collected and used on "Internet of Things" in the UK 2013-2014 (Statista 2015)

The most interesting concern through years is the worry of being hacked and it had increased more from twenty-four point four percent (24.4%) to thirty-one percent (31%). On the other hand, the ratio of “organizations will be able to track my life” and “no concerns” decreased quite much. In general, they do not really know that from the first step they start using the Internet any single movement of them has been tracked and recorded already. Taking Google as an example, how much do you think this company knows about you? (Conosco 2015) By owing numerous companies in different industries, from engine searching machine, photos and video sharing, maps to Android platform, etc. they know almost everything of single individual on the planet. Things are not different if you use wearable techs. According to FTC report (Hammond 2014), users’ data such as: identifying data, interests, travel data or health data are collected and may be used for malicious purposes.

In a positive perspective, collected personal data can be very useful in some emergency cases. Therefore, ethics of the business of companies is very

important nowadays. Depending on how they treat customers' personal data and to whom they share, privacy information becomes usefulness or threats.

Moreover, companies should not only pay attention on privacy but also consumers themselves who should know how to use their wearable techs reasonably. These innovative devices are made to help in creating more productive work if employees use it wisely (Goodwin 2014). For example: employees can use smart glasses to enter a virtual meeting room and negotiate with partners in different places but cannot use it to record the meeting because of company private issues. People use a tiny camera integrated in a smart watch to take photos in a museum where photographing and videos are prohibited. Therefore, awareness of users and policies or rules in public places are also necessary in the near future.

One more problem that the development of wearable tech industry can make worse. It is the relation between people. According to some reports (Duggan & Smith 2013), people are spending their time quite much on Internet especially on social networks such as Facebook, Instagram or Twitter. Most of the people surf several times daily or even hourly. Internet is useful with tons of information and entertainment there but addiction causes consequences, one of those consequences is to affect real relationships. Fantasies that people image can exceed all realistic expectation for their online love (Saisan et al. 2015) because users often lie about their personal information and hide their disadvantages. Moreover, some people become addicted to internet and related things because of their guilt, stress, anxious or depression they get from real life (PsychGuide). In the next few years, when virtual reality glasses are ready for commercialization, the number of Internet addicts will be increasing more. Therefore, interaction and guidance from families and friends who are close to addicts is necessary.

The development of wearable techs industry does not only create new involved businesses but also causes reduced demand in others. Virtual assistants on wearable devices like smart glasses can replace the human being in some cases. Visitors may not need a tour guide to inform them of the history of a castle or tourist attractions anymore. They will be shown images of history, related special events in their own languages and more which a real tour guide

cannot remember all and exactly comparing to their new technical friends. Reduced demand may cause unemployment or replacement for old industries which have been using human as main workforce as well.

4 FURTHER DEVELOPMENTS OF WEARABLE SMART PRODUCTS

4.1 Software

Windows 10 was released globally in summer 2015 (ITPro 2015) by Microsoft Corporation. This new operating system is promised as an innovative platform which can change the world of technology. We have been using different operating systems or different versions for PC, laptop, smart phones and tablets due to compatibility of applications to processors (Shad 2015); but when Windows 10 is revealed, a unique OS for all devices come true. One platform that all devices can run on will become more attractive to developers of peripherals and third-party devices (Langshaw 2015).

However, there are hundreds of fields that wearable technology can be designed to work for. Therefore, in some typical fields, a need of having their own platforms is necessary. Specific platforms can give related wearable devices better support and full function access. The Lumo Wearable platform is one potential OS that should be invested in and developed more. The main idea of it is to measure and analyze human biomechanics (Lumo News 2015). The data collected by wearable devices using this platform will be stored on cloud services and can be shared and used by apparel industries as well.

4.2 Applications

Unless the users use wearable techs for bad intentions or break regulation violation of organizations or human rights, wearable smart technologies' following applications will change the world into a better place:

Wearable things become health trackers besides normal functions integrated on them. Earphones (Sony), smartwatches, smart earrings (Ear-O-Smart) are typical products which have sensors to measure heartbeat, calorie burned, steps taken of wearers. Health tracking is becoming more popular because awareness of people about health has been increasing so wearable smart technologies as daily life items will become trends soon.

In addition, health trackers which have abilities to detect early risks such as a stroke will attract consumers. By collecting symptoms of body through brain

waves, the Early Detection Sensor & Algorithm Package will alert users via smartphones or tablets in case they receive a stroke in the next seconds (Hyun 2015). Moreover, some wearables such as: Philips BlueControl (Editors 2014) can help to treat diseases as well.

Phones have changed the way we communicate through long distance for years but wearable techs will make it even greater. By creating a new way to communicate, people now can talk to each other almost every time. In the future, you do not even need to go to a meeting but can use smart glasses to join a virtual one and do your business there. The virtual environment created by smart glasses will also be used for science such as exploring Mars (O'Kane 2015) or education and entertainment (Shanklin 2015).

Moreover, via sensors integrated on your smart watch or other wearable medical techs, your current health status is always updated, tracked and linked to local hospitals. Any further harmful issues will be noticed and taken care of in a very short time. In addition, used together with other industries, the efficiency of wearable techs will be increased better. Patients who suffer a sudden heart attack would have better a chance to survive if medicine and rescue equipment are delivered as soon as possible (Lavars 2014). By linking together, medical history, location and status of the victim will be sent immediately to the nearest hospital then a drone - an unmanned aerial vehicle (UAV) or a flying robot (Whatis.com) - will carry emergency medicine, necessary equipment and guidance to the field so anybody staying near the victim can have the ability to aid him/her while the rescue team and ambulance are on the way.

In the future, the network of wearable devices may become a useful tool for early warning of natural disasters. First tremors of earthquakes can be measured then the center of them, how strong they are will be pointed out (Brandom 2015); after that, emergency notifications will be sent to people who are in the affected area through smartphones, tablets, wearable techs or announcement of authority in order to let them be alerted and wary. However, this idea is still young and being developed on smartphones only but in the next few years, when the IoT becomes true and this application is applied on

wearable techs as well, more and more people could be saved from natural disasters.

Cooperating between drone and wearable smart device industries may even develop further in rescuing when the new drone of Lockheed will be used to help finding missing people (Davies 2015). By tracking the signal sent from wearable devices on the ankle or wrist of victims, rescuers then can locate their position quickly and offer the fastest rescue method. Cameras carried by drones are useful as well for people who do not use wearable tracking devices. Therefore, people who are in dangerous situations have more chance to be alive and saved on time.

4.3 Developments of related businesses

There will be companies joining in creating the virtual environment market. People who do not have time via virtual spaces can visit famous destinations around the world while lying in bed at the same time. Companies need strong servers, good interaction with customers besides creating interesting tours in order to handle hundreds or thousands of users connecting to systems at the same moment. People will no longer have limitations about where they want to go. All places on the Earth or even in space, now can be displayed by smart glasses.

Gaming and filming industries are also becoming potential fields when smart glasses gain certain success in market share of wearable smart technologies. More interesting games and films with true feelings when standing in first-person view will be released, giving spectators new experiences and emotions that they have never been through before. Consumers will not have to go to cinemas to enjoy extremely high quality movies but will use virtual reality glasses at home instead.

Most of the diseases now can be diagnosed at the very soon moment. Health of billions of people now can easily be monitored and alerted if there is anything wrong happens. Deaths caused by cancer will be reduced and people can live longer and happier thanks to healthcare wearable equipment.

Last but not least, the virtual assistant Cortana on Windows 10 will be very helpful for wearable technology users when the operating system is released (Ash 2015). Voice interactions can save much time when people use devices. Moreover, applications of third-party, example Uber, will be connected and supported in Windows 10 (Hernandez 2015). Giving command by voice, orders will be processed fast and correctly.

5 CUSTOMER BEHAVIOR

5.1 Theory

Women and men choose and use technologies in different ways so reasons causing their behavior are not the same. Understanding it would give an advantage for manufacturers or retailers in earning the market share. Results from a discussion of women leaders and entrepreneurs showed that women tend to pay more attention on the technological products' value and its practical use (Business training center 2015). Moreover, it is undeniable that being young and beautiful is what women always want so if they have to go shopping for wearable technology, their purchase behavior would turn toward a device which possesses functions that help them in keeping shape or being healthier. In contrast, generally, men tend to pay more money on what they want (Ronaghi et al. 2013, 1026) but in Ronaghi's research, the result was concluded that "there is a no significant difference between female and male consumer shopping behavior in term of price" (Ronaghi et al. 2013, 1030).

By analyzing results collected from the survey about wearable technologies, the following hypotheses will be verified whether they are true or not in this case:

1. There is no significant difference between women and men respondents in term of price.

2. Male respondents tend to pay more money than women do.

3. Female respondents pay more attention on products' value and functions.

4. Female tend to use devices which can track their health more than men do.

5.2 Methodology and implementation

A primary quantitative research was conducted by the author to study about customer behavior, how they choose and spend money on wearable smart technologies. The survey was built on Webropol and the link was sent via emails of Lapland University of Applied Sciences and via Facebook. The

survey contains seventeen (17) questions (Appendix 1). There are eleven (11) questions with single choice and six (6) questions with multiple choices.

Totally, fifty-three (53) people took part in this survey. However, there are some questions, a number of respondents declined. Question number 8 received fifty-two (52) answers, question 9 received forty-five (45) answers, question 10 received forty-six (46) answers and question 12 received fifty-two (52) answers. Other questions received a hundred percent (100%) respondents replied.

The respondents were divided into male and female in order to analyze behaviors when choosing wearable smart products.

The survey was divided into three (3) parts:

Part 1: General information of respondents (question number 1 to 4): to collect information about nationality, gender, age and occupation of respondents.

Part 2: General knowledge of respondents about three (3) representing smart wearable devices which are smart health trackers, smart watches and wearable cameras (question 5, 6, 9 and 11): to assess how much respondents know about health trackers and to figure out which features on smart watches and wearable cameras respondents want the most.

Part 3: Strategic plan (question 7, 8, 10, 12, 13, 14, 15, 16 and 17): an assumption was created in order to know successful possibility of a strategy and concerns and purposes of respondents when they decide to purchase smart technologies.

5.3 Survey analyses

Fifty-three (53) respondents took part in the survey: twenty-six (26) males and twenty-seven (27) females. They are from different countries such as: Finland (53%), Vietnam (26%), Russia (4%), etc. Most of them are students (86.8%), some are office employees and teachers or staff at Lapland University of Applied Sciences.

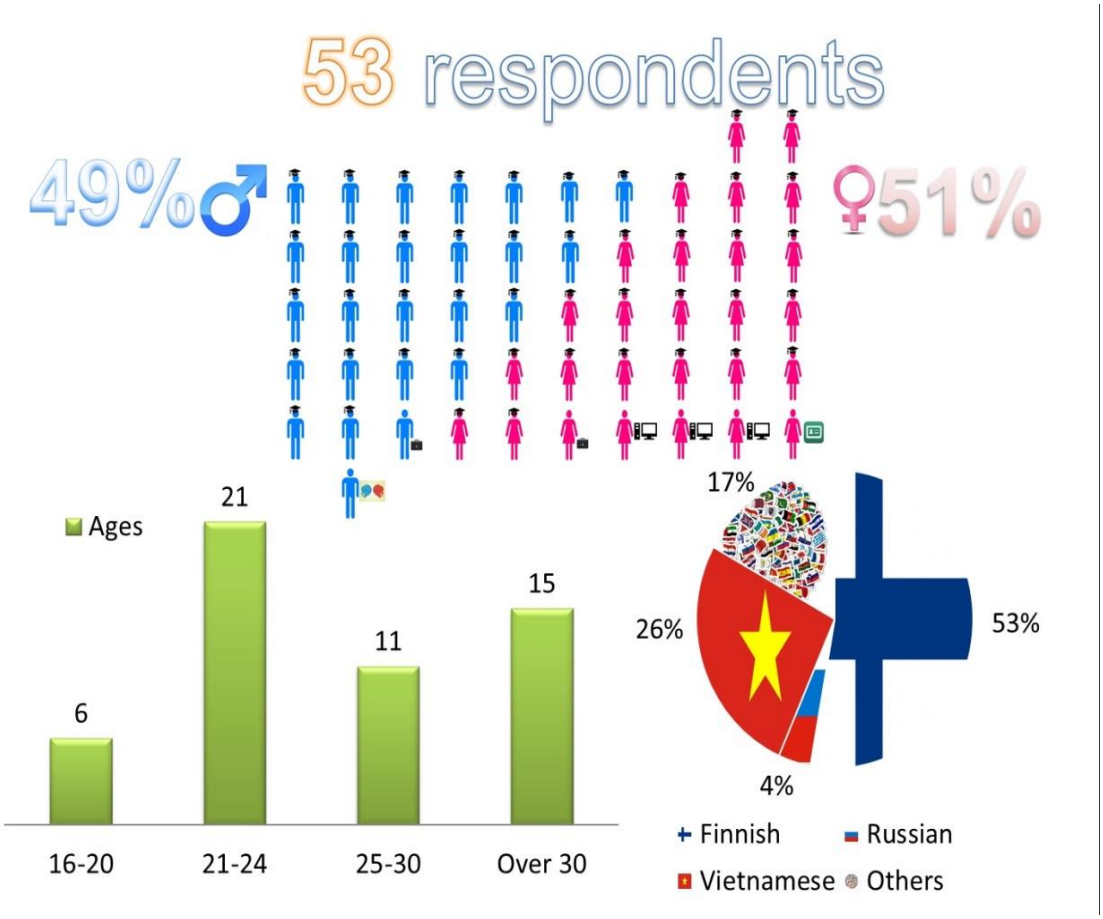


Figure 8. General information of respondents (N=53)

Ages of respondents were divided into four (4) groups, which were:

+ 16-20 year olds: six (6) young people who may depend mostly on grant of their parents.

+ 21-24 year olds: twenty-one (21) people in this group are students and less depend on grant from families.

+ 25-29 year olds: eleven (11) people who may be graduates or maybe having jobs but their income is not stable yet.

+ Over 30 year olds: fifteen (15) people who may have stable a career and income.

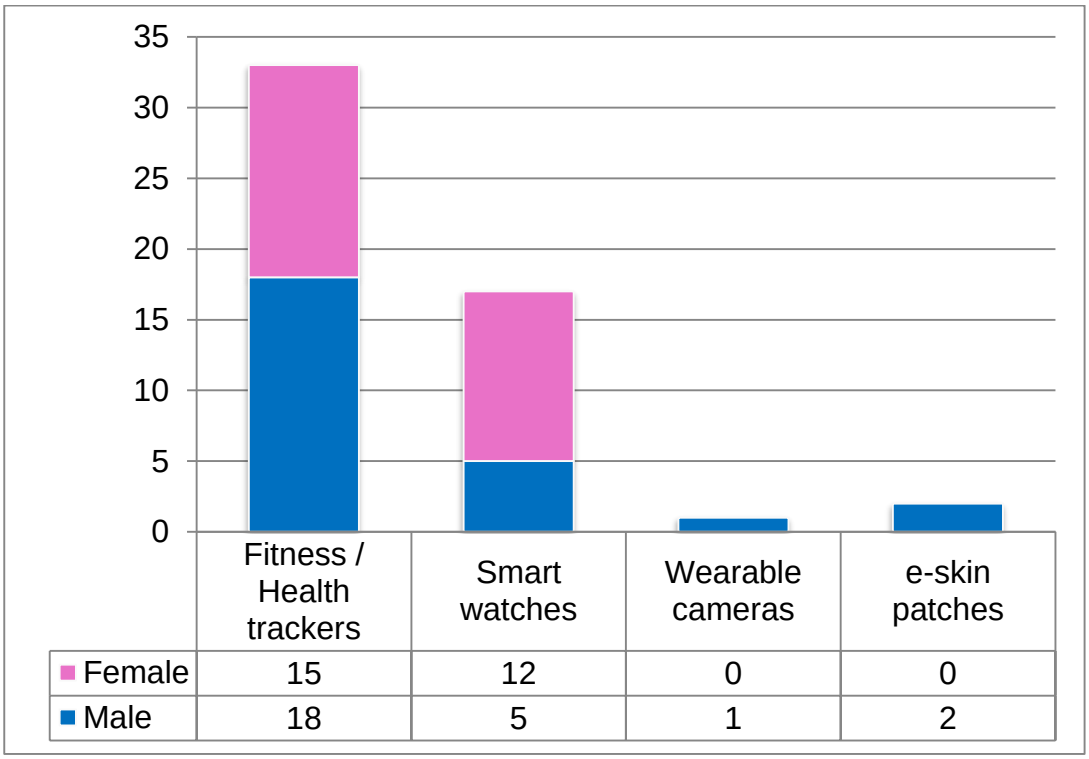
Not many people took part in the survey. However, numbers of female and male are quite equal so assessments and comparisons for both groups will be more accurate.

General knowledge

- Fitness trackers

Respondents were given a picture of a smart technology and asked if they can choose the correct category for it.

Over sixty-two percent (62%) (33 over 53) respondents answered correctly.



	Fitness / Health trackers	Smart watches	Wearable cameras	e-skin patches
Female	15	12	0	0
Male	18	5	1	2

Figure 9. Numbers of male and female respondents voted for each option (N=53)

The male respondents had greater correct percentages (69.23%) than female respondents (55.56%) but some of them chose “wearable cameras” and “e-skin patches” while female respondents did not. This shows that some female respondents made mistakes because they could not distinguish the differences between health trackers and smart watches. Three men who did not choose the correct answer also show their imagination as well: a small camera can be worn on a user’s wrist or an e-skin patch which can be used in healthcare services.

- Smart-watch

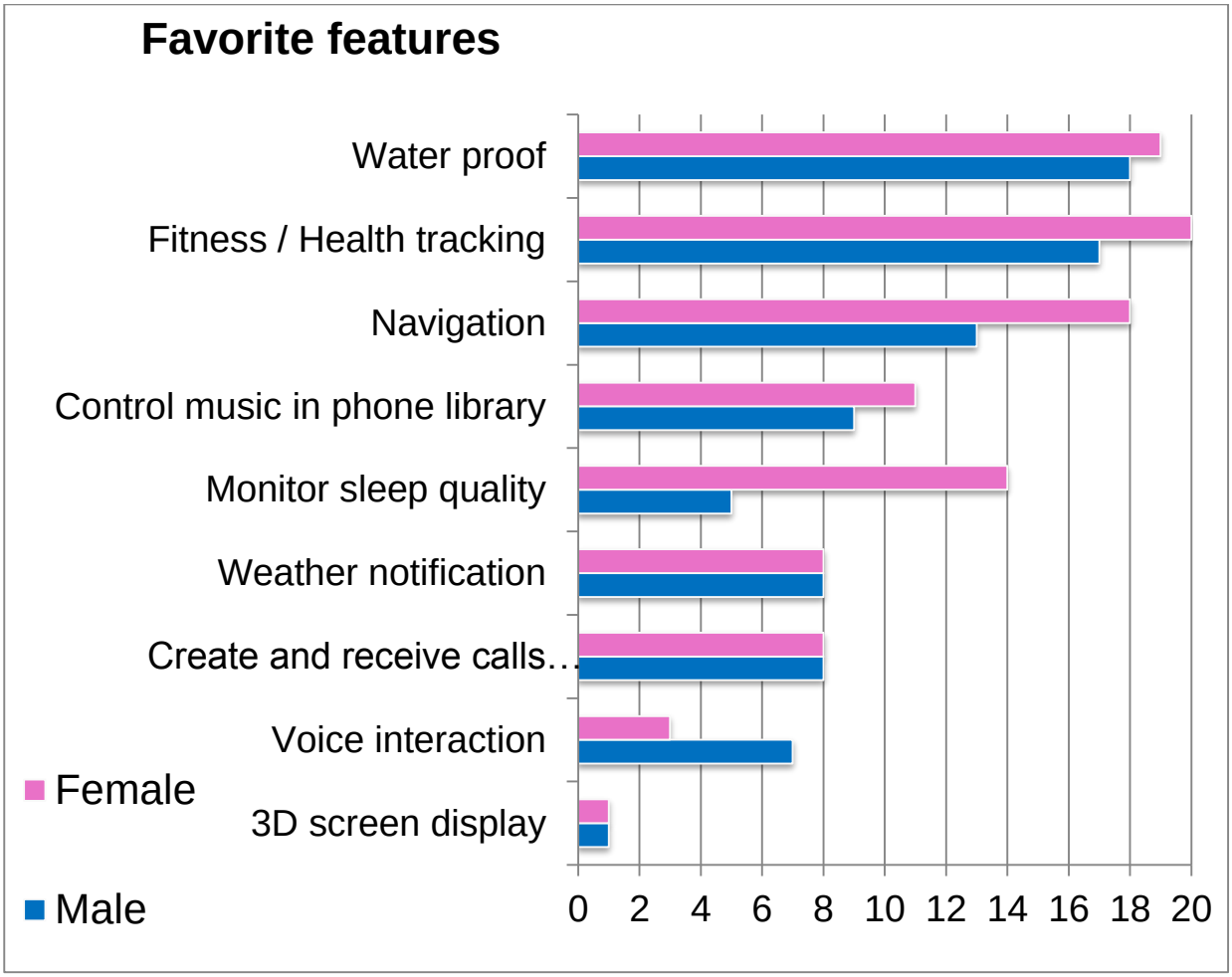


Figure 10. Top favorite features on smart watches in different gender (N=53)

When asked about favorite features on smart watches, people voted water proof, health tracking and navigation as the top three they want to have on their own smart watches. However, male and female respondents had different priority for these features.

Men tend to move most of the time so they desire flexibility and entertainments in using devices (music control, create and receive calls & texts), useful applications on-the-go (navigation, weather notification) and ruggedness (water proof). While women tend to use technologies as tools for beauty as well so they focus on fitness/health tracking and sleep quality monitoring. Besides, navigation and water proof are concerned by women too.

- Wearable cameras

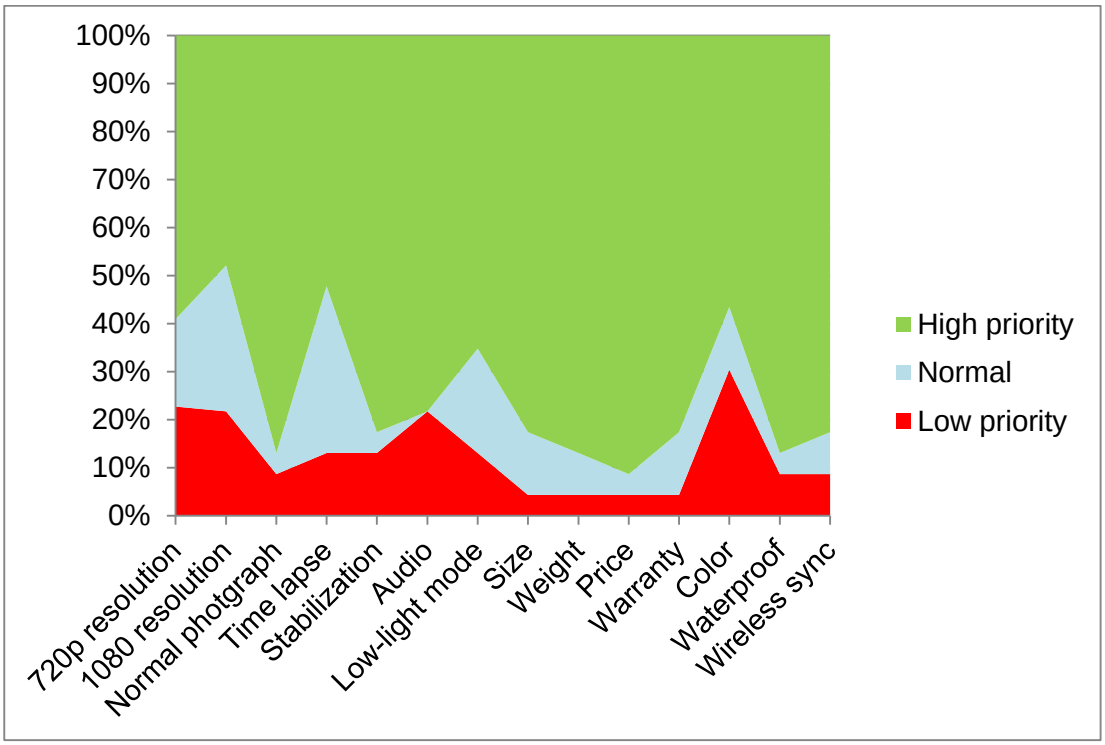


Figure 11. Priority features of women on wearable cameras (N=23)

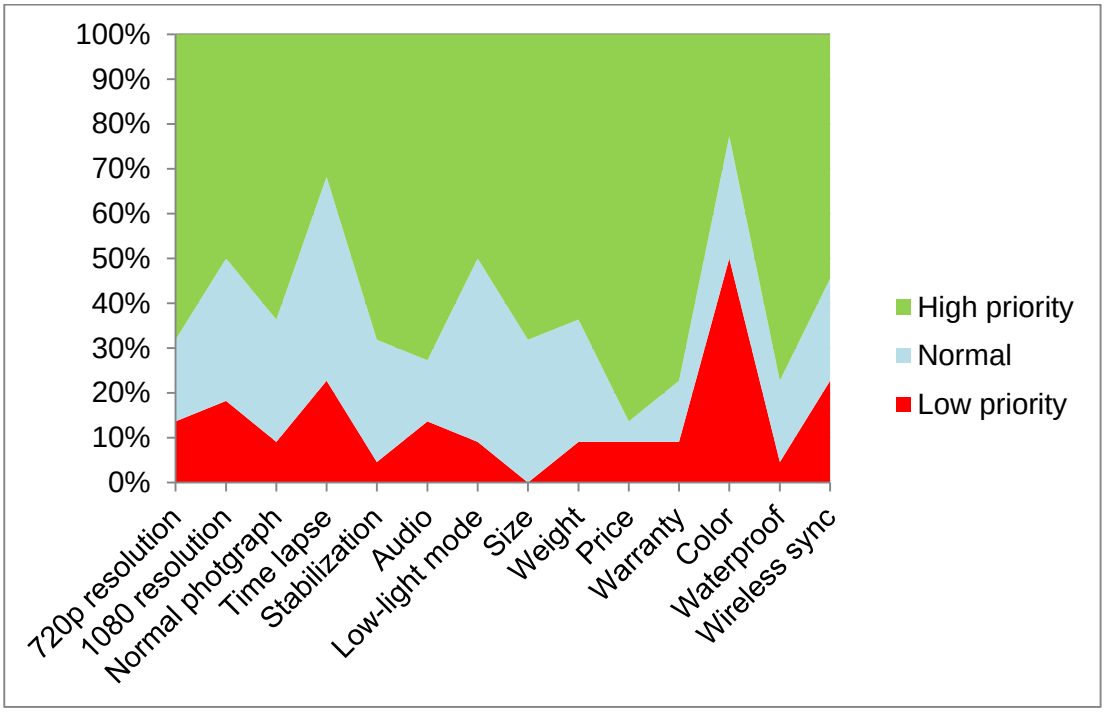


Figure 12. Priority features of men on wearable cameras (N=22)

Firstly, figure 11 and figure 12 above were made based on results of the survey (question 9). High priority is combination of two (2) options: “partly important”

and “very important“, while normal is “no matter if it exists or not” and low priority is combination of options: “not important at all” and “rarely important”.

Looking at the high priority as main assessment, results showed that price is the top criteria for both genders when they choose wearable cameras. With nineteen (19) over twenty-two (22) votes (86.36%), it seems men less care about price a little bit than women do (21 over 23 votes, about 91.30%).

However, some features such as: normal photograph, time lapse, weight, color and wireless sync have big differences between men and women. To be more specific, percentages of women interested in mentioned features are higher than men, especially normal photographing, time lapse, weight and color (the gaps are over 20%). These features represent capacities of taking pictures, being fashionable and sharing awesome moments directly to social network. In other words, women really pay attention on features which keep them beautiful and always connected with family and friends. They tend to share moments of lives and keep being in touch with others than men do. This result is proof for the hypothesis number three (3) that women pay more attention on products’ value, they really care what their products can do.

Only two (2) features that men care of more than women do are: 720p and 1080p resolution which belongs to video mode.

Strategic plan

An assumption was made among respondents that there was a free actual test in one week and whether they participate or not. Forty-three (43) over fifty-three (53) respondents answered positively and the following figure 10 will show which smart devices that respondents desire to have in an actual test:

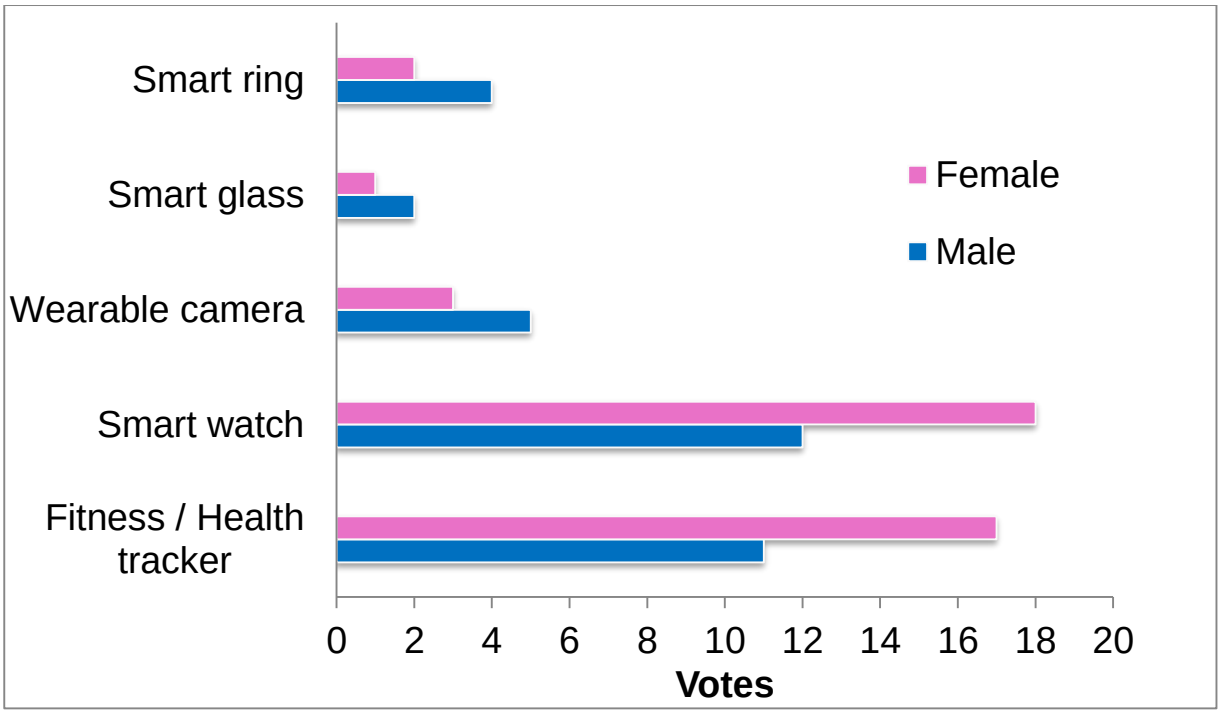


Figure 13. Desired smart technologies of respondents in virtual free actual test (N=51)

Two (2) main chosen categories were smart watch and fitness tracker. The number of female respondents who chose these two categories is much higher than the number of men respondents. It is seemed that female care about main functions of these wearable techs which are health tracking.

Next, respondents were asked whether they decide to purchase those smart devices if results after the actual test do not fail their expectations. Almost four fifth (81.1%) were in consideration while only nine point four percent (9.4%) answered “Yes”.

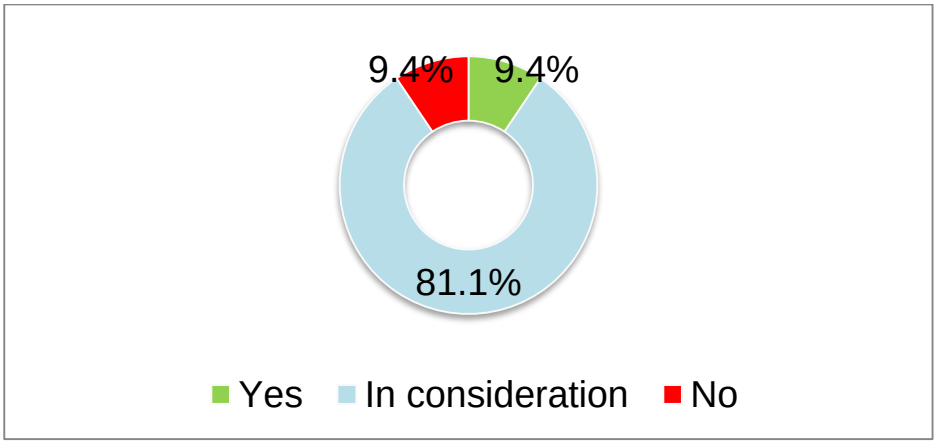


Figure 14. Would you buy wearable device if it doesn't fail your expectations? (N=53)

Digging deeper in those considerations, the following figure shows top six (6) concerns of participants for smart wearable devices:

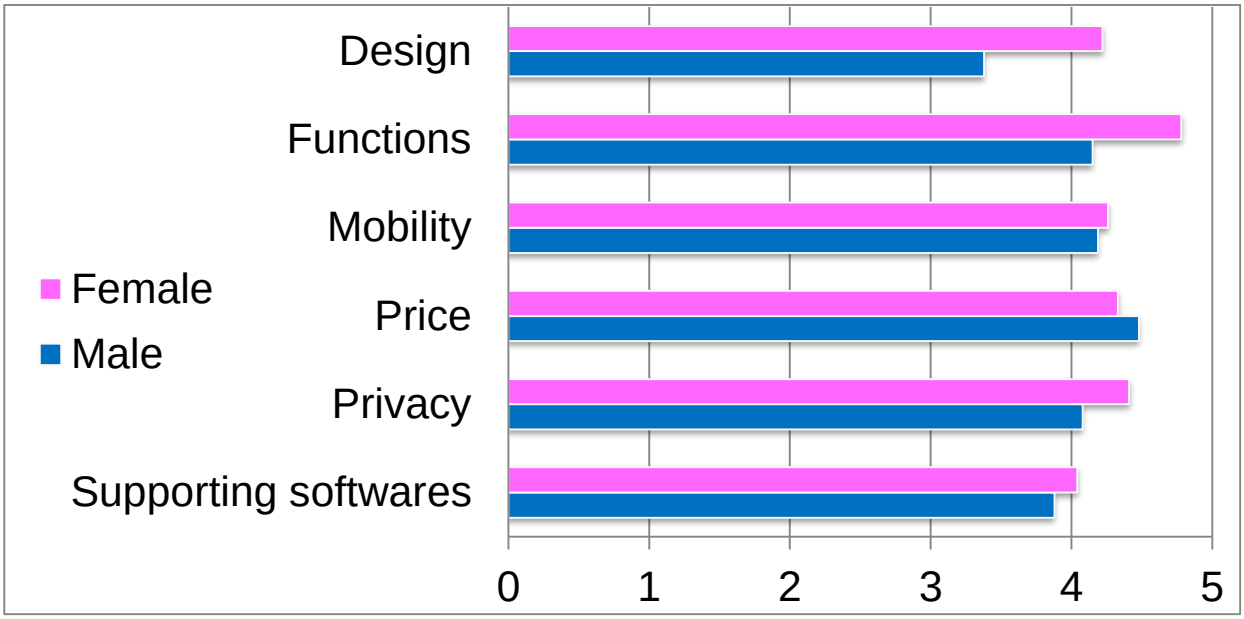


Figure 15. Top six (6) concerns of participants for smart wearable devices (N=53)

Male and female respondents had different priorities for their concerns. Female respondents voted functions as the most important of the list and followings were: privacy, price, design, mobility and supporting software. On the other hand, men respondents voted price as the most important feature and following were: mobility, functions, privacy, supporting software and design. It is clear that men care about price a bit more than women do.

Taking price as an exception, remaining concerns are different according to each individual. Those concerns are based on each respondent's characteristic, gusto or emotion. Therefore, price is assumed to be the only obstacle that prevents customers to purchase wearable smart devices.

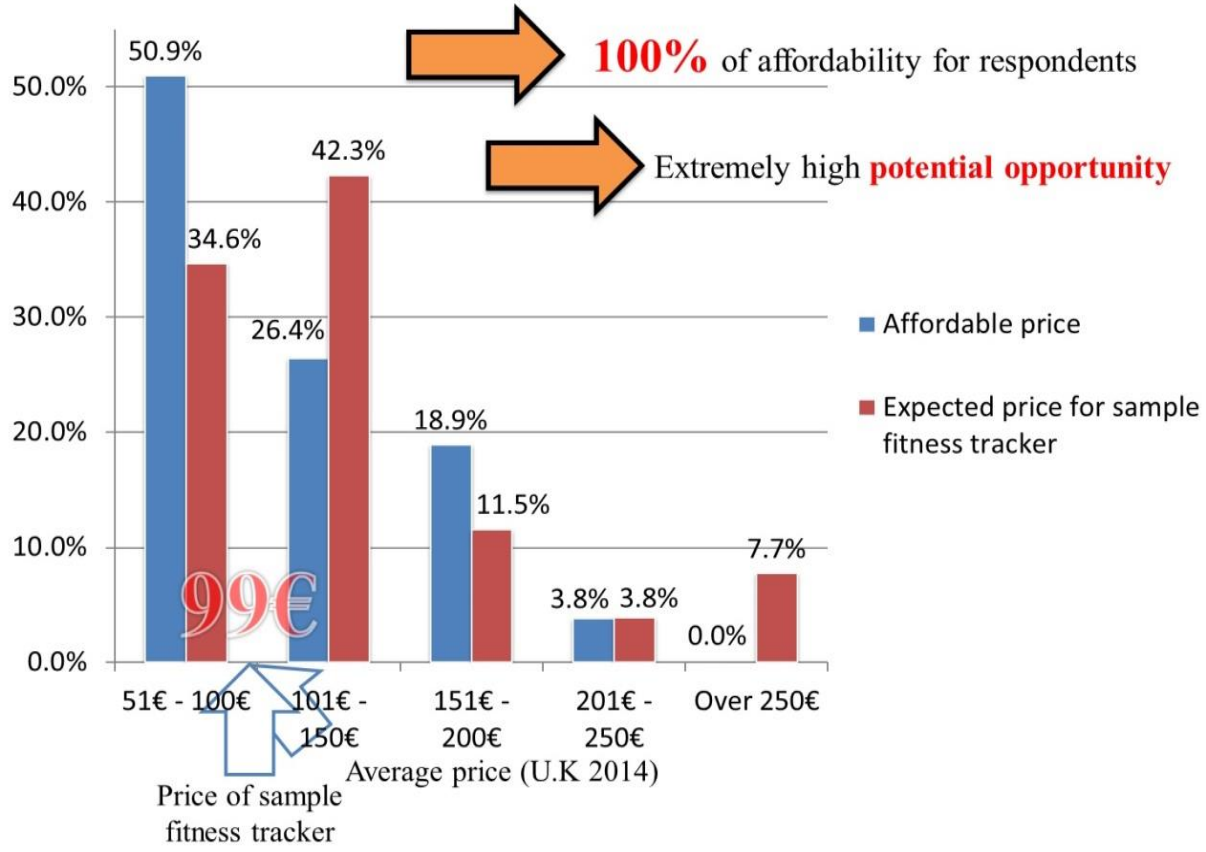


Figure 16. Prices of fitness trackers

Respondents were asked for price of a sample smart fitness tracker and maximum expenditure they are willing to pay for it. The fact is ninety-nine euros (99€) were both for the sample device and average cost for a smart health tracker in UK between January and September 2014 (Statista 2015), so it can be said that one hundred percent (100%) of respondent can afford this technology.

The sample was Fitbit Flex (costs seventy-nine (79€) to ninety-nine euros (99 €), depends on retailers). However, if consumers are willing to pay a bit more in order to own better versions with more useful technologies, Fitbit Charge HR (costs about one hundred and thirty-nine euros(139 €)) is an ideal model which is recommended for them. At that price, percentages of respondents are still pleased to pay for it decreased to forty-nine point one percent (49.1%). It is a very big decline in theory but in reality with a good marketing plan and a little bit of persuasion, customers can pay a bit more to possess them.

In addition, figure 17 below will show how much men and women will be pleased to pay for the sample device in different range of price.

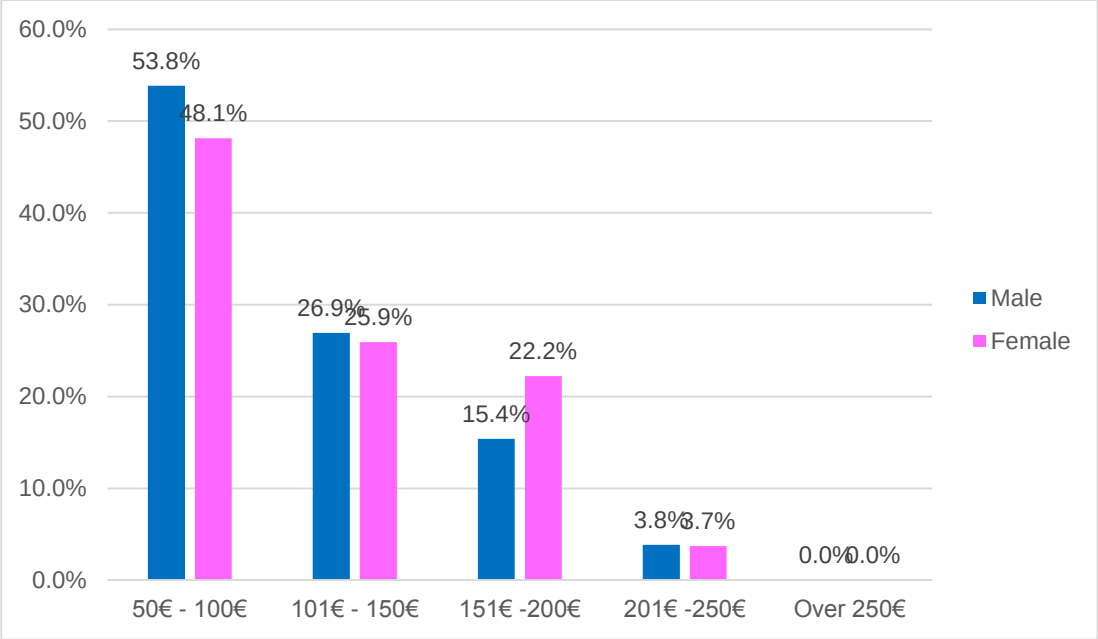


Figure 17. Percent of male and female respondents are willing to pay for sample fitness tracker in different range of price (N=53)

Men respondents accepted the device with lower prices while women respondents were willing to spend more money for the device. The average price that twenty-six (26) men respondents willing to pay is about one hundred and ten euros (110€) while twenty-seven (27) women respondents willing to pay is about one hundred and sixteen euros (116€).

Then, a same technique was applied for smart watches. About sixty percent (60%) of respondents can be reached when average price for smart watches was 163 GBP, approximately 225 EUR (Figure 18). However, adhesion of Apple Inc. in smart watches industry from March 2015 will change the scene of this market. Minimum price for an Apple Watch is 349 USD (U.S market) and the most expensive is 17000 USD (U.S market), they are absolutely more expensive than others existing on the market but somehow these products can attract customers around the world strongly. For example, in China, the most expensive version (20000 USD) sold out less than an hour (Barrie 2015) or in U.S estimate delivery is about 4 to 6 weeks or later even thought this happens only in 6 hours after pre-order started (Rossignol 2015). This will lead to

average price of smart watches worldwide increase, which means there are less respondents can afford for smart watches with new price.

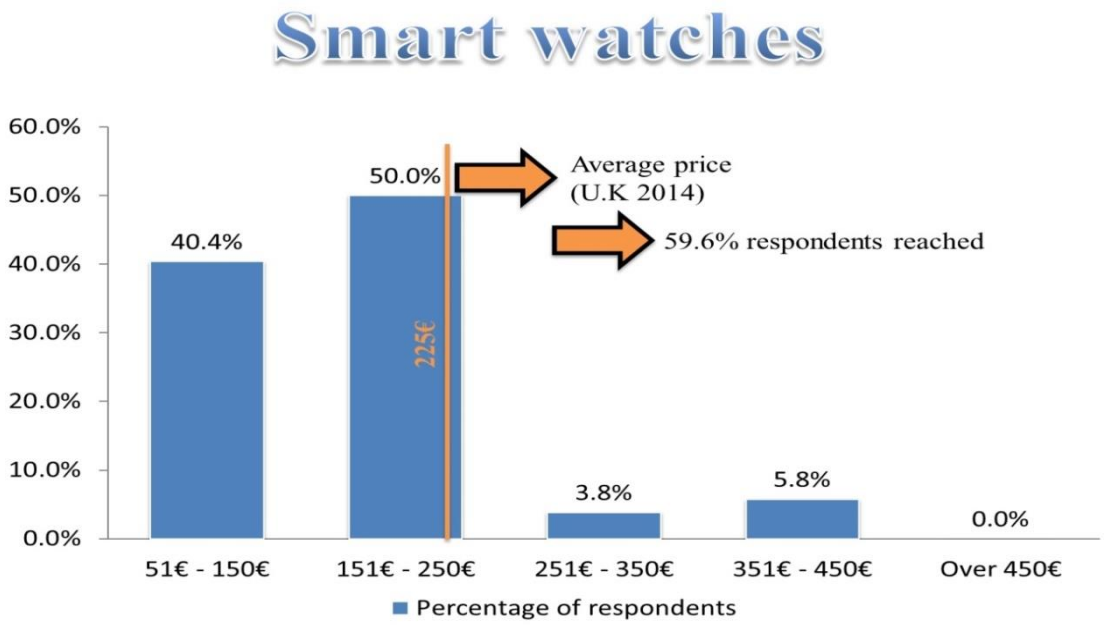


Figure 18. Prices of smart watches

Looking deeper into answers, figure 19 will reveal how much money men and women respondents are willing to pay for their ideal smart watches.

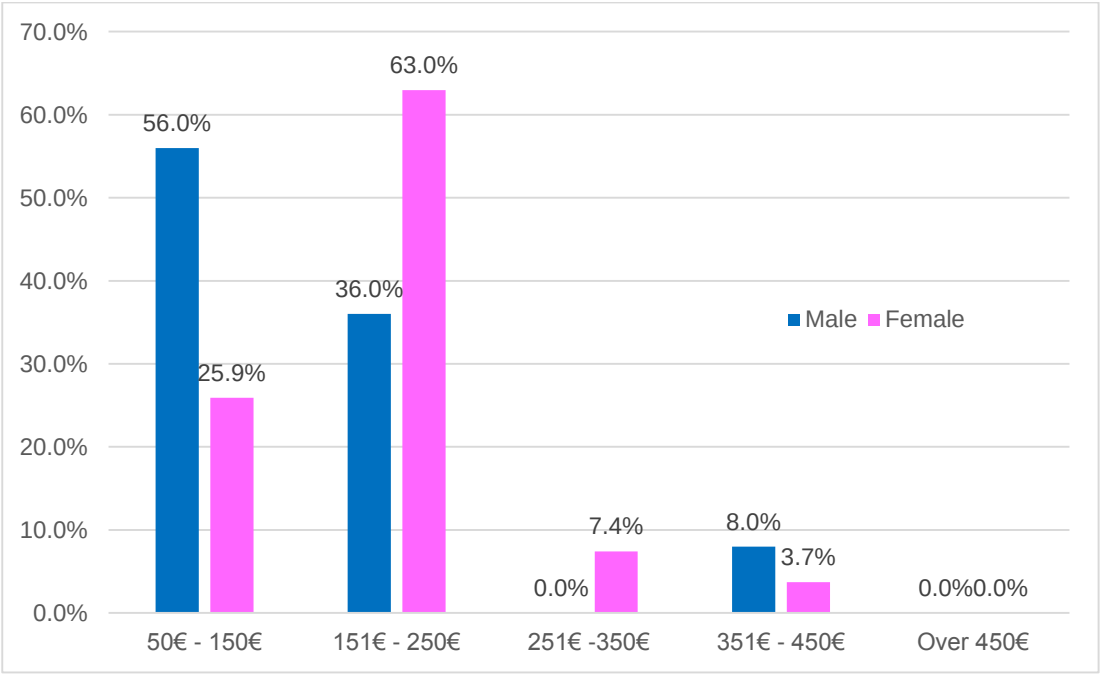


Figure 19. Percent of male and female respondents are willing to pay for their ideal smart watches in different range of price (N=52)

Once again, women are the one who may pay more to get their ideal wearable technologies. Their average price is about one hundred and eighty-nine euros (189€) while twenty-five men answered this answer only want to pay one hundred and sixty euros (160€). However, at the high range price 351€ - 450€, number of men accept to pay for their smart watches is a bit higher than women's (2 over 1). Anyway, the overview and average price proved that women will pay more to get what they want.

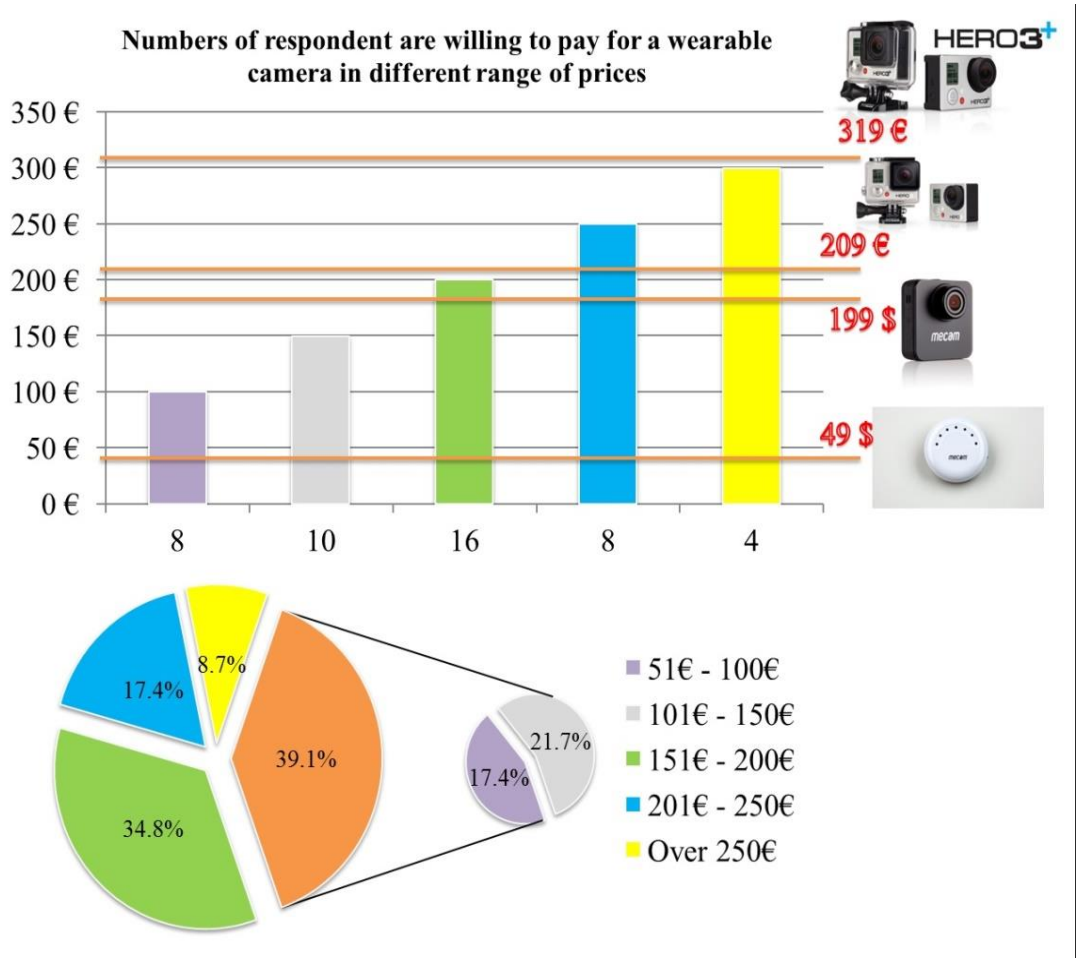


Figure 20. Prices of wearable cameras

In wearable cameras situation, chosen sample device was Mecam HD (Mecam) and a recommended ideal one was SnapCam (iOn SnapCam).

MeCam HD costs one hundred and ninety-nine US dollars (199 USD), approximately one hundred and eighty-seven euros (187€) so over sixty percent (60%) respondents can afford for this brand. However, the ideal one which is iOn SnapCam costs only one hundred and forty-nine US dollars (149

USD), approximately one hundred and forty euros (140€), this makes ratio of potential customers increased to eighty-two point six percent (82.6%).

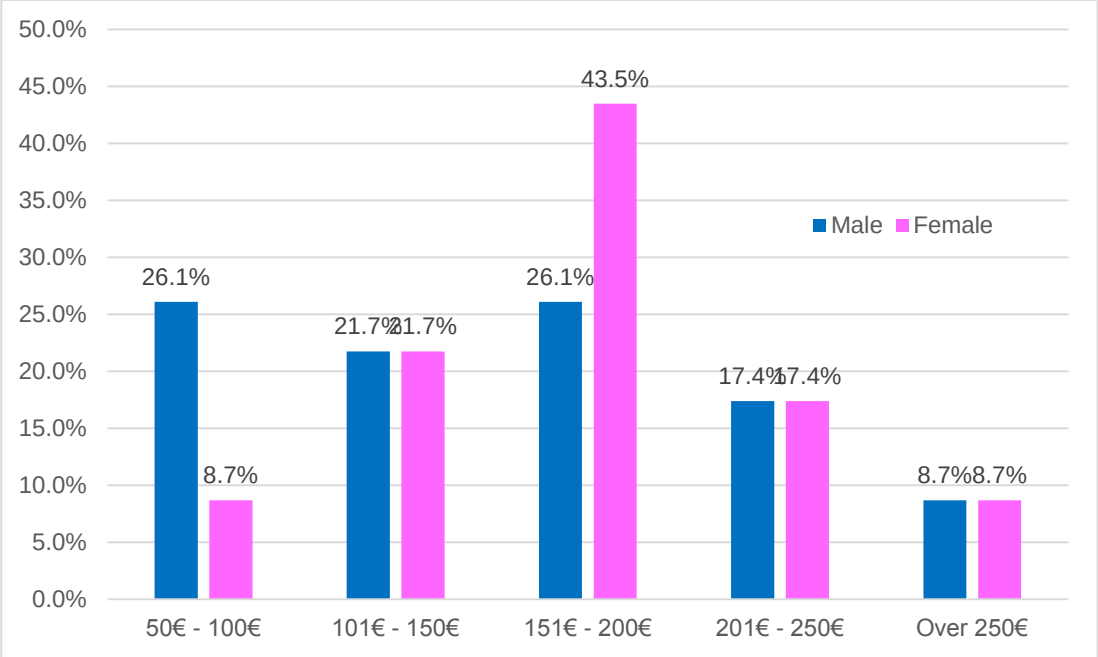


Figure 21. Percent of male and female respondents are willing to pay for a recommended wearable camera (N=46)

There were twenty-three (23) male respondents answered this question and the same for women. In most of range of price, quantity is even for both sides but in the range 50€ -100€, men took a win while women led the top in the range 151€ - 200€. This makes average price that men can pay for the recommended wearable camera is approximate one hundred and fifty-six euros (156€) while women may pay one hundred and seventy-three euros (173€) for it.

5.4 Survey results

After analyzing the survey's result, the conclusions are:

1. There is significant difference between women and men respondents in terms of price. Men respondents tend to pay more attention on the price than women do.

2. Male respondents pay less money on what they want while in contrast, female respondents are willing to spend heavily for their favorite products.

3. Female respondents really care about what the products can do. Because they pay more, they seriously want to have best services and functions that serve their purposes.

4. Female respondents tend to be attracted by wearable devices which possess functions related to healthcare or fitness tracking.

Moreover, based on knowledge and favorite features that respondents want to have on three main smart devices, samples and ideal models were given in order to investigate prices that these people are willing to pay to have those technologies.

Table 3. Different prices for top 3 wearable techs

	Average price (U.K 2014)	Sample device	Ideal device
Fitness / Health trackers	73£ ≈ 100€ 100%	99€ 100%	139€ 49.1%
Smart watches	163£ ≈ 225€ 59.6%		249€ 59.6%
Wearable cameras	220£ ≈ 305€ 8.7%	199$ ≈ 180€ 60.9%	149$ ≈ 135€ 82.6%

Table 3 shows the price and percentages of respondents who can afford wearable smart device in different products. According to the table, a big amount of respondents was reached which means prices of these technologies are in affordability of respondents. Therefore, obstacles between these people and smart devices can be products themselves. Design, mobility, privacy, functions and software are things that each individual have different ways to feel and assess. Then, the actual test assumed to conduct is necessary in order to let consumers have better look at devices before deciding to buy them.

The actual test is a marketing tool that needed to be used in this case. Steps for this strategic plan are:

1. To choose a specific area of neighborhood or a company.

2. To collect lists of participants who are willing to take part in the actual test.

3. To deliver samples to participants and to guide and answer their questions.

4. To collect samples (after a period of time: one week is recommended) and feedback from participants.

5. To offer participants to buy products with a good discount.

The idea of this strategic plan is to let chosen participants can have their own experience in using smart technologies which were totally strange for them. After the test, with certain satisfaction, they will have a chance to buy devices with a good price even though the ordinary price is not as high as they expected. Good products and low prices make customers happy so maybe they will advise, recommend for family members, friends, co-workers to use smart technologies as well.

There is another kind of actual test that will be applied in reality by Apple Inc. after Apple Watch is revealed. Consumers who have a desire to experience can make appointment or go straight to local stores to “walk through a try-on” (Gurman 2015). This is totally an innovative way to reach customers who have doubts if the value of the products matches their costs.

There is a need of having events like these to happen in order to increase awareness of people. Wearable technology is still new and in low popularity, so if companies want to pop out of the crowd, they should have effective plans to do it. One of the best ways to make it happen is to create more interaction between customers and the product itself.

6 PREDICTIONS ABOUT WEARABLE SMART TECHS INDUSTRY IN THE NEXT THREE YEARS

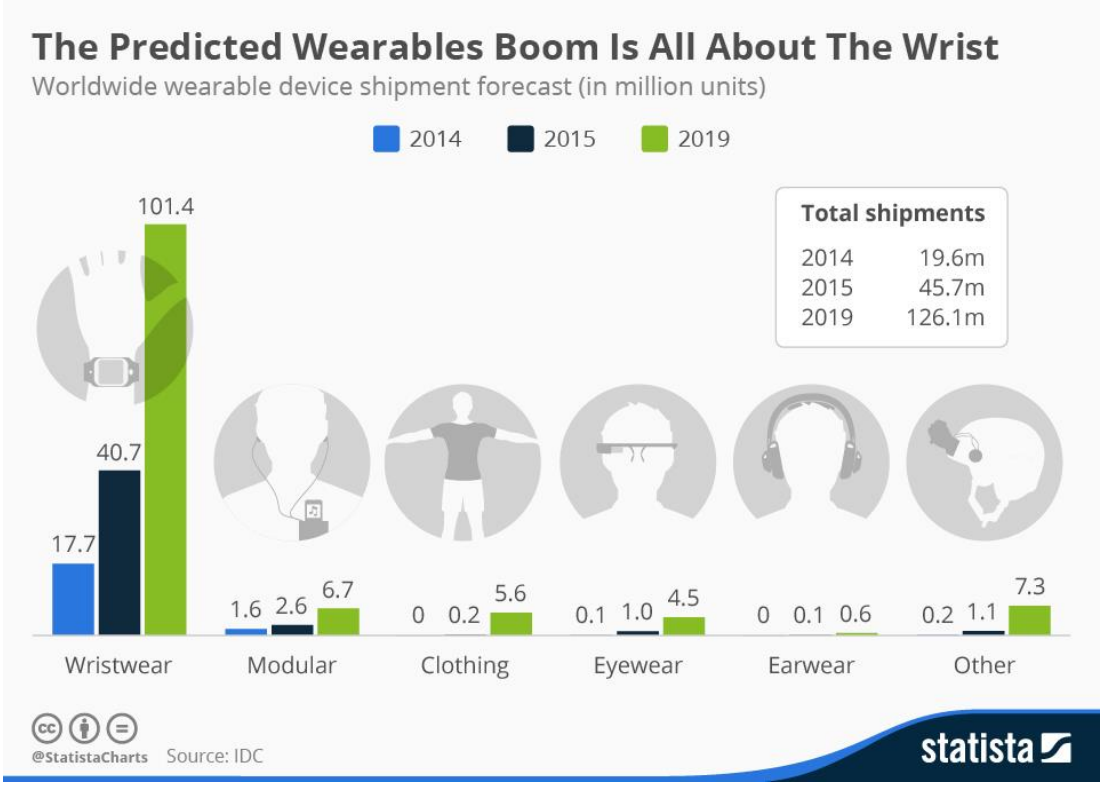


Figure 22. Worldwide wearable device shipment forecast in million units (Statista 2015)

Wearable smart technologies are in boom years of development when more and more companies with different types of products are joining the market. In the next three years, there will be a huge jump in the number of sold units especially in wrist-wear segment (Figure 22). Health/activity trackers and smartwatches will become trends and take about eighty-seven percent (87%) of all wearable techs shipped in 2018 (Curtis 2014). In addition, according to figure 23, most wanted feature on smartwatch is activity tracking. Other features are ranked differently in different countries: while Asian use smartwatches to make or receive phone calls as second highest feature, Western people tend to use wearable techs as time indicators more often.

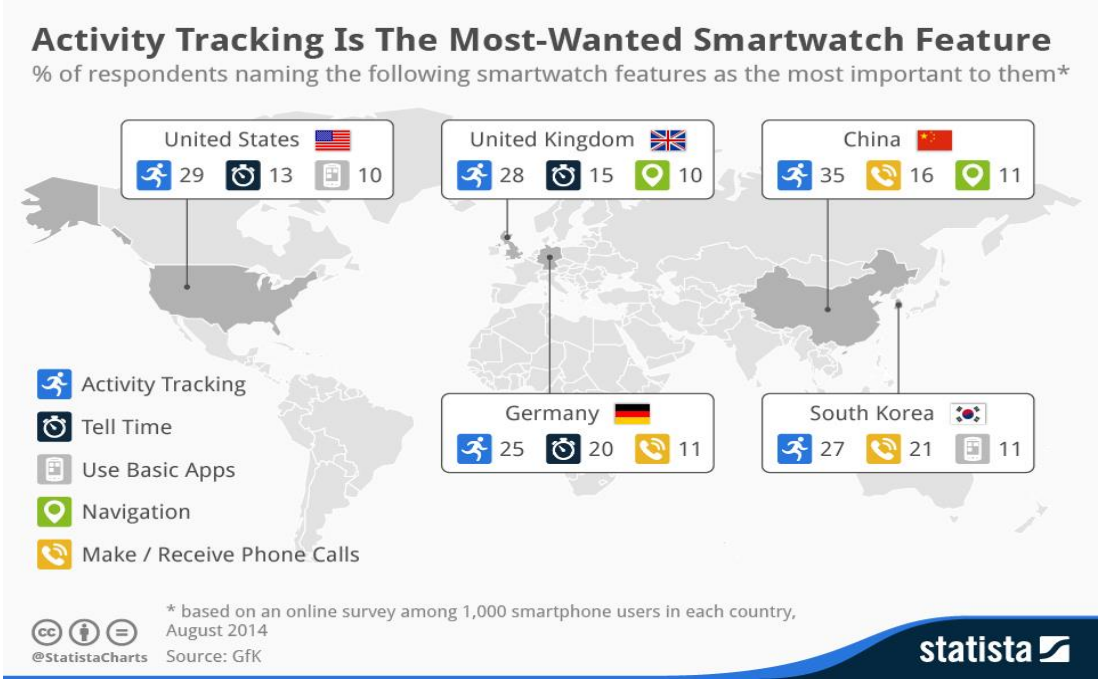


Figure 23. Most important features on smartwatch voted in different countries (Statista 2014)

Predicted figures also point out that there will be more than 110 million wearable devices in 2018 (Gagliordi 2014; Hamblen 2014) and the market will be worth about 5.8 billion USD (TransparencyMarketResearch 2014)

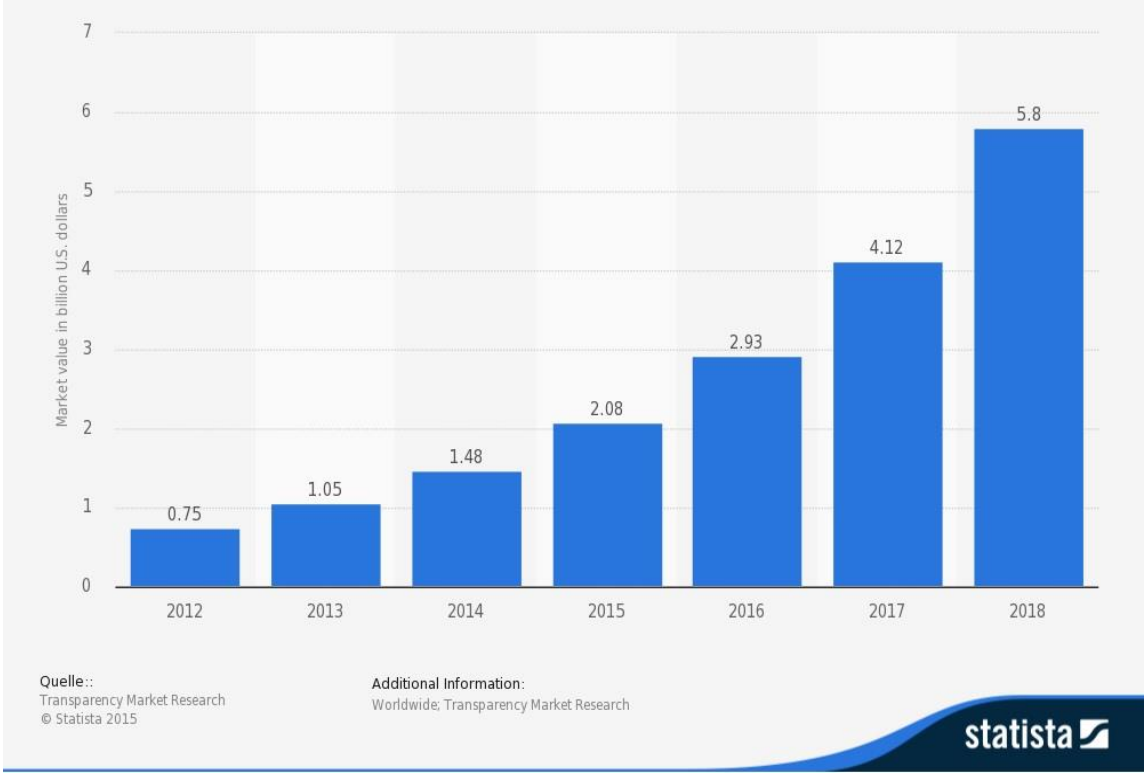


Figure 24. Forecasted value of the global wearable devices market from 2012 to 2018 in billion U.S dollars (Statista 2015)

The figure 24 shows strong growth of wearable devices in next few years. The average growth rate over years is a hundred and forty percent (140%). This is an impressive numbers that may attract more investment into this potential market.

Besides smartwatch, virtual reality glasses and headgears will gain certain success in wearable techs industry as well. Number of active users is predicted to be raised dramatically, from about two hundred thousand (200 000) users in 2014 to one hundred and seventy-one millions in 2018 (Figure 25).

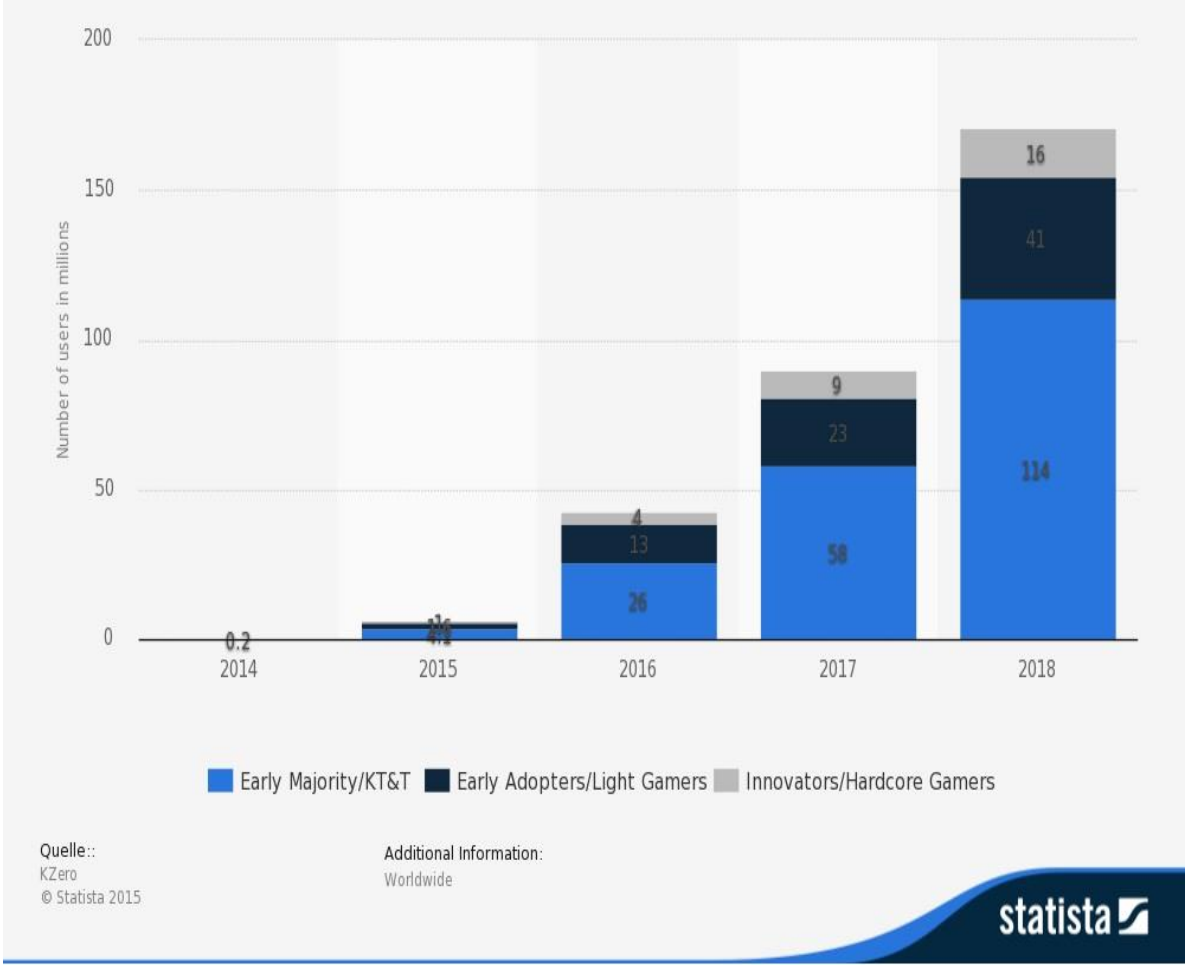


Figure 25. Number of active virtual reality users worldwide from 2014 to 2018 in millions (Statista 2015)

Among groups, early majority/KT&T is predicted to dominate with about two third active users. However, number of users who are willing to pay for virtual reality software is not that high (less than 20% of active users).

7 LIMITATIONS AND CONCLUSION

Firstly, the size of the study was not big enough because the data was collected at the beginning of March when the beginning of self-study week started and lasted for one week. Therefore, not many answers were collected but enough to give relative conclusions about behavior of male and female customers when they decide to buy wearable smart technologies. In addition, because of the small size of the research, the result was different from Ronaghi's case which was conducted on a bigger group of people.

Secondly, one of the most common concerns of manufacturers is about battery duration of products which was not mentioned in the study. This issue somehow affects the decision of consumers to buy products. However, difference in battery duration between manufacturers is not big at the moment and they always have offers for extra battery for products themselves before checking out so the problem somehow is solved.

Used figures in analyzing and reports are GBP and USD while the main currency in survey was EUR. Therefore, if prices taken into account were in some EU countries, they could be more expensive due to tax and transport fee, then percentages in some data properly different in theory. However, the potential in reality of smart devices is still high and wearable smart technology industry should be invested more.

The last one is about the actual test itself. The test should be run by manufacturers in order to introduce different types of products in the same branch only. For example, Samsung gets the actual test run to market Samsung Gear Fit (fitness tracker), SamSung Galaxy Gear (smart watch) or Samsung VR Innovator Edition (smart glasses).If retailers who sell different products from many manufacturers do this marketing plan, then they need to choose wisely which products should be on the lists because they cannot offer all branches and it will costs a lot. Moreover, with help from main manufacturers, the plan can be implemented easily and effectively.

There should be a deeper research with a size of at least one hundred respondents and more specific questions in order to study better how

differently men and women choose and use wearable technologies. Moreover, respondents should be chosen from a specific target group so the result will be more accurate and effective.

In the next few years, the amount of active wearable smart technologies will be increased rapidly worldwide and the market itself turns to a potential field that attracts investments from other industries in order to become incredible tools improving people's lives. New products and wonderful applications will create a new era: totally change the way how people communicate through distances or interact with the world, diseases and natural disasters may be forecasted right on time to save lives, people who are missing or in dangerous status can be found and rescued and many awesome changes the world would have if wearable smart technologies receive more attention from consumers. Their support and reaction will become an inspiration and necessary factors for wearable techs industry to grow.

Besides, problems such as privacy of customers, security of software or violations when people use wearable techs for evil purposes that cross the law need to be paid attention to by manufacturers, software of third parties or the government. Limitations should be outlined clearly and protected. Moreover, users themselves should not abuse wearable techs too much but have to balance their lives between virtual social network and the real one because no matter how awesome prospects the technology can create, what makes the world stay beautiful is what people can give away to each other in reality.

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APPENDICES

Survey questionair Appendix 1

1. What is your nationality?*

- Finnish
- Russian
- Chinese
- Vietnamese
- Other

2. What is your gender?

- Male
- Female

3. How old are you?*

- 16-20
- 21-24
- 25-30
- Over 30

4. What is your occupation?*

- Student
- Teacher
- Entrepreneur
- Officer
- Other

Following questions belong to one kind of technology only (Question 5 to 8):

5. Choose the correct category to describe the following wearable device:*

- Fitness/Health trackers.
- Smartwatches.
- Wearable cameras.

- e-skin patches.

6. In your opinion, this device can:

You can choose maximum 4 answers:

- Measure heart beat
- Track activities (workouts, distance, calorie burned, etc.)
- Receive call notifications.
- Make calls and texts.
- Be a watch / Time indicator.
- Control music in mobile library.
- Monitor sleep quality.
- Silent wake-up alarm.
- Other

7. Indicate the range of price that you will pay for this kind of technology:*

The maximum price you will able to pay for this technology is in the range:

- 50€-100€
- 101€-150€
- 151€-200€
- 201€-250€
- Over 250€

8. In your opinion, what is the suitable price if the device have following features:

+ Count step taken, distance traveled + Measure calorie burned + Calculate sleep hours and sleep quality + Wireless sync with phones + Supporting software

- 50€-100€
- 101€-150€
- 151€-200€
- 201€-250€
- Over 250€

Following questions are for Wearable Cameras only (Question 9 & 10):

(Wearable cameras are cameras which can be attached on your headgear, helmet or on your clothes)

9. Scale the following criteria for Wearable Camera that you want to buy:

	1 - Not important at all	2 - Rarely important	3 - No matter if it exists or not	4 - Partly important	5 - Very important
720p video resolution					
1080p video resolution					
Normal photograph					
Time lapse photograph					
Image stabilization					
Audio quality					
Low-light mode supported					
Size					
Weight					
Price					
Warranty					
Color of model					
Waterproof					
Wireless synchronization					

10. In your opinion, what is the suitable price for the following wearable camera with features:

+ 1080p video resolution + Can take photos + Image stabilization + 64GB memory + High quality audio + HDMI output + Supporting software

- 50€-100€
- 101€-150€
- 151€-200€
- 201€-250€
- Over 250€

Following questions are about Smart Watches only (Question 11 & 12):

11. Which following features would you like to have on your ideal smart watch?*

You can choose maximum 4 features:

- Fitness/Health tracking.
- Create and receive calls and messages.
- Control music from phone.
- Navigation.
- Weather notification.
- Monitor sleep quality.
- 3D screen display.
- Water proof.
- Voice interaction.

12. The maximum price you are willing to pay for your ideal smart watch is:

- 50€-150€
- 151€-250€
- 251€-350€
- 351€-450€
- Over 450€

Please answer general questions below:

13. If you have a chance to take part in a test for real experience about wearable technologies in 1 week for free, would you willing to get involved in?*

- Yes
- No

14. If yes, which wearable device(s) do you want to have?*

- Fitness / Health tracker(s)
- Smart watch(es)
- Wearable camera(s)
- Smart glass(es)
- Smart ring(s)
- Others: ☐

15. After the test, if the results don't fail your expectations, would you like to buy that (those) wearable device(s)?*

- Yes
- I will consider about it
- No
- Others: ☐

16. Reasons that you want to buy wearable device(s) are:

You can choose maximum 3 answers:

- I want to have new experiences
- To fulfill my personal demand(s)
- To give away as gift(s)
- It's a trend and I don't want to be outdated
- They are beautiful and fashionable
- Others: ☐

17. Scale following criteria which concern you when choosing a wearable technology:

	1 - Not important at all	2 - Rarely important	3 - No matter if it exists or not	4 - Partly important	5 - Very important
Functions					

Mobility (weight & size)					
Design of product					
Color					
Price					
Warranty					
Privacy of personal information					
Supporting software					
Ability to replace parts of device					