South East European University

Faculty of Contemporary Sciences and Technologies

MASTER THESIS

Topic: Wearable Technology in the Workplace: Benefits and Constraints in Global and Local Context

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Abstract

Wearable technology is a part of a larger family of devices known as Internet of Things. As such, wearables represent the largest type of Internet of Things devices that can have a variety of uses in many spheres of life. One of the important areas of use is the workplace, which is a huge part of the everyday life of people being an integral part of the workforce. The implementation of these devices bring a lot of benefits as well as constraints, which have different impacts on the organization. The purpose of this thesis is to show not only how these devices can help one organization grow from the benefits that they bring, but also outline the constraints as well, making the implementation fruitful for the company. Through the use of Literature Review and a research questionnaire we intended to learn more about how employees in North Macedonia feel about the technology that might come in their workplace, based on the benefits and constraints, as well as comparing this information with pre-existing research conducted by other organizations. The results received from both types of research concluded that wearable technology has a positive impact on people and it should be implemented by organizations across North Macedonia.

Keywords: Internet of Things, Wearable Technology, Workplace, Benefits, Constraints

Абстракт

Технологијата која што може да се носи е дел од група уреди позната под името Интернет на Нештата. Како таква, оваа технологија го завзема најголемиот дел под тоа име и воедно ужива најразлични апликации во повеќе сфери од животот. Едни од најзначајните корисници се луѓето како движечка сила во секоја компанија односно работно место. Воведот на ваков тип технологија со себе носи големи придобивки но и ограничувања во однос на организацијата која ги користи. Целта на овој труд е да ги прикаже сите придобивки, но и претстави ограничувањата од користење на оваа технологија, што би довело до успешно имлементирање на ваквите уреди во една компанија. Сево ова продлабочено со темелна анализа, прашалник и паралелна споредба на глобални и локални истражувања се стреми да го утврди ставот на вработените во Северна Македонија кон користењето на овие уреди на работното место. Резултатите го потврдија позитивниот став на луѓето кон имплементацијата на технологија која што може да се носи на работното место проследено со позитивното влијание кое таа го има врз работната сила во Северна Македонија.

Abstrakti

Pajisjet (teknologjia) veshëse janë pjesë e një familje më të madhe pajisjesh, të njohur si Interneti i Gjërave. Si të tillë, pajisjet veshëse përfaqësojnë llojin më të madh të pajisjeve të Internetit të Gjërave që mund të kenë një larmi përdorimesh në shumë sfera të jetës. Një nga fushat e rëndësishme të përdorimit është vendi i punës, si pjesë integrale e fuqisë punëtore. Zbatimi i këtyre pajisjeve sjell shumë përfitime, si dhe kufizime, të cilat kanë ndikime të ndryshme në organizatë. Qëllimi i kësaj teze është të tregojë jo vetëm se si këto pajisje mund të ndihmojnë një organizatë të rritet nga përfitimet që ato sjellin, por gjithashtu edhe mënyrën e trajtimit të shqetësimeve, për një zbatim të suksesshëm për kompaninë. Përmes shqyrtimit të Literaturës dhe një pyetësori kërkimor kemi synuar të mësojmë më shumë rreth asaj se si ndihen të punësuarit në Maqedoninë e Veriut, në lidhje me teknologjinë që mund të vijë në vendin e tyre të punës, bazuar në përfitimet dhe kufizimet, si dhe krahasimin e këtij informacioni me kërkime të kryera nga organizata të tjera. Nga rezultatet e marra dhe krahasimi me hulumtimet ekzistuese arritëm në përfundimin se teknologjia veshëse ka një ndikim pozitiv tek njerëzit dhe ajo duhet të zbatohet nga organizatat në të gjithë Maqedoninë e Veriut.

Introduction

Since the inception of the Internet in the late 1960s, a lot of things have changed, especially in the way of how we interact with things around us, but also on how we receive information. The commercialization of the Internet lit the path for new technologies to be built, all with the intention of connecting people. These new technologies then began being divided into different families, one of them being Internet of Things.

Internet of Things, is a large family of devices that have the Internet in mind with the purpose of providing help and communication to us users. By having such devices connected to the Internet we can assign certain tasks to be done without the need of actually interacting with them, and all of this is done through a single connection - the Internet. However, the Internet of Things is a large family of different types of technologies with different functionalities that allow people convenience. The largest group of devices under its umbrella are the Wearable Technologies as they represent the most available type of Internet of Things devices that are currently owned by millions of people around the world.

Wearable technology, as the name suggests, are devices that can be worn by people or users. These devices are small and have dozens of functionalities. They are simple yet sophisticated devices that have small processors so powerful as to allow uninterrupted communication for its users. With the addition of sensors, wearable technology allows people to track different kinds of vitals or metrics, thus enabling them to increase their health or, in general, improve and make their lives easier and better. As mentioned, they are the most popular Internet of Things devices, ranging from fitness trackers, to smartwatches, to even virtual reality headsets. Until recently, wearables were used for commercial purposes, sold as consumer products, and were used mainly for individual purposes, but now organizations try to improve their businesses by implementing these technologies to help their employees in the workplace.

Many companies around the world are implementing wearable technology in the workplace, as a means to increase efficiency and accuracy. As with consumer use, organizations can also utilize certain wearable devices to help themselves do some tasks faster and improve quality of execution. Various types of wearables can help organizations in different ways, for example fitness trackers can be used to track the vitals of the employees, whereas augmented reality glasses can help the employee with showing where certain things need to be placed in a warehouse or on how something needs to be done by providing step by step guidance. As with every technology, wearables have their own benefits as well as constraints when implementing them in the workplace. The main reason of this thesis is to lay out the most common benefits as well as constraints, but also conduct a literature review to find global research on the matter of wearable technology in the workplace and conduct a questionnaire research to gather information on how employees feel about the most common benefits and constraints of using wearable technology in their workplace.

Existing researches show that there are a lot of benefits of using this type of technology in the workplace however, there are some constraints that everyone should be aware of when using such devices. With an increased worldwide usage the introduction of wearable technologies in Republic of North Macedonia could be what's in store for the future of the larger organizations as well as the new start-ups that implement international trends, all with the intention of receiving these benefits.

At the end of this master thesis, we will show a few global researches followed by the results of the questionnaire that we conducted. All this information will be compared to view whether the trends and perceptions internationally will correlate with the results received from the questionnaire that we conducted.

Chapter 1: Introduction to Internet of Things

The release of the Internet for commercial use brought a lot of changes in the way people interact with their surroundings. As we know the Internet is the largest network that connects everyone in the world. With the increased use of this technology many companies tried to find ways of using it in many different ways. One of these is the Internet of Things. But, what exactly is the Internet of Things? There are many definitions of what Internet of Things actually is but the most comprehensive ones are given by Margaret Rouse, and SAP. According to Margaret Rouse: “Internet of Things is a system of interrelated computing devices, mechanical and digital machines, objects, and everyone that has been provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-machine interaction”[1]. What this means is that the Internet of Things represents everything that has a chip stored that will allow for seamless transfer of different data without us doing anything. On the other hand, SAP community, one of the largest software companies in the world, have given the following definition: “The Internet of Things is a network of physical objects like vehicles, machines, home appliances, and more, that use sensors and APIs to connect and exchange data over the Internet”[2]. When observing these two definitions we get a perception that the Internet of Things is meant for physical devices which have the opportunity to transfer data through the use of the Internet. Now we found how the data is being transferred and how these devices are communicating between each other. In order for this communication to work, every device needs to have the possibility of being assigned an IP, or Internet Protocol address. This communication can transfer data to a person which afterwards can make appropriate decisions based on the data received. The goal of the Internet of Things is to have devices that will have the opportunity to report in real time, which will improve efficiency and bring important information more quickly [3]. With this being said, due to increased usage of Internet of Things, the market is expected to reach $8.9 trillion in value in 2020 [4]. Internet of Things is a relatively new term that has been used in the last 20 years but it was an idea used even before that, this will be covered in the next section.

1.1 History of Internet of Things

As mentioned before the Internet of things is a relatively new terminology used by the tech industry for all the devices that have sensors and the ability to transmit data through the use of the Internet. The person that coined the term 'Internet of Things' is Kevin Ashton, who first mentioned it during a presentation at Procter & Gamble in 1999 for the use of RFID tags to be used by the company [5]. Even though the terminology was first mentioned in 1999 it took almost 10 years for it to be officially recognized with Cisco stating that that recognition came around 2008 and 2009 [6]. This does not necessarily mean that 1999, or 2008/2009, were the periods when the Internet of Things was initially created as the idea of using such uses was discussed even before that, in the 1980s. To better explain the timeline of the development of the Internet of Things we would refer to the articles written by Sandra Khvoynitskaya [7] and another one by Andrew Brown [8]. As an initial start of the Internet of Things must be taken the same date as the invention and deployment of the Internet for the first time in the late 1960s, because without the Internet we could not have Internet of Things. Based on the research, the official start of the Internet of Things can be dated back to the 1980s. In other words the development of the Internet of Things can be divided into four stages that correlate with its 4 decades of existence.

The 1980s

During the beginning of the 1980 the basis of the Internet, named ARPANET, became available to be used by everyone. This allowed programmers from Carnegie Mellon University to create the first connected device in 1982. The device that they connected was a Coke vending machine. What they did is that from the connection they had with the machine they could view the amount of inventory was inside, whether there were any drinks available, when was the last refill of new inventory, if the cooling was working properly, and whether they should refill the inventory. This is considered the first 'thing' that used a connection to transfer information to a human being.

The 1990s

This is the decade when there was development of internet connected devices which were closely related to the modern Internet of Things devices. In 1990, John Romkey was the first that connected a toaster to the Internet with the intention of turning it on and off remotely. As this has proven to be a trend in the next few years, in 1993, engineers from Cambridge University created a system that would take photos of the coffee maker three times a minute, by creating this they were able to see the amount of coffee available using the Internet. 5 years later, in 1998, IPv6 became a draft standard that will allow the opportunity of creating many IP addresses which would be crucial for the use of Internet of Things. In 1999 we will first hear of the term “Internet of Things”, which was coined by Kevin Ashton during a presentation in Procter & Gamble for using RFID tags.

The 2000s

After the presentation given by Kevin Ashton, the term “Internet of Things” would begin being used by many people worldwide. This resulted with LG creating the first smart refrigerator which would allow users to use the Internet to order groceries online by using the refrigerator. As the interest continued to be on the rise, in 2008 led to the creation of the 1st International Conference on the Internet of Things, which was held in Switzerland. This continued with the term being used in new books and the decade ended with the first tests by Google on self-driving cars, using sensors and the Internet.

The 2010s

In the beginning of the 2010s, the market research firm Gartner placed the Internet of Things technology on its “hype cycle” which meant that IoT had huge potential in the long run. During the next few years many companies tried to create devices that would successfully integrate the Internet into the way they operate which culminated with the creation of the Google Glass

in 2013 as well as the Amazon Echo in 2014. Amazon Echo was the first smartspeaker that would use the Amazon Alexa virtual assistant to allow its users to control the smart devices in the home, order food, book plane tickets, etc.

This revolution made by this device turned into the period of massive development of new smart devices that would conclude with cheaper devices being rolled out every month due to the high interest on the market.

1.2 Uses of Internet of Things

Since we got an introduction of what IoT actually is as well as the history of the technology it is good to show the many applications of the technology. As mentioned, the Internet of Things has embedded the Internet into devices that would ease the way of living for people that will use it, but on the other hand, companies are using it to increase productivity in their production lines by using such devices. The applications of the technology vary from simple home outlets, to cars, and even cities.

1.2.1 Smart Home

Smart home is the most widely known application of the Internet of Things, as it includes devices that are most used by us in our homes. Smart home is another way of saying home automation, and this means that with the use of these devices we can automate the number of things that are being done around the house. By using sensors, smart speakers, cameras, outlets, and other smart devices we can set things to be done by themselves or by giving small input. For example, the Nest thermostat can connect to the Internet and through it can connect to your smartphone and smart speaker which we can use to give instructions on the temperature we want even if we are not present in the house. Using the previously mentioned sensors the devices can learn your habits and then adjust lighting, temperature in the house which in return can lower the money we pay on electricity and also save time needed for some things around the house. The rise of IoT in the home is expected to become as common as having a smartphone today.

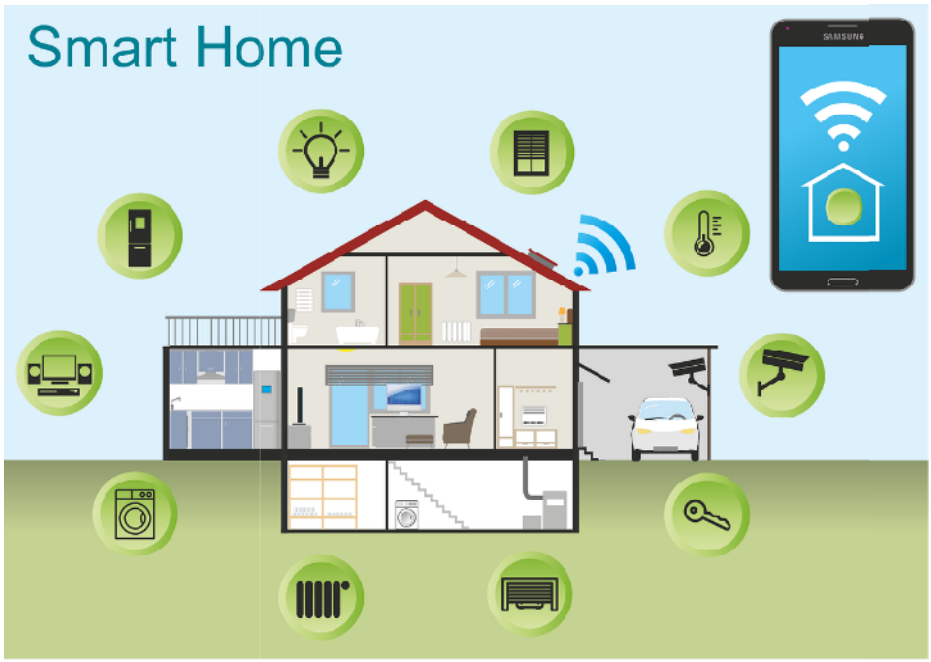

Figure 1 - Smart Home

Source:https://theiotmagazine.com/the-internet-of-things-will-have-a-huge-impact-on-home-utilities-514f38695f1d

1.2.2 Wearables

After the smart home, the next biggest application of IoT is the wearable technology, which is the main issue we will research in this thesis. Wearable technologies are appropriately explained by the word wearable, which means that these devices are meant to be worn on our body. Many people believe that these devices are accessories, but they vary from simple watches to more sophisticated exo-suits that increase productivity of the wearer. As mentioned, the most used wearable is the smartwatch and smart band which are meant to allow its users the flexibility of not taking your smartphone all the time to do simple things, as these devices are connected to your smartphone at all times. Many tech companies have developed their own wearables starting like Apple, Google, Samsung, and others. General notifications, smart home remote usability as well as advanced health tracking are just a few of the many possibilities these devices offer which will be covered later on in this thesis.

Figure 2 - Wearables

Source: https://techcrunch.com/2016/03/29/you-are-what-you-wearable/

1.2.3 Connected Cars

The idea of creating a connected car has begun with the first tests made by Google of creating a self-driving car. The term connected car is applied by traditional car manufacturers that along with many new market entrants began including sensors, radars, and cameras all with the intention of creating a new experience for the driver. By various options included in these vehicles the passenger has more safety and comfort. Traditional manufacturers like BMW, Mercedes, and Audi began using the sensors, cameras, and radars of their vehicles to create a complex system that, by using them, can interact with nearby objects to create semi-autonomous vehicles and be vary of impending traffic or accidents and avoid them accordingly, but this is also being used by new entrants like Tesla. What Tesla does is creating a new experience for drivers by offering them new safety features due to the way their car connects to the environment around it.

Figure 3 - Connected Cars

Source: Shutterstock.com

1.2.4 Industrial Internet of Things

These types of IoT devices are the ones used in industrial engineering by using smart machines that are connected to the network. Their purpose is by using big data, sensors, and software, to machine new products based on the general need for production automatically with no or little intervention by a human hand. This allows for faster and more precise manufacturing which furthermore decreases cost in one company.

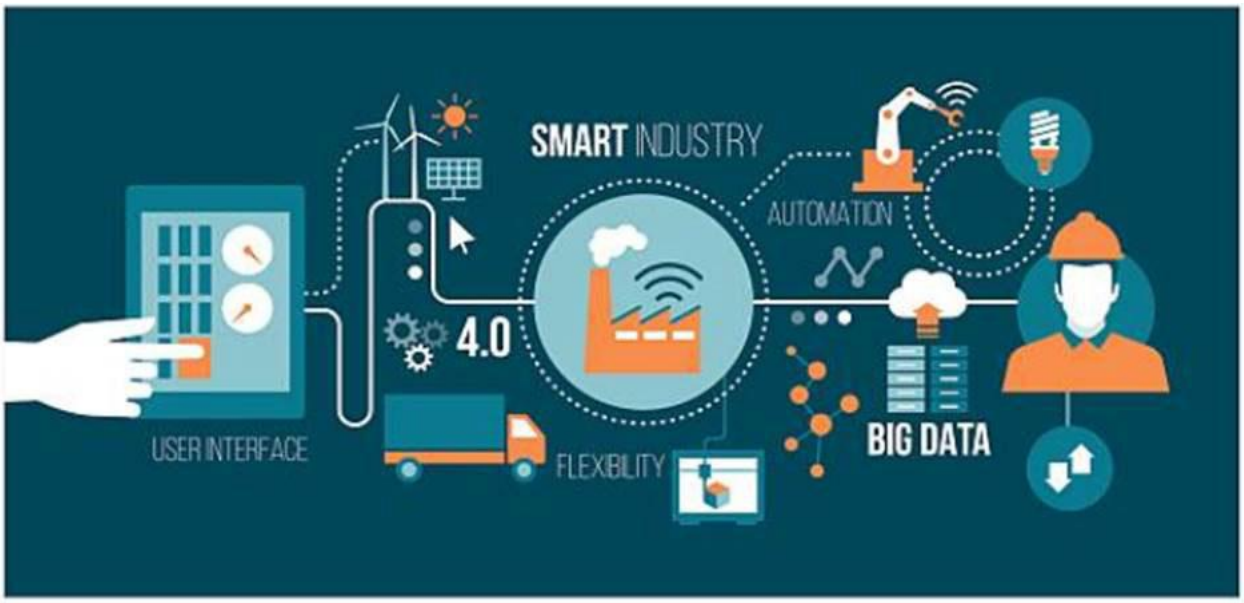

Figure 4 - Industrial Internet of Things

Source: https://www.digikey.com/en/blog/the-rise-of-the-industrial-internet-of-things

1.2.5 Smart Cities

Smart cities is the most ambitious application of the Internet of Things as it is meant to connect every part of one city by sensors, cameras and through the use of web applications to be available to everyone to get information on what is happening in the city at any time. An example of things that can be helped in one city are smart trash cans which will send information to the necessary recycling company if the trash can is filled and it needs to be emptied and this will lower the pollution generated by one city. Another example is the use of sensors in the public parking lots for which people can connect to the web application provided by the city to see information of which places have free parking and how to get to that place. These two examples are just a few of the many benefits this application can bring for one city, with the main intention being lowering pollution, consumption of electricity, and better traffic planning.

Figure 5 - Smart City

Source: https://www.iotworldtoday.com/2019/08/16/smart-city-initiatives-guidelines-for-success/

1.2.6 Smart Retail

The use of Internet of Things in retail allows the shops to learn the activity of their customers by using sensors, cameras, and even RFID tags. By using RFID tags one shop can learn which products are sold the most, but also prevent theft by knowing the location of the RFID tag at all times. Gathering this data afterwards can allow the shop to make decisions on where to store items to get the most coverage based on interest of customers and maximise profits of the store. But by learning the patterns of customer activity by using sensors and cameras a shop can create a profile of a customer and create a strategy that will increase customer satisfaction. Using smartphones, a customer can learn of new offers every time they enter a store or even by walking through an aisle they will receive a notification to learn about new offers that some products have at the place you are passing by.

Figure 6 - Smart Retail

Source: https://www.viewsonic.com/library/business/smart-retail

By learning about the history of the Internet of Things we can get an idea that the possibilities are endless. From starting a few decades back we have achieved a great thing with this technology all with the intention of increasing not only the well-being of everyone, but also changing the way we interact with the world. As this is a broad topic which has numerous books, for the case of this master thesis we will focus on one of these applications of the Internet of Things, and that is Wearable Technology. These simple devices have enormous potential not only for residential use but also in the everyday work life in companies, which we will cover more in the following chapters of this research.

Chapter 2: Introduction to Wearable Technology

In this thesis we will be working on discovering Wearable Technology in the Workplace. Previously we elaborated on what the Internet of Things is, and that Wearable Technology is part of it. But before we continue on the implementation of such technology in the workplace we need to explain what the technology stands for, its history, types and uses, which will all be mentioned in this chapter.

The main question is what Wearable Technology really is. According to Will Kenton, on Investopedia.com, "Wearable Technology is a category of electronic devices that can be worn as accessories, embedded in clothing, implanted in the user's body, or even tattooed on the skin. The devices are hands-free gadgets with practical uses, powered by microprocessors and enhanced with the ability to send and receive data via the internet"[9]. What this means is that wearable technology are small devices that we can wear and use to ease our life. This is achieved by using a number of sensors, microprocessors, and antenas, all without any direct human interaction. The sensors allow for many activities to be tracked, like steps, heart rate, and form that into data. Microprocessors then run through all of the data and compile it into usable information. The antennas through the established connection can transfer this information via the Internet in front of the eyes of the user. But how this information is displayed depends on the wearable device, some have dedicated screens while others synchronize with the smartphone of the user to give all the information together with relevant statistics. With everything being said we can understand why these devices are getting adopted widely in the lives of every individual in the world, which is why they are the main reason the Internet of Things is so popular in recent years [9]. But wearable technology had its development, and we must admit that they weren't this advanced in the past, and that history will be discussed in depth in the next part.

2.1 History of Wearable Technology

Wearable technology didn't have the start that we all expected, while the development of the modern wearable technology as we know today started in the 20th century, this technology's roots go further back in the 13th century. In this section, we will go more deeply into the history of Wearable Technology and how development went back. Based on Joel Laforest and John from Smartwatch Labs [10][11], the history of wearables is as follows: We mentioned that the roots of this technology goes back to the 13th century, this is when the history starts, when the first eyeglasses were created in Italy.

In the next few hundred years there were no major leaps into development of new wearables, not until the 16th century. At this time, the first watch was created in the form of the necklace that allowed the user to tell the time, but this technology had few iterations in the following centuries. In the 17th century, the watch received a new iteration meaning that it now was worn as a pocket watch. Again, in the late 1600s it was changed again by becoming a wristwatch, which is the form of watch that we now know. This ended the development of this technology until the modern times when the development of the modern wearables began.

In 1977, the company HP created the first calculator watch which at that time was a huge success but that also marked the beginning of the modern wearable technology. The same year we got the first wireless EKG heart rate monitor that was developed by Polar Electro. In the 2000s, the world started using the first iPod, as well as Fitbit's fitness tracker which began the massive use of wearable technology in modern times in 2009.

After 2010, many companies started developing their own version of wearables, in these times the most important is the creation of the smartwatch. The first official smartwatch was created by Samsung in 2013 and followed by the Apple Watch from Apple in 2015. In these years many other companies expanded the category of what was included under the wearables umbrella, like Google creating their Google Glasses, and Oculus developing their VR headset Oculus Rift.

The history started from very simple things that reached out to the high tech that we have today.

2.2 Types of Wearable Technology

Thanks to the history of wearables we now know that there are a lot of devices that are under this big tech umbrella. There are many articles and research done that define the types of Wearable Technology that we can see and use around us. Even though there are a lot of devices, the most popular types of wearables are: fitness trackers, smartwatches, headwear, smart jewelry, smart clothes, hearables, and implatables.

2.2.1 Fitness Trackers

Fitness trackers are one of the most popular wearable devices. They are small wristbands that have sensors that originally tracked only steps, but now they have additional sensors that help with tracking heart rate as well as calories burned. Other than the tracking features of these devices most of the newer products offer features like making phone calls or even notifying the user of any incoming notification. These devices require connection to the user's smartphone for the notification feature to work but also to allow the user to view the information that the fitness tracker gathered through the sensors, and make decisions based on that. There are many companies that develop fitness trackers but the first company that created the first consumer fitness tracker was Fitbit (Figure 7), in 2009, with companies like Samsung, Huawei, Xiaomi and others quickly following.

Figure 7 - Fitbit Fitness Tracker

Source: https://www.fitbit.com/uk/charge4

2.2.2 Smartwatches

As the name suggests, these wearable devices are the new and improved digital versions of the classical wristwatch. They consist of a screen, that other than telling the time has access to applications that help the user with many things that ease his life, sensors that track many of the vitals just like a fitness band, and a band that wraps around the arm of the user to hold it in place. The smartwatch is powered by a microprocessor that allows for all the applications and tracking to move smoothly, while different antennas allow for them to connect to a smartphone. While the device can work as a standalone device they are at their full capacity when connected to a smartphone. By connecting the smartwatch to the smartphone the user can use various features, like making calls, sending and receiving emails and messages, searching for information on the Internet, and many more. As with fitness trackers, the smartwatch is also one of the most popular wearable devices, and they represent what is expected of the Internet of Things to do. Due to its popularity many companies have created their own versions of a smartwatch, with Samsung creating its first Samsung Gear smartwatch in 2013, with Apple introducing its Apple Watch in 2015, and other companies like Huawei, Garmin, Xiaomi, etc. But even classical watch companies like Tag Heuer and Fossil have joined in the development of smartwatches.

Figure 8 - Smartwatch

Source: https://www.apple.com/newsroom/2017/09/apple-watch-series-3-features-built-in-cellular-and-more/

2.2.3 Headwear

Headwear is a relatively developing type of wearable technology in which companies have started taking interest in the last few years. They include a display from which they show the necessary information to the user. Based on how they display information they are divided into 2 subtypes: Augmented Reality and Virtual Reality.

Augmented Reality, or AR, is a type of headwear that uses a screen and a projector that allows for digitally generated fields to be added in front of the eye. This way the user can see all the notifications, receive phone calls and text messages, all while paired with a smartphone. AR is a field in which many companies have taken interest in due to the many benefits that it can offer to the user. The first AR headwear was created by Google, Google Glasses, but it was relatively short lived but it allowed other companies to learn from previous mistakes and work on the technology to further develop it.

Virtual Reality, or VR, is the type of headwear that uses a display that allows the user to visit a digitally created virtual world and to cut themselves off the real world. Even though this doesn't help the user with transfer of information the main purpose of this type of wearable is entertainment. The first consumer VR headset was created by Oculus in 2016 named Oculus Rift, which was followed by HTC Vive and Playstation VR.

Figure 9 - Oculus Rift

Source: https://en.wikipedia.org/wiki/Oculus_Rift

2.2.4 Smart Jewelry

As many companies focus on developing fitness trackers for the mass, there is a niche market for something more appealing to people. Smart jewelry offers the same tracking of steps that fitness trackers have, but in a more appealing style. Smart jewelry takes the form of earrings, necklaces, or even rings. Some companies that are popular in this field are Fossil, Ringly, and Bellabeat.

Figure 10 - Smart Jewelry

Source: https://www.digitaltrends.com/wearables/best-smart-jewelry/

2.2.5 Smart Clothes

Smart clothes are garments that have sensors embedded within the fabric, and are being developed by many of the traditional apparel companies. They have the opportunity to track the user's heart rate, as well as track the location, but there is a need for a connection to a smartphone. Other than the traditional apparel companies, one of the most popular smart clothing are the Spectacles developed by the tech company Snapchat.

Figure 11 - Smart Clothing

Source: http://www.justscience.in/articles/use-smart-clothes-helping-medical-patients/2017/11/17

2.2.6 Hearables

Hearables are a relatively new type of wearable technology. They are represented by the true wireless earphones, that have the opportunity to connect to a smartphone, and use the integrated Virtual Assistant of the phone to search for information on the Internet, as well as take phone calls, receive and send messages, all without the need of taking the smartphone out of the pocket. There are many companies that have their own types of wireless earphones like Apple, Samsung, Huawei, Xiaomi and others.

Figure 12 - Hearables

Source: https://www.apple.com/airpods/

2.2.7 Implantables

Not every wearable device can be worn on the body, some of them can be placed under the skin, like the implantables. They are small chips or devices that can serve different purposes, while mostly being used for medical purposes they can also be used to store personal information on the user.

Figure 13 - Implatables

Source: https://www.hiclipart.com/free-transparent-background-png-clipart-dgfvr

2.3 Uses of Wearable Technology

All the many types of wearable devices can be used in a variety of industries all with the intention of making the lives of people easier. Based on a study from Grace College[12], wearable technology has a variety of uses mostly in: fitness, healthcare, entertainment and media, retail and in the workplace.

2.3.1 Fitness

With fitness trackers and smartwatches being used mostly, we can state that fitness is one of the major places where wearable technology can be used. Thanks to all of the sensors that allow for tracking different things of the user. When exercising, wearables can give that ad hoc information to the user, for example the number of steps they made during the exercise, what was their heart rate during the entire workout, and even the calories that they burned while exercising. This allows the user to make better decisions the next time they are going for a workout, by knowing how much they can push themselves.

2.3.2 Healthcare

The healthcare sector has a huge potential when talking about the use of wearable technology. Healthcare is positively affected by all of the types of wearables, mostly due to the sensors. Now sensors can observe the behavior of different vitals of the user and that information can be sent to the doctor, which can see whether one person should be treated for some diseases. Some devices like the Apple Watch have an EKG feature that gives a clear heart reading that also can help people prolong their lives, but also other devices can help with tracking of other things.

2.3.3 Entertainment and Media

Wearables are simply gadgets that can provide fun to the user. Various types like the Virtual Reality headset can take the user to digitally created worlds that would entertain them. By

having the option for wearables to connect to social media profiles, many companies can make special tailored advertisements that will be pushed directly to the screen of the user.

2.3.4 Retail

Thanks to wearable technology retailers can now increase their customer service experience of all of the customers that enter their stores. When using a wearable, and through the use of sensors, the retailer can see which areas are mostly visited by their customers, and make appropriate arrangements to make the store more appealing for the next people that come. Based on a specific location within the store, the retailer can send a notification to the user with all the promotions that are occurring for that sector of the shop or general promotions of the store. This results in a better customer experience that many users wish for.

2.3.5 Workplace

As wearables have a lot of uses in many different areas many employees want their companies to integrate wearable technologies. This would allow for the company to track things better and improve efficiency and productivity at work. But this also places security in one organization, and also the wellbeing of the employees in the company. As this is the main point of this thesis, we will go in more depth in the next chapter.

Chapter 3: Wearable Technology in the Workplace

As mentioned, wearable technology can be used in different ways from personal use at home, to even using them in our place of business. In the previous chapter we have mentioned that the Workplace is one of the places where there is great potential for use of wearable technology, thanks to that we will cover more in this chapter.

The work environment represents a good part of the life of one employee, and that is why companies need to find ways to improve the satisfaction and well-being of their employees. With this being said we can make sure that implementing wearable technology is one of the many ways that companies around the world are working on improving these stats. But this raises the question of how this affects the workplace.

By implementing wearable technology in the workplace the organization can increase productivity, satisfaction, health of their employees, as well as improve processes and influence how this is being done in the organization more efficiently.

To better understand how these expected outputs can be achieved in the workplace we will break down each of these aspects.

Productivity is one of the main stats that can be improved by implementing wearable technology in the workplace. This can be achieved through the use of various devices that will allow the employee to view all their metrics, to know where they stand with work and where they need to improve in order to achieve a higher level. But this also allows the organization to see how their employees are doing and to identify pain points in the productivity and act upon it.

Satisfaction is another aspect that can be tracked through the use of wearable technology. The organization can see how the employees are accepting some of the decisions that affect them, and then use that information to improve future decisions and see which variables affect the employee satisfaction.

Health is one of the major things that, if not the first thing, companies try to improve when implementing wearable technology in the workplace. The most popular wearables allow companies to track employees heart rates, and other vitals, which will allow them to see if their employees are tired and if they should take a break or even go home to take some rest. But also the wearables can inform the employee if they need to take a short walk in order to reduce the back pain from sitting on a chair for their entire workday. With certain tracking the organization can acknowledge which types of precautions they need to take to make sure that every employee is healthy.

Processes can also be improved with the implementation of wearable technologies, especially those that are complex and require a lot of attention. For example, some wearables like VR and AR can allow the user to work on a product by detailly assembling as is required by the organization by following the exact same building process placed.

Wearable technology offers a lot of things that can improve the work environment, and these were only a few examples of many. In the next section we will discuss the uses of each type of wearable tech in the workplace.

3.1 Uses of Wearable Technology in the Workplace

In Chapter 2, we laid out all the popular types of wearable technologies that exist on the market. In this section we will talk about how they can be used in the workplace.

3.1.1 Fitness Tracker

Fitness trackers, or commonly known as smart bands, are small band-like devices that allow the user to track various parameters like burned calories, heart rate, distance passed, etc. But newer versions offer much more than this, in addition to everything they could do so far, now they are able to transfer messages and show notifications to the user. Based on the features of these devices, many companies are using these for various purposes in the workplace.

Fitness trackers are widely used by companies for creating a Wellness Program in the workplace. By tracking heart rate and other parameters, companies can make decisions that will benefit the health of its employees. For example: If some employees show increased stress that results in increased heart rate, then the company can notify and give that particular employee some time off. This will result in increased employee satisfaction in the organization, by showing that the company cares for the well-being of their employees.

Another use of Fitness Trackers in the workplace is to track the permissions of one employee, and to track which areas did that employee accessed while being in the office. Although this might limit the access of employees in certain places within the organization, it has great security implications.

3.1.2 Smartwatch

The smartwatch is a device that has all the functionalities that the fitness tracker plus many more. The smartwatch offers many more possibilities by embedding various sensors to track certain things, but also to transfer phone calls, messages, emails and other notifications that can be accessed through the small screen that lies on the wrist of the user. As mentioned the smartwatch can be used by organizations for creating custom made Wellness Programs, but these programs can be broadened thanks to the more capable sensors that these offer. An example would be the Apple Watch and its two most popular features, the EKG measurement and Falling tracking feature.

The EKG feature helps the user to detailly see the heart measurements and to track any anomalies that might prevent the employee from doing the job properly. Recently many doctors rely on this feature because it was proven to help lives. But from the workplace point of view, it can allow the organization to better take care of their employees.

The new Falling tracking feature can help for a safer workplace. If an employee loses consciousness the watch immediately sends a notification to the first point of contact as well as automatically contacting the Medical Services for help. This feature has proven to save many lives, and it can be used in the workplace for improving employee well-being.

GPS antennas found in smartwatches in addition to the proximity sensors can allow better management of the warehouse, that can help one employee look for certain products by looking at directions on the watch screen. But this also can allow warehouse employees to place the correct products on the right shelf.

The NFC sensors also allow the workplace to be more secure by allowing the watch to be the key for accessing various places within the organization, everything based on the level of the employee.

3.1.2 Smart Clothing

Smart Clothing allows the use of various sensors that are added within the fabric of the apparel to track various health metrics. Even though these smart clothes won't have a purpose in the traditional office, they have a lot of uses in a workplace where there is a lot of physical work. The workplace of a construction company can use this type of apparel to oversee the health progression of their workers while they are constructing a building. With this if they can notice that one of the employees shows signs of being tired, they can pull that employee and give him some time off to rest. This type of apparel can also be used in the mining industry workplace, by tracking the vitals of the employees while they are doing their job in the mine. But these are only a few of the workplaces where Smart Clothing can find great use to increase employee satisfaction.

3.1.3 Virtual Reality

Virtual Reality is a headset device that allows for the user to enter a digitally created world through the use of various motion sensors as well as a big screen that is placed in front of the wearer's eyes. In terms of its uses in the workplace, virtual reality can allow the HR department to create custom made orientations for new hires as well as training for existing employees. By wearing the device on their heads the employees can be placed in a virtual classroom where they can be trained on new things in the company. This also allows for an employee to search for tutorials on various things especially learning blueprints for various product builds.

3.1.4 Augmented Reality

Just like a virtual reality headset, augmented reality can take the form of a headset. The main difference between the two is that AR places a digitally generated object in front of the wearer's eye whereas VR creates a fully digital experience. The uses of AR in the workplace can be to help employees in the building of different types of products, by offering an on demand schematics with steps of the build. This can be especially useful in the aeroplane assemblies where the engineer building the plane has a lot of things that he or she needs to be aware of, since a small mistake may cost lives. By detailing out of the steps of the build process the engineer can walk through the process without making any mistakes.

But training and on demand guides is not the only thing that this technology can provide to the workplace. Since this technology usually takes the form of glasses it can be used to allow managers to view various types of statistics and notifications all without interfering in their regular work.

In warehouses these can be used to show on screen directions to the employee on where certain products need to be placed.

Chapter 4: Benefits and Constraints of Wearable Technology in the Workplace

In the previous chapter we talked about the uses of Wearable Technology in the workplace, and how it affects the workplace. To build up on that in this chapter we will elaborate the benefits and constraints that come with the introduction of such technologies in the workplace. Even though there are many benefits and constraints to match them, in this thesis we will talk about the most common ones.

4.1 Benefits

During the literature review of available information, we identified 5 main benefits that come with introducing Wearable Technology in the workplace, and those being: increased productivity, health, satisfaction, safety, and real time data.

4.1.1 Increased Productivity

One of the key benefits of introducing wearable technology in the workplace is that it increases employee productivity. This benefit represents the biggest reason why companies tend to implement wearables in their workplace. According to experts from the University of London [13], “Wearable Technology can boost employee productivity by 8.5 percent, as it allows users to solve issues at a faster rate”. Wearables help users solve issues in different ways depending on the industry and the type of device. Some examples according to a blog post from Nextrio [14] are car dealerships, real estate, and organizations that use manual labor.

Car dealerships can use AR glasses to show a customer how the vehicle would look in real life, or for the repair technicians to access car parts. They can also use smartwatches to see current car inventory which will help the salesperson tell the customer in real time which models are in stock. All of this lowers the time needed for tasks to be completed which increases efficiency and productivity.

Real estate agents can use VR headsets to give a tour of a certain house or an apartment to a potential buyer, even if the house is not available to be checked at a particular moment in time. This allows the agent to decrease the needed time to travel from one place to another and will allow him to serve more buyers in a shorter period of time. Even if they have to go to a particular place they can use a smartwatch to have necessary information about the listing, which will again lower the needed time to look for certain information which will increase efficiency and, with that, productivity as well.

Organizations that perform manual labor can use exoskeletons that will allow the employees to do tasks that would require more than one person to do, for example heavy lifting.
These three examples are just a few of many ways how wearables help increase productivity of employees. Some additional industries that are worth mentioning are warehouses, assembly lines, and retail.

In a warehouse the employees can use smartwatches to track where certain products are being stored which will allow them to lower the time necessary to locate them once needed, but also when planning where things should be placed.

By using AR glasses certain assembly line workers can access blueprints on how one product should be built properly, this will lower the time needed to assemble a product as well lower the chance of making any human errors.

Employees in the retail business can use smartwatches to see whether certain products are in stock which will allow them to be more productive when giving information to customers.
With this we can be sure that one of the biggest benefits of introducing wearable technology in the workplace is definitely the increase in employee productivity.

4.1.2 Health

With many companies becoming more aware of the well-being of their employees, introducing wearables in the workplace is the perfect solution that will increase the health of employees within the organization. Many HR departments want to know how the employees are doing throughout their working hours, this will prove helpful when deciding if an employee needs a break or how intensive is their current workflow. Not only that but they also want to help employees be healthier and more fit in their everyday life. According to an article from Clodoc [15], “Several wearables provide the option of customization according to the user’s personal health and fitness information. This, in turn, allows the user to be better aware of his or her health and maintain it to the best of their ability.” The most suitable wearable device that is constantly being used by organizations are the fitness trackers. As mentioned in Chapter 2, fitness trackers are small devices that usually take the form of a wristband which have different types of sensors embedded in them which allows for various metrics to be tracked. One HR department within an organization can use these devices to track different vitals of the employees and make appropriate decisions depending on the information gathered.

By tracking heart rate and fatigue, employers can make appropriate decisions if they notice that one employee needs to take some rest before continuing with work. The HR department can create various wellness programs that will give more benefits and incentives to employees to exercise, rest, and take breaks when needed all with the intention of making sure that everyone in the organization is working with full capacity. Healthy employees will result in lower costs for insurance on the business side as well.

4.1.3 Satisfaction

The satisfaction benefit that comes from introducing wearable technology in the workplace is tightly connected to the previous two benefits that we mentioned, productivity and health. According to Kelly Creighton [16], “When employees are provided with more resources to be better and more efficient at their jobs, their satisfaction rates increase”. This simply proves that if we value employees and show them the company cares about their wellbeing - they will be more happy to work better, thus increasing their productivity. Wearables help employees distinguish between work time and personal time. This is done by giving them constant reminders when it is time to rest, to better plan their time which balances work with personal time, which can result in increased employee satisfaction.

4.1.4 Safety

Safety is another thing that can be connected to the health benefit by introducing wearable technology in the workplace. Through the many sensors located on different types of wearables, the company can track many things. Tracking from how one particular task is being done, to tracking the toxicity of the air. According to Scott Smith [17]: “Data derived from wearables can not only help prevent workplace injuries, but also help an organization glean insights that help them the overall workplace environment”. This will allow one organization to make decisions on when employees are pushing themselves to their limits if they work manual labor, to pull them on the side to rest thus preventing injuries that might cost the organization lots of money.

As an example, we can take miners in a mining operation. Through the use of various sensors the organization can track if the air is not breathable in the mine and notify the employees to go back to the surface, and go back once things are back to normal.
Wearables in terms of safety can help organizations lower their insurance bills by providing a safer place for all of the employees.

4.1.5 Real Time Data

The last most common benefit that comes with the introduction of wearable technology in the workplace is that these devices can provide real time data to the user at anytime, anywhere. Having the option to access the latest data at any time allows employees to better plan their work based on the available data. Warehouses and retail stores are some examples of how real time data benefits the organization.

Warehouses can use wearables to see the exact time of deliveries scheduled, the amount of packages, as well as information about delivery drivers, location of certain packages within the warehouse, all of this shown in real time. This will help organizations to have more flexibility when planning on the spot.

Retail stores can use real time data by having an overlook of the products in stock at the same time a potential customer asks for the information. Retail employees can see the exact number of products available right on their wrist by using a smartwatch that will be connected to the Supply Chain Management system, not only within the store but also in the warehouse or another store. Having this data ad hoc will allow the employees to spend less time looking for the information and this will result in better customer service.

4.2 Constraints

No technology is perfect, other than the benefits there are also 5 constraints that came out during the literature review process with the introduction of Wearable Technology in the workplace, such as: privacy, distractions, cost and return of investment (ROI), not independent, and security.

4.2.1 Privacy

One of the biggest concerns that arise from introducing wearable technology in the workplace is privacy. With introduction to new technologies people are exposed to many things that collect personal data which can have a negative impact on personal lives. This also happens with wearables. Through the use of various sensors, wearables collect different types of data that are afterwards transferred to organizational servers. Although the reasons behind collecting such data are purely with the intention of helping employees have a better, safer and more productive work environment it still collects personal data that might be used in different ways. By having personal information of the employees available at any time some people might be left out from company decisions if they're deemed not suitable for certain things, for example not being promoted to certain positions if they are of bad health, or even lay off certain employees if the data shows that the productivity is not increased properly within a certain time period.

4.2.2 Distractions

As with different types of technology, usually everything with a screen, wearable technology in the workplace might negatively impact the productivity of employees by distracting them from their day-to-day work. There is a concern that employees will focus more on what is happening on the screen of their wearable technology rather than focus on what is lying in front of their eyes.

According to Fred Coon [13],” Due to the size of certain devices, employees may be tempted to discreetly, and more frequently, text, chat, or check on social media while working.” In the case of smartwatches, employees can use these small devices to add applications in the form of games, this will allow them to be focused on entertainment rather than work-related tasks. Wearables can also distract employees even if they are working or are in a meeting by sending constant notifications, like reminders to stand up or information flows. All of these distractions can affect employee productivity that can result in bad organizational performance.

4.2.3 Cost and Return of Investment

Implementing technology in the organization is not a cheap investment, it needs allocating a lot of resources to make it work, it requires the creation of a special infrastructure that will allow communication within the network. This also applies with the introduction of wearable technology in the workplace. These devices although becoming cheaper every year are still expensive when we talk the number of pieces needed to be purchased, but purchasing these devices is not the only investment needed to be made, the organization needs to invest in an infrastructure that will allow for these devices to communicate with each other as well as links to the systems from which they will read and write important information. According to Schatsky [18], “Device costs depend on the type of wearable, its degree of sophistication, and the quantities purchased”. With that being said, fitness trackers as a type of wearable cost the least whereas AR glasses or VR headsets cost thousands of dollars, but all of these provide different options to its users all depending on the needs of the organization.

4.2.4 Not Independent

We are aware that many devices are stand-alone, meaning they have the necessary hardware to work without the need of being connected to another device to complete certain tasks. Unfortunately, this is not the case with wearable technology.

Since wearables as technology devices are still relatively new on the market, they don’t have the necessary processing power to complete certain workload, this means that there might be a

need for a certain wearable device to be connected to a third-party device which will do most of the processing power, in the case of fitness trackers or smartwatches that would be the smartphone. But also, these devices will have to be connected to a certain unit that will contain the information that these devices will gather.

This connects the not independent concern with the cost one since investing in more devices that will potentially benefit the organization will mean that costs will increase by a substantial amount.

4.2.5 Security

Other than the privacy concern, security presents a serious concern when introducing wearable technology in the workplace. According to Lorri Freifeld [19], "Any device that has the ability to store data (i.e., iPod, MP3, tablet, etc.) also has the ability to be connected to a computer and, thus, creates the potential for stolen data". Even if the organization finds a way to regulate personal data collection with its employees, the collection of data from these devices is always at risk to be leaked. Since the main usage of wearables is done by consumers, they are not equipped with industry grade encryption that will protect this data. If one of these devices is compromised during a cyber attack they can connect to the main servers of the organization and look into all of the employee personal data. But this is not only affected by potential cyber attacks, in the case of a wearable device being lost it can pose a security breach where someone can access personal or organizational information.

Chapter 5: Comparison between Worldwide and Macedonian Research on Wearable Technology in the Workplace

The main purpose of this chapter of the thesis is to elaborate on the research that is currently available, how many people were included in the research, and what were the results received at the end. On the other hand we will also lay out a foundation for a research conducted within the Republic of North Macedonia with the intention on receiving results on similar questions

with the addition of results based on the Benefits and Constraints that were discussed in Chapter 4 of this thesis, by using a structured questionnaire.

At the end of this chapter we will make a comparison on the results from the conducted research as well as what information is currently available globally.

5.1 Introduction to Available Global Data

For the purpose of this thesis we looked for available research concerning Wearable Technology in the Workplace and we found 2 results that showed information that we will be using in this thesis as a foundation for comparison with the research conducted in North Macedonia.

The first research was conducted by an office search engine organization named Office Genie [20]. According to Office Genie with a survey conducted with 1.000 UK employees found out that:

- 36% of employees surveyed said that Increased Productivity is a benefit of using wearable technology in the workplace.
- 42% of the employees stated that Stress Monitoring is an appropriate use for wearable technology.
- 41% believe that the supporting physical health would be an appropriate use of wearable technology in the workplace.
- 30% believe that wearable technology should be used to boost productivity.
- 20% state that wearable technology should be used to monitor mental health.
- 51% of the employees surveyed think that wearable technology is beneficial for the workplace.
- 33% would use employer-provided wearable devices for professional use only.
- 23% would use employer-provided wearable devices for both professional and personal purposes.
- 49% of the employees are worried about the negative effect that wearable technology can have on employees' stress levels.

- 58% are concerned that their employer could look at data recorded by the devices outside of the workplace.
- 67% of employees worry that the use of wearable technology in the workplace can result in a big brother-style surveillance culture.

The second research was conducted by PricewaterhouseCoopers (PwC) in 2016, again in the UK but on a larger scale, with over 2000 workers being surveyed [21]. According to PwC, the results that were received at the end of their research were the following:

- 65% of people think that technology has a real role to play in health and wellbeing.
- 61% of employees would want for their employer to take a more active role in their health.
- 45% of employees surveyed actually think that their employer takes an active role in their health.
- 38% of the respondents do not trust that the data gathered from wearable technology would be used to benefit the employee.
- 25% of the respondents said that if they were given an incentive they would share their data.
- 73% of the respondents between the age of 18 and 34 believe that their employer should be involved in their health and wellbeing.

5.2 Introduction to Questionnaire Research in Macedonia

In order to learn more about how employees in the Republic of North Macedonia feel about wearable technology in the workplace based on the benefits and constraints introduced in Chapter 4 we created a questionnaire. The questionnaire was conducted over a period of two weeks and included 63 participants. Structure wise, the questionnaire was divided into 5 modules consisting of 15 questions. The intention behind this was to divide the questions into more understandable groups that would allow the respondents to easily understand what needed to be answered, but on the other hand it would allow data to be grouped for better visibility. When it came to providing answers on the sections for benefits and constraints by using a Likert scale, based on a five-point scale, we allowed the participants to answer how

much they agreed or disagreed with the question asked. For simplicity reasons the results received from the conducted research will be divided and explained based on the sections. Before we lay out the results we will show the sections and questions that were included in the research, those being:

Section 1 - General Information

1. Age
2. Gender

Section 2 - Education and Industry

1. Education Level
2. Industry

Section 3 - Benefits of Wearable Technology in the Workplace

1. Will using Wearable Technology in the Workplace increase your Productivity?
2. Will Wearable Technology help you track/increase your health?
3. Will Wearable Technology increase your Job Satisfaction?
4. Do you think that Wearable Technology can help increase your Safety at work?
5. Do you think having Real Time Data available on your Wearable is useful?

Section 4 - Constraints of Wearable Technology in the Workplace

1. Do you think that Wearable in the Workplace will negatively affect your Privacy?
2. Will the use of Wearables distract you from daily tasks?
3. Do you think that the money given for an expensive wearable device can be used for an alternative purpose?
4. Will the need of carrying a smartphone to accompany your Wearable affect your usage of Wearable Technology in the Workplace?
5. Do you think that your personal data from your Wearable is at risk by a potential Security breach?

Section 5 - Types of Wearables at Work

1. Which type of Wearable Device would you want your company to implement in the workplace?

5.2.1 Results

As mentioned above, in this part of the chapter, we will provide the results that were received from the questionnaire research conducted over the course of two weeks, which reached 63 responses within the same period. Thanks to the sections used to divide the questionnaire into more feasible parts, we will use that to elaborate the results based on the sections.

General Information

When talking about the general information we have some diversity concerning the age and gender of the participants that were included in this research.

More than half of the participants, 52.4%, were between the ages of 26-35, or 33 of the responses. The interesting fact is that among the participants we received some responses that are from the 46+ bracket which is translated into 12.7% of all respondents, or 8 people. 3 people, or 4.8%, were between the ages of 36-45, and 30.2% or 19 people were between 18-25.

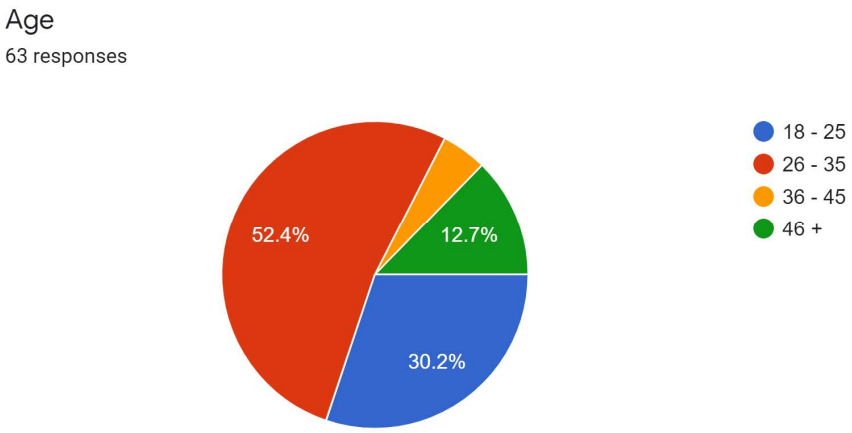

Figure 14 - General Information: Age

Based on the question of the gender of our participants we received data that 66.7% of all reponds were females, or 42, whereas 33.3% were males or 21.

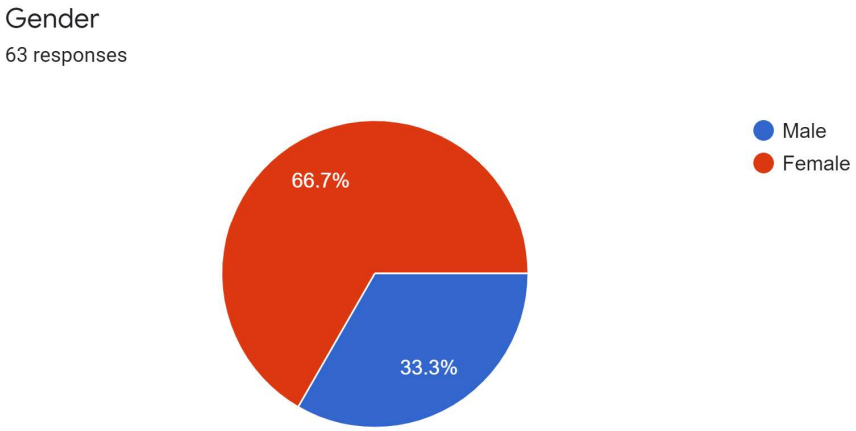

Figure 15 - General Information: Gender

Education and Industry

To further explore the people who participated in this research, we also wanted to know their Education Level and the Industry in which they were working in.

We found out that 57.1% had at least a bachelor's degree which accounted for 36 of the responds. 14 participants, or 22.2%, had a master's degree, and 20.6% that translates to 13 participants having a High School degree.

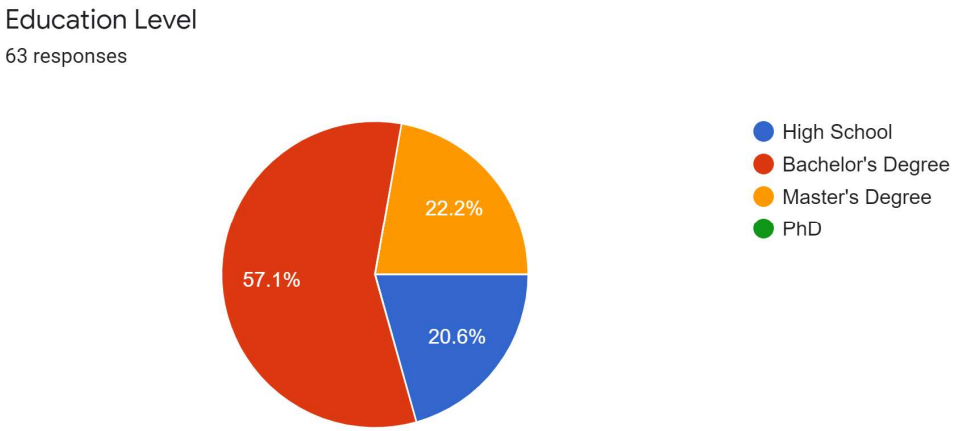

Figure 16 - Education and Industry: Education Level

Based on the industry in which our participants most of the participants come from these three industries:

- Sales/Marketing - 30.2% that equals to 19 respondents
- IT/Tech - 28.6% that equals to 18 respondents
- Healthcare - 7.9% that equals to 5 respondents

The other respondents come from different industries ranging from Law to Fitness, but have a lower percentage of the total number of respondents.

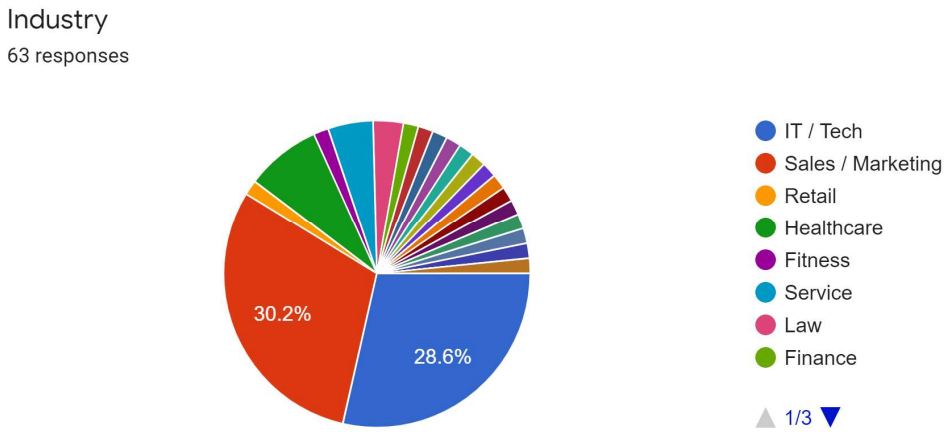

Figure 17 - Education and Industry: Industry

Benefits of Wearable Technology in the Workplace

This represents one of the two most important sections within the questionnaire as it shows how the respondents feel about Wearable Technology based on the Benefits that they bring to the Workplace.

When asked about how it will affect their productivity, we learned that more than half of the respondents, 50.8%, agree that it will increase their productivity, while 33.3% of the respondents said that it might increase their productivity level.

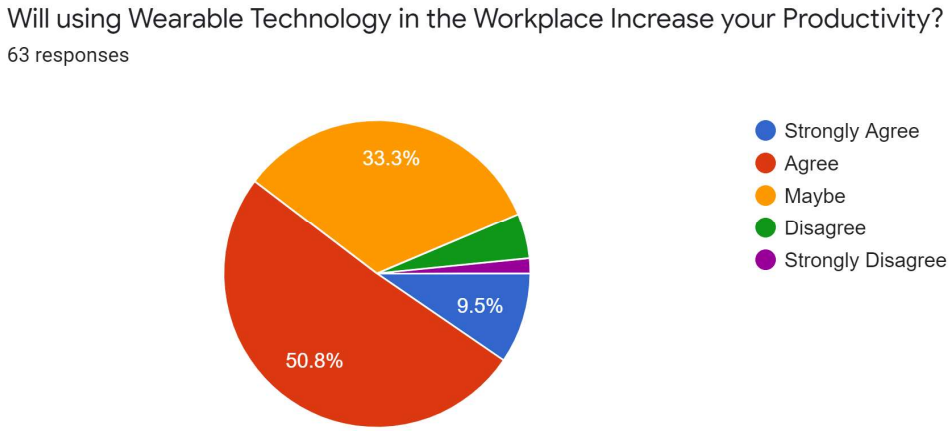

Figure 18 - Benefits: Productivity

Concerning the health benefits that wearables bring to the workplace, we received the same percentage of respondents that agree with the benefit, or 50.8%. The difference here is that the number of respondents who think it might help is lower i.e. 19% but, on the other hand, we can also notice that respondents who strongly agree that wearables would help them increase their health is higher, or 23.8%.

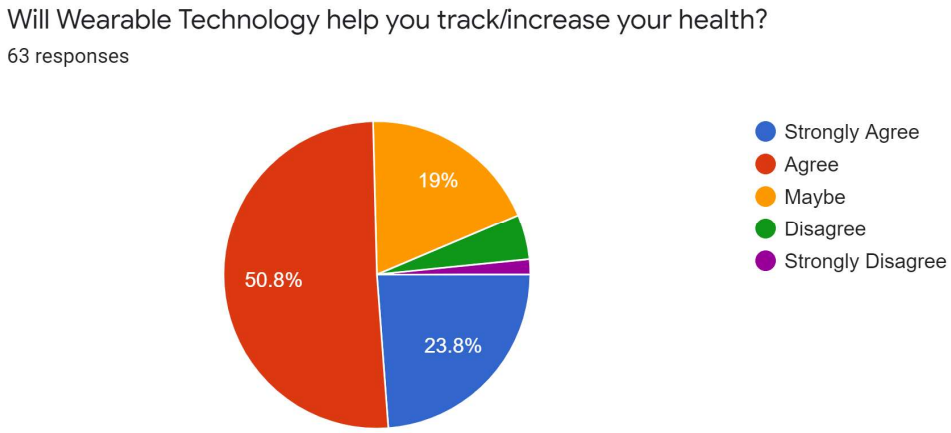

Figure 19 - Benefits: Health

We mentioned, in Chapter 4, that the increase of productivity and health of the employees usually increases the job satisfaction, but in the case of North Macedonia we received results where 39.7% agreed that it will increase their job satisfaction, however we also learned that 38.1% think that wearables might increase their job satisfaction.

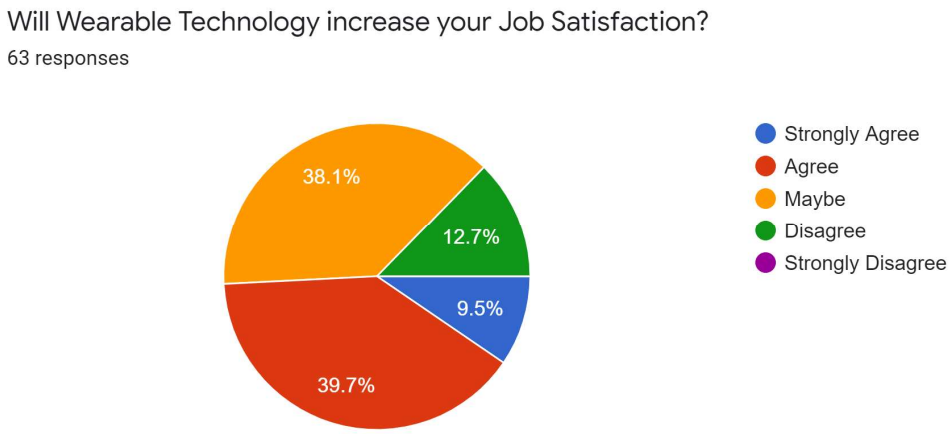

Figure 20 - Benefits: Job Satisfaction

When asked about the safety benefit of using wearables in the workplace we received similar results, where respondents who agree that this will increase safety at work are on the same level with those who think it might increase it which amounts to 41.3%. Furthermore, respondents who strongly agree with this benefit take up 9.5% which gives a general idea that employees somewhat agree that wearables actually do increase safety.

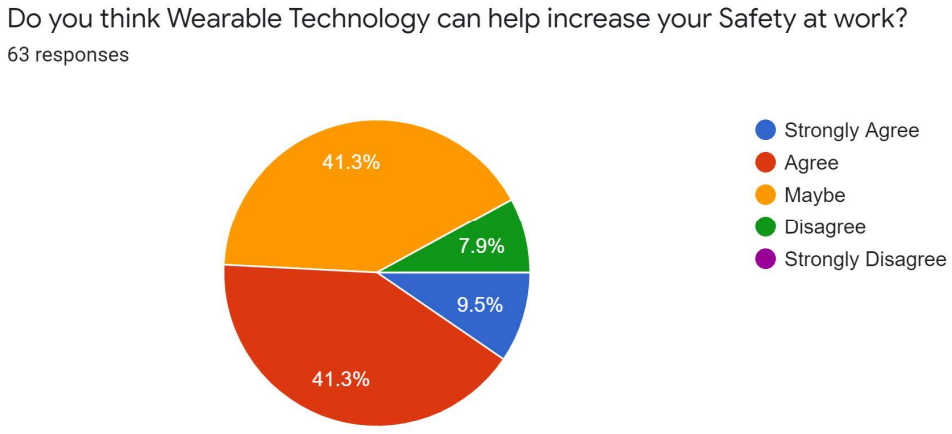

Figure 21 - Benefits: Safety

Real time data proves useful for around 82.5% of the respondents, which all either agree or strongly agree that having the opportunity to have the right information at the right time would be useful for them at work.

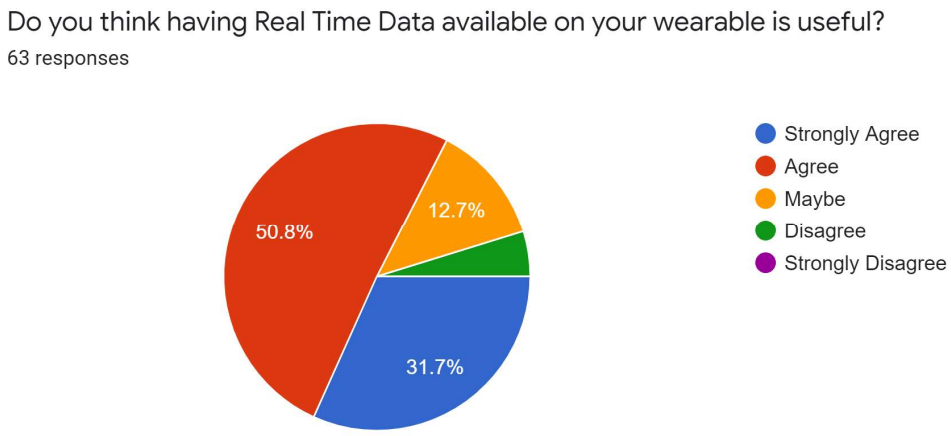

Figure 22 - Benefits: Real Time Data

Constraints of Wearable Technology in the Workplace

The second most important part of the research was to observe how the respondents feel on the matter of the most common constraints of wearable technology in the workplace. The general observation is that the majority of the respondents claim that the constraints might be an issue when their company would implement wearable technology in the workplace. Here is the breakdown of the results based on the individual constraints.

The majority of the respondents, 41.3%, claim that wearables in the workplace might negatively impact their privacy, with 25.4% stating that it will negatively impact their privacy. On the other hand, 19% of the respondents disagree with this statement and claim that wearable technology won't affect their privacy negatively.

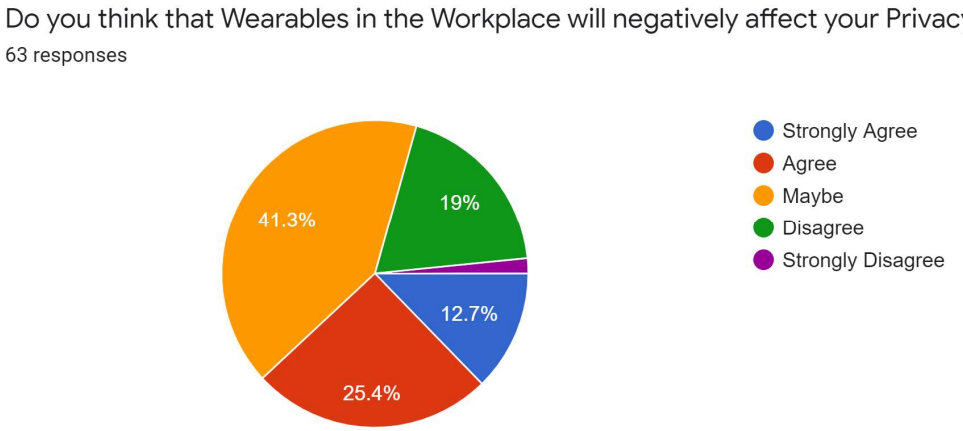

Figure 23 - Constraints: Privacy

In terms of distractions, 44.4% of the respondents stated that wearables might distract them from their daily tasks at work, followed by 20.6% claiming it won't distract them from daily tasks. Research shows that 19% think that it will actually distract them from work.

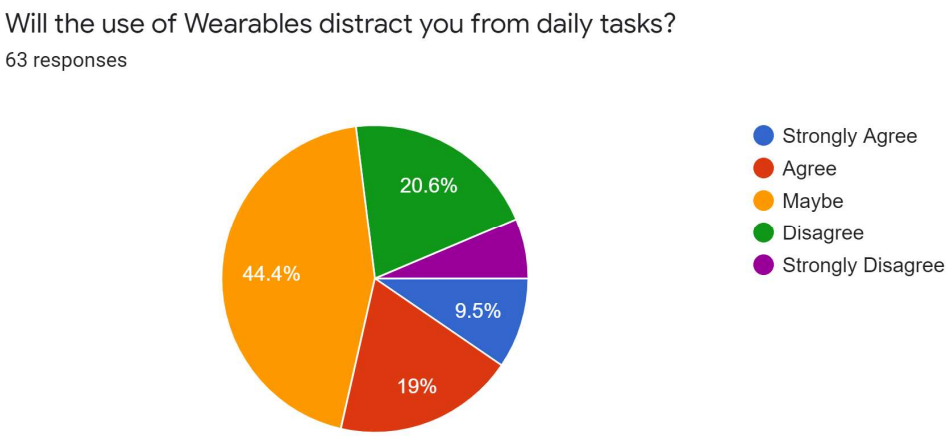

Figure 24 - Constraints: Distraction

Cost wise we can notice that the trend continues among the respondents, with almost half of them saying that the investment made for wearable technology might be best suitable for another place, although 25.4% agree that these money should be spent elsewhere, this is accompanied by 15.9% who claim that those money should be definitely allocated towards another thing.

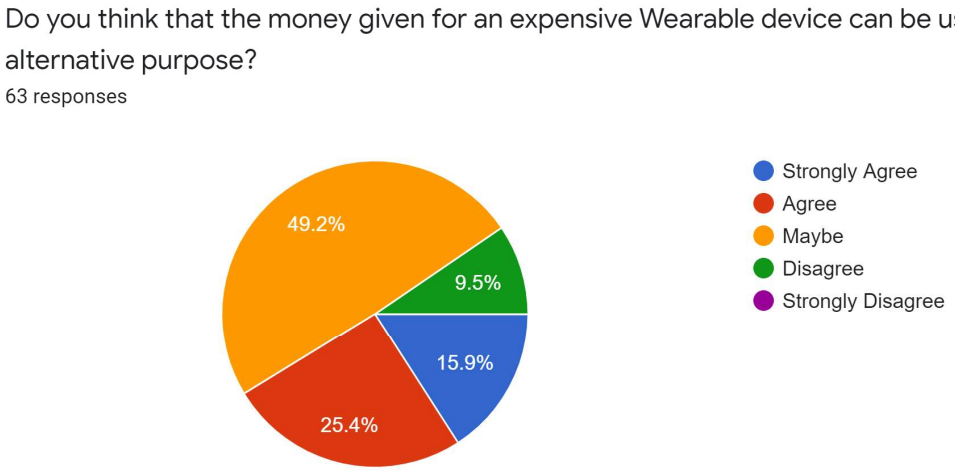

Figure 25 - Constraints: Cost

When asked whether the need of carrying a smartphone to accompany their wearable device would deter them from using wearable technology, 36.5% said that it might. 28.6% stated that it will affect their usage, but 25.4% of respondents disagreed with this.

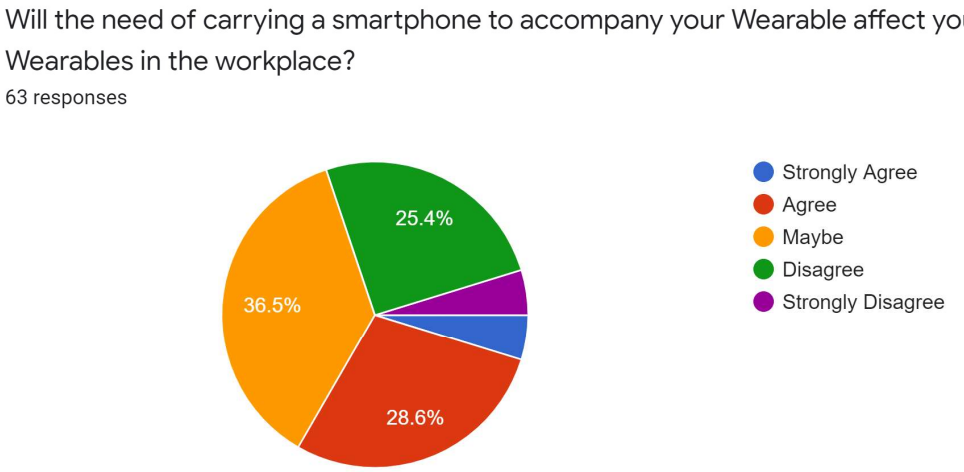

Figure 26 - Constraints: Not Independent

As with every technology, even wearable devices are prone to security breaches which might result with personal information being targeted, and the results actually show that people are aware that this might actually happen.

For 41.3% of the respondents, their personal data is at risk in the event of a security breach, accompanied by 15.9% who claim that their personal data is definitely at risk; while 31.7% of respondents think that their personal information might be at risk in the event of a security breach.

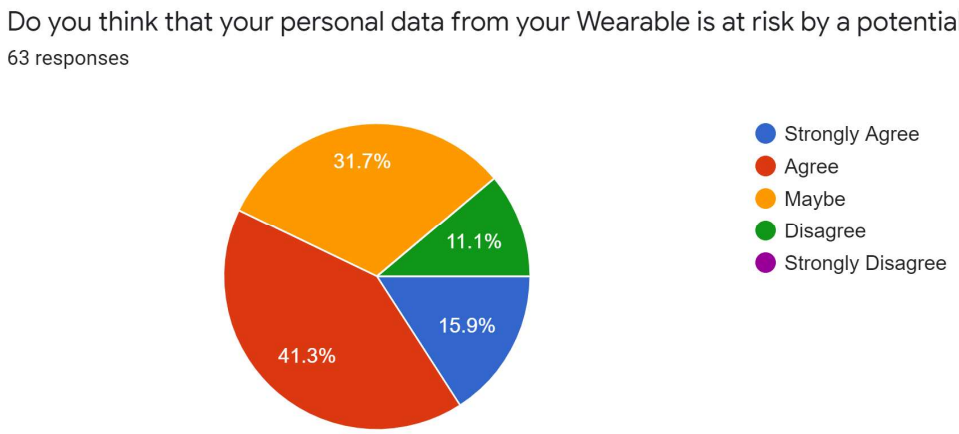

Figure 27 - Constraints: Security

Types of Wearables at Work

Since we are asking about the benefits and constraints of wearable technology in the workplace, we also wanted to know which types of wearable devices do employees want their company to implement in the workplace. Most of the respondents stated that they want a smartwatch to be implemented at work, being 60.5%, whereas people who would want to see fitness trackers at work accompanies 38.1% of the responses.

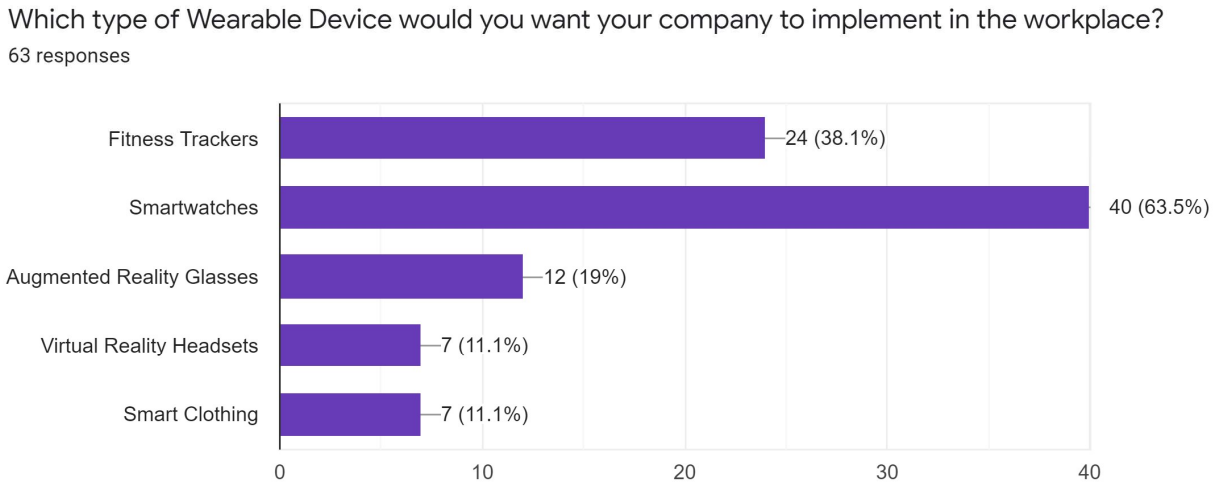

Figure 28 - Types of Wearables at Work

5.3 Comparison between Research: Local and Global

After conducting the questionnaire, we have compared the information gathered matching them to the currently available research globally. We discovered that the research found was developed in a more general sense rather than focusing on all the major or most common benefits and constraints that come with the implementation of Wearable Technology in the Workplace. On the other hand, we can see that some parts of the research found through the use of Literature Review have parts that match with the research we conducted in North Macedonia. Even though our research is entirely focused on the benefits and constraints we will compare the matching information.

The first piece of information that we can compare is the amount of people included in every conducted research. We can notice the information that was received from the research from two different researchers can be counted in thousands of answers, 1000 were included in the Office Genie Research whereas PwC had around 2000 responses. On the other hand the research conducted in North Macedonia counted only 63 responses.

All of these responses represent a small fracture of the total workforce in every country, with the Office Genie research covering 0.0036% of the total UK workforce, which in 2019 accounted for 27.67 million people, and the PwC covered 0.0072% of the total UK workforce. In the case of North Macedonia, the amount of responses translates into 0.0078% of the workforce which was 777,546 in 2019. When comparing the percentage of how much each of these responses represent within the total number of employees in the country, based on 2019 statistics, we can see that all of these are in the near percentile.

The second information that we will compare is the productivity benefits that comes from implementing Wearable Technology in the Workplace. The Office Genie research found out that 36% will see productivity benefits by using these whereas the research conducted in North Macedonia found out that 50.8% of the respondents' state that this type of technology will actually help them have increased productivity.

When talking about health benefits, Office Genie found out two separate uses of wearables concerning, one for physical health which is 41% and the other one 20% for monitoring mental health. The PwC and the Locally conducted research take a more general approach towards the health benefit of using wearables. The PwC research has received that 65% think that it will actually help increase health, whereas the research conducted in North Macedonia received information that 50.8% think increased health is a benefit from implementing the technology in the workplace.

Finally talking about concerns, the information from all the available research used in this thesis claim that Privacy is a major concern when it comes to using wearables in the workplace. 58% of the people surveyed by Office Genie think that outside data will be observed by the employers, whereas the PwC research says that 38% of people think that the data gathered won't be used for the benefits of the employees. In North Macedonia, 41.3% think that the use of wearable technology might negatively affect their privacy.

Office Genie Research (UK)	PricewaterhouseCoopers Research (UK)	Local Master Thesis Research (NMK)
1000 participants	2000 participants	63 participants
36% - Productivity Benefits	/	50.8% Productivity Benefits
41% - should be used for supporting physical health	65% - health and wellbeing	50.8% - Health Benefits
42% - should be use for Stress Monitoring	/	/
/	61% - want their employer to take an active role in their health	/
/	41% - actually think they take an active role in health	/
/	/	39.7% - Increase Job Satisfaction
30% - should be used for boosting productivity	/	/
/	/	41.3% - Increase Safety at Work
20% - should be used for monitoring mental health	/	/
/	/	50.8% - it is Useful to have Real Time Data available on the wearable
51% - think it is beneficial for the workplace	/	/
58% - Concerned that their employer will look at data outside the workplace	38% - do not think the employer will use the data collected appropriately	41.3% - might negatively affect privacy
49% - worry that it will negatively affect stress levels	/	/

/	/	44.4% - might distract them from work
/	/	49.2% - money spent for wearables might be better invested
/	/	36.5% - think that the need of a smartphone might discourage them from using a wearable
/	/	41.3% - think their data is not secure
67% - worry that use can result in big brother-style surveillance culture	/	/

Chapter 6: Discussion and Conclusion

6.1 Summary of the Thesis

Thanks to the creation of the largest network known as the Internet, we wouldn't have had a lot of the technologies available today. The Internet of Things, along with Wearable Technology, wouldn't be around us to help make our lives easier. Wearable devices by providing us so many uses allowed us to live better from the use of the sensors embedded in fitness trackers and smartwatches, to being entertained through the use of Virtual Reality headsets.

Not only people, but also organizations saw the opportunity to use these devices to help their business grow and increase their competitive advantage and profitability as well as taking care for the health and satisfaction of employees. Investing in wearable technology has proven to have lots of benefits but also constraints that if overcome all that the company can see is an increase in efficiency and effectiveness.

Through the use of literature review we found results from two different research studies that gave us the big picture of what employees in the UK think about having wearable technology in their workplace, which allowed us to learn how they feel when using these devices. Locally we conducted research in the form of a questionnaire that consisted of 15 questions divided into 5 modules, centered more around the most common benefits and constraints of implementing wearable technology in the workplace. From the research we found that employees in the Republic of North Macedonia can see the benefits that wearable technology will bring to them but it also shows that they are aware of the constraints, but in general think that those might be issues that would deter them from using if it actually is an issue that arises. With that the two hypotheses that we set for this thesis were generally confirmed. Those being:

H1: The benefits that arise from the introduction of wearable technology in the work environment is larger than the number of constraints.

H1a: The number of constraints that arise from introducing wearable technology is lower than the number of benefits.

In the case of these hypotheses we decided that balancing the number of benefits and constraints was the better choice, as they represent the most common ones that we found during the literature review that was conducted. But in terms of the results received from the research we can say that the benefits outweigh the constraints.

H2: Macedonian users see great benefits in introducing the wearable technologies in the workplace.

H2a: The ratio of benefits and constraints with usage worldwide are consistent with the views of Macedonian users.

These hypotheses were confirmed in full, from the research conducted from both literature review and the questionnaire results, we saw that macedonian employees see the benefits of wearable technology as something that would help them in their workplace. But also the results we got from the questionnaire are consistent with the percentages we found during the literature review, with macedonian employees having the same or somewhat similar thoughts as employees from other countries.

6.2 Future Development and Discussion

The use of wearable technology is on the rise, with many people buying the latest smartwatches or fitness trackers available on the market, as they can see the benefits that come from them for personal use. This, no doubt, will lead towards more and more organizations implementing wearable technology, as they continue to see how these can help increase their competitiveness and profitability. Wearables represent a trend that will continue to grow, but also help users become better at what they do, both personally and professionally.

There are a lot of possibilities for research concerning wearable technology in the workplace, as a future development there might be a use of conducting research on more general aspects of wearable technology in the workplace to receive results that will be more closely related to the information that we received from literature review international research.

Concerning the results received from the responses of the questionnaire conducted in North Macedonia we can further investigate and analyze the data collected, this can allow us to group benefits information based on age, industry, gender to learn even more about how employees in North Macedonia feel about the subject. Of course, this investigation can also be used to view the side of constraints as well. The responses received can be treated differently to get an even better understanding of things that can come from implementing wearable technology in the workplace.

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