THE REPUBLIC OF TURKEY
BAHÇEŞEHİR UNIVERSITY

THE SOCIOECONOMIC DISRUPTION
OF ARTIFICIAL INTELLIGENCE IN
THE FOURTH INDUSTRIAL REVOLUTION

Master's Thesis

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ABSTRACT

THE SOCIOECONOMIC DISRUPTION
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Master's in Business Administration

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The Fourth Industrial Revolution is characterized by the combination of various emerging and entwined technologies. Unlike the others that came before it, it has the capacity to not only disrupt entire industries globally but also change our societal structures and how humanity views concepts such as labor, education and governance.One of the most disruptive technologies that has taken a leading role in 4IR is Artificial Intelligence. In this thesis, the effects of 4IR and AI will be discussed.The basic problem that led to this research was the conflicting predictions that exist today on the impacts of Artificial Intelligence.This thesis presents the most highlited topics in the socioeconomic context of Artificial Intelligence and offers the various perspectives whether optimistic or pessimistic.

Keywords: Fourth Industrial Revolution, Artificial Intelligence, Disruption, Economic Growth, Unemployment, Society

ÖZET

ENDÜSTRI 4.0 VE YAPAY ZEKANIN YARATTIĞI
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Endüstri 4.0'ın en belirgin özelliği, birbirine bağlı ve gelişmekte olan teknolojilerin birleşimidir. Diğer sanayi devrimlerinden farklı olarak, sadece küresel çapta tüm endüstriyel düzeni değiştirmekle kalmayıp, aynı zamanda toplumsal yapıları ve insanlığın iş gücü, eğitim ve yönetim gibi konulara olan bakışını da değiştirme kapasitesine sahiptir. Endüstri 4.0 da öncü rol oynayan en önemli teknolojilerden birisi Yapay Zekadır. Bu tez çalışmasında Endüstri 4.0'ın ve Yapay Zekanın etkileri incelenecektir. Bu araştırmaya yol açan temel sorun, Yapay Zekanın etkileri üzerine günümüzde varolan çelişkili tahminlerdir. Bu tez Yapay Zekanın sosyoekonomik açıdan en çok vurgulanan konuları üzerine iyimser veya kötümser farklı bakış açıları sunmaktadır.

Anahtar Kelimeler: Dördüncü Sanayi Devrimi, Yapay Zeka, Bozulma, Ekonomik Büyüme, İşsizlik, Toplum

CONTENTS

LIST OF TABLES

ABBREVIATIONS

3D   : Three Dimensional

4IR   : Fourth Industrial Revolution

AI   : Artificial Intelligence

AGI   : Artificial General Intelligence

AM   : Additive Manufacturing

ANI   : Artificial Narrow Intelligence

ASI   : Artificial Super Intelligence

CEO : Chief Executive Officer

DL   : Deep Learning

GPT   : General Purpose Technology

MA   : Machine Learning

ROS   : Robot Operating System

STEM : Science, Technology, Engineering, Mathematics

WEF   : World Economic Forum

1. INTRODUCTION

Since the beginning of time, the betterment of the life of humans went hand in hand with technological advancements. From the first tools and the discovery of the wheel until now, technology, the tangible progeny of human intelligence, has led humanity to longevity, comfort and provided the tools for understanding of the cosmos surrounding it. This progress was not always fast and disrupting. However since the 18th century the world has started to change faster. The disrupting processes were named Revolutions denoting that those events were abrupt and radical in nature. Each one brought about some new technological advancement that would mark the era. And now humanity is standing on the threshold of the latest; The Fourth Industrial Revolution. Out of 4IR's many technological advancements, Artificial Intelligence has the potential to become the most disruptive.

1.1 OVERVIEW

This thesis will focus on the socioeconomic disruption Artificial Intelligence is capable of and ways to respond and adapt in the era of the 4IR. In the first section of the literature review, a brief overview of the previous Industrial Revolutions will be presented as well as the nature of the 4IR, its elements and characteristics based on recent literature. Moreover the megatrends that mark the 4IR will be discussed in a concise manner. The second section will present definitions of AI, one of the 4IR's most disrupting megatrend; a brief timeline of milestones will be included in order to offer insight on its gradual evolution and its types and methods of algorithmic learning will be discussed. The third section will delve deeper into the different opinions and forecasts that exist today on the impacts of AI on the economy and society.

This thesis will discuss what AI is in a comprehensive manner, without delving into too much technical information and study its impacts from a socioeconomic prism.

1.2 OBJECTIVES

The motivation behind this thesis came from a combination of reasons, the first being the limited understanding the public has on what constitutes AI and the reality of it. The public's average opinion on AI has been largely shaped by science fiction and movies and has been influenced by sensational headlines[1] on the media outlets, which contribute to the general misinformation. A survey conducted by Bristows (2018) about the public perception of AI shows that there is a broad but not deep understanding of AI; in particular while three quarters of the respondents have some level of understanding of AI (with a wide range of degree) only 1 in 7 believe they have had direct contact with it so far and only 2% believe that it has an effect on society already(Bristows, 2018). This thesis's purpose is to gather a wide range of existing information on AI in the context of the 4IR, to reconcile the gap between AI hype and AI reality by offering insight, to create a comprehensive guide that is meant to be concise and informative on the potential impact on employment, economic growth and to present ethical issues that already raise concerns for the future.

The second reason behind the motivation of this thesis is to create a meaningful dialogue with working professionals and opinion leaders on the impacts of AI and ways to mitigate its effects. Russell, Dewey and Tegmark(2015) argue that for the past twenty years the research on AI has focused on the construction of intelligent agents, but as advancements in AI are progressing it is imperative to start a discussion on how to maximize the economical and social benefits AI has to offer; and subsequently not to fall into its various pitfalls (S. Russell, Dewey, & Erik Tegmark, 2015). Schwab (2017) also stresses that we need to acknowledge the forces of change; the reality of disruption is inevitable and the difficulty there is to proactively address the impending issues is a sign that the world is not adequately prepared. Microsoft (2018) agrees that we need to address potential problems in order to prevent mistakes that will cost the trust of the public. The second part of this thesis is going to focus on interviews with working professionals and opinion leaders on the impacts of AI and ways to respond and adapt in the 4IR.

2. LITERATURE REVIEW

2.1 A BRIEF OVERVIEW OF THE PREVIOUS INDUSTRIAL REVOLUTIONS

The world as we know today is shaped by the ever advancing technology. From the very start of human civilization, human development went hand in hand with technological advance .The need of society towards the betterment of living conditions, highest quality of life, increase of life expectancy , exploration of the world, communication and equality between the people have always pushed humankind to find new ways to utilize technology to accommodate our needs. This drive and motivation led to certain abrupt events in the history of mankind, called the Industrial Revolutions.

The first industrial revolution, which started in the half of the eighteenth century, brought about the steam engines, railroads, and cotton spinning. Henry Cort's "puddling" invention in England in the year 1784 that saw the transformation of pig iron into wrought iron is recognized by economic researchers and historians as the initiation of the First Revolution and the beginning of automation. More so, the development of energy-intensive fuels such as coal and petrol was followed by the locomotives and steam power. Transportation revolution then followed suite through broader travel and infrastructure constructions such as ports, tunnels, and bridges (Krinis, 2016). During the revolution, the British agricultural revolution also occurred, supported by selective breeding and crop rotation that contained labor intensive costs and foodstuffs.

The Second Industrial Revolution, which came in the twentieth century, is famous for electrification and assembly lines. It was attributed to three elements including efficient connectivity in production, higher degrees of automation to accommodate the creation of mass production and further development through the utilization of petroleum and electricity energy. Also, the supply chain evolved as the revolution was limited to the internal environment of the firm and was increased in many companies and countries (Baweja *et al.* 2016). More so, automation led to another agricultural revolution through increasing yields through fertilizer production and an introduction of innovative food storage techniques such as refrigeration. Also, during the revolution, standardization

was introduced including quality standardization and transportation systems and trade protection to the innovators (Ian , 2016).

The Third industrial revolution, that took place in the 1960s, brought about the mainframes, personal computers, and the internet (Schwab, 2017). In the year 1969, real-time connectivity started to form as a concept when the first message was delivered through ARPANET and became the foundation of the current internet. Also, Moore's law that describes the electronic circuitry improved the automation context and advanced automation, forming the basis for the revolutionary technology. More so, it increased appreciation of the environmental damage leading to better farming which gave rise to the Green Revolution. Moreover, Moore's law led to enhanced computing strength and more complicated activities were automated (Baweja *et al.*, 2016).

2.2 THE FOURTH INDUSTRIAL REVOLUTION

Klaus Schwab, founder and Chief Executive Officer (CEO) of the World Economic Forum (WEF) , coined the term 4th industrial revolution which he referred to as the modern generation of advancements in technology. The improvements include biotechnology and genetics, sensors, 3D printing, robots, self-driving vehicles, Big Data, the Internet of Things, Robotics, Artificial Intelligence and Machine Learning among others. There is a debate among researchers whether or not the term Revolution is merited for the period we are coursing through. There has been other names to describe these times of unimaginable technological leaps such as the Digital Age, the Second Machine Age, Industrie 4.0(Jung et al., 2018). According to Klaus Schwab the world is experiencing the infancy of the Fourth Industrial Revolution that started at the dawn of the 21st century, which will have an impact on the economies, governing bodies, businesses and societies as well as the individual self all around the globe. It's not a matter of inevitability anymore, but rather one of preparedness. (Schwab, 2017)

The 4IR built upon the Digital Revolution and eventually was fueled by the ever-expanding internet and our subsequent worldwide connectivity to it. The basis of the Digital Revolution such as computers, software or the internet, of course is not new in

any way but the integration of all these now sophisticated systems in our daily life, has transformed the way we think of machines. Whereas in the past revolutions, machines were created to substitute for muscles and menial tasks now they are created to compliment the human mind and perhaps even substitute it in the future.

2.2.1 Characteristics

In order to understand how the 4IR came to be and why now, we need to examine its key characteristics. According to Eric Brynjolfsson and Andrew Mcafee (2014) the 4IR is exponential, digital and combinatorial. To address the exponential factor we need take a look at Moore's Law. In short, Moore (1965) theorized that "*the complexity of minimum component costs has increased at a rate of roughly a factor of two per year*" in which "the complexity of minimum component costs" roughly translates to the amount of processing power one could buy for one dollar. Overall Moore had noticed that the computing power doubles every year and would continue to do so for a decade. However, Moore fell short on his prediction of just one decade as this phenomenon lasted for about four decades and has since slowed down. Nowadays it is commonly accepted that the period needed for doubling the computing power is around eighteen months. The reason why Moore's Law is used to describe the exponential character of the 4IR is because the computing power has evolved so much while driving down the costs at the same time that it has allowed for all these technologies such as autonomous cars and Big Data to exist. To put that into perspective, in 1972 IBM's 370/145 processor that run on 4.9 MHz cost 700.000$ whereas in 2001 Dell released their Dimension 8100 that boasted a 1.3 GHz processor at the price of 1,699$. It's evident that the correlation between costs and computing power is in reverse proportion(McCallum, 2008).

The digital character of the 4IR , is almost self-explanatory. Information –in relatively all of its forms, anything from what we see, hear, experience through our body and so on, can be translated into data and passed to a computer where it can be replicated and shared throughout the internet with other users, simultaneously. Never before in history, could information travel that fast, with such detail and reach that big of an audience. Digitization's gift to the world is the new way to acquire knowledge and this

subsequently leads to innovation. (Brynjolfsson & Mcafee, 2014, p.37) But these are not the only things digitization made possible. Digitization or else Digital transformation is not only about evolving our devices but has to do more with our need to data-enhance everything. Big Data is the by-product of this constant need. The sum of all the data that exist today and have been obtained by any device is called the Global Datasphere and as of 2018 it has reached 33 zettabytes and is expected to grow to 175 zettabytes in 2025 (Reinsel, Gantz, & Rydning, 2018). As each user keeps "feeding" information to their social media, devices, wearables etc., data start piling up to create patterns that reveal preferences, schedules, the state of one's personal affairs or even his psychological state and many more. This load of information however cannot be analyzed by traditional means but when Artificial Intelligence and Machine Learning (backed up by enormous computing power) are brought into the picture then the value of Big Data grows exponentially, the more the better. Big Data is the technology that brings "understanding" into the conversation.

The third and last characteristic of 4IR is its combinatory nature and it is closely related to the concept of general purpose technology (GPT). GP Technologies are those that can have a enormous impact on several industries at the same time. For the Second Industrial Revolution that breakthrough was electricity. But electricity on its own is something to be studied by physicists, when one uses it however to power entire industries and our daily life, the impact is unfathomable. As formulated by Bresnahan and Trajtenberg (1995) "*Most GPTs play the role of enabling technologies, opening up new opportunities rather than offering complete, final solutions*". (Bresnahan & Trajtenberg, 1995).

Enabling technologies such as the sophisticated sensors the 4IR brought about, when combined with massive computing power and the ability to translate the data that these sensors gather and utilize data that already exist (digitization), create endless possibilities, from autonomous vehicles to Smartbands to Robots. In short, the combinatory nature of the 4IR refers to the ability all these GPTs have to act as building blocks that can be added one on top of the other with any combination the human mind can conceive and create innovation.

While Eric Brynjolfsson and Andrew Mcafee dwell on the intrinsic nature of the 4IR, Klaus Scwabb's take on its characteristics is reviewed under the prism of the impact it causes. Specifically he addresses three distinct differences as compared to the other three revolutions, the speed, the size, and its scope and complexity. Firstly, the speed at which the 4IR is taking place is too rapid as opposed to the other revolutions. It took more than a century for the First Industrial Revolution to spread outside of Europe, whereas now, new emerging technologies are spreading like wildfire. Of course globalization and the new digital age played the central role to this rapid change. Secondly, the revolution is not concerned with just one specific area or industry, rather the technologies comprising the 4IR transcend any industry and their applications are virtually unlimited, because they range from networks, material science, 3D printing, nanotechnology, computing, sensors and Artificial Intelligence among others in addition to the interplay between the technologies making the force very powerful. In that sense, Schwabb agrees with Brynjolfsson and McAffe in that the 4IR saw to the birth of many GPT's at the same time or at a steady pace and that gave way to endless possibilities and combinations of these technologies. Additionally, the technologies tend to become affordable after an initial period of time, making their spread diverse. Thirdly, the innovation takes place in the whole system instead of a single service or product as compared to the other revolutions. (Schwab, 2017,p.7).

2.2.2 Megatrends

According to the Cambridge Dictionary a trend is defined as a *general development or change in a situation or in a way that people are behaving.*[2] In Economics it denotes *a pattern of gradual change in a condition, output or process…a general tendency of a series of data points to move in a certain direction over time.*[3] Combined with the prefix "mega-:" , it denotes a trend of a very large scale, one that will have a fundamental and worldwide impact and its ripples and implications will stretch over many years to come (Holler et al., 2014). As mentioned in the previous chapter, the 4IR's size and scale are two of its distinct characteristics according to Schwab and that also applies to the technological megatrends that identify this era. The table bellow, presents us with the

twenty-three prevalent megatrends and ten corresponding advanced technologies (GPT's) that the world already experiences in some form and will certainly experience by 2025 according to projections.

Table 2.1 Megatrends

	Physical	Digital	Biological
Advanced Technology	1. Autonomous vehicles 2. 3-D printing 3. Advanced robotics 4. New materials	5. IoT, remote monitoring technology 6. Block chain and bitcoin 7. Sharing economy and on-demand economy	8. Genetic engineering 9. Synthetic biology 10. Bioprinting
Megatrends	1. Implantable technologies 2. Digital presence 3. Vision as a new interface 4. Wearable Internet 5. Ubiquitous computing 6. A supercomputer in your pocket 7. A storage for all 8. Internet of things	9. Connected home 10. Smart cities 11. Big data for decisions 12. Seif driving cars 13. Artificial intelligence and decision-making 14. AI and white-collar jobs 15. Robotics and services 16. Bitcoin and the block chain	17. Sharing economy 18. Governments and the blockchain 19. 3-D printing and manufacturing 20. 3-D printing and human health 21. 3-D printing and consumer products 22. Designer beings 23. Neurotechnologies

Source: Jang, Y. J. (2016)

As it evident, the advanced technologies and their ensuing megatrends that the 4IR encompasses are split into 3 categories; the Physical which correspond to their tangible nature, Digital and Biological. Bellow some of the most prevalent megatrends that the world already experiences will be discussed in some extend, while a brief mention for some others will be included.

2.2.2.1 Autonomous vehicles: self-driving cars

With the recent developments in sensors and backed by enormous computing power, the concept of autonomous vehicles in now a reality. These vehicles have the capacity to understand their surroundings, distinguish between objects that they come across, have a real-time understanding of the subtle changes in their environment, have the ability of deciding on and performing complex maneuvers and are capable to comply with the rules that are on place (Mark Campbell, Egerstedt, How, & Murray, 2010). Their applications are countless. From the most obvious, that is self driving cars to the more

innovative such as the use of drones in agriculture, for a more precise fertilization and watering plan (Schwab, 2017, p. 20).

2.2.2.2 AM/3D printing in manufacturing, human health and consumer products

According to the American Society's for Testing and Materials definition, Additive Manufacturing is *a process of joining materials to make objects from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing methodologies* (The American Society for Testing and Materials, 2012) They distinguish the broad term from 3d printing stating the difference is not in the process but in the quality and capabilities of the machines used. One can only imagine the possibilities AM and 3D printing can offer with the right amount of creativity. Right now the technology is used in large scale industry manufacturing like the automotive, in health applications such as implants. AM also offers a great deal of customizability to consumer products. It won't be long, when it will become the norm for consumer experience. This trend is expected to experience a surge when the costs are driven down and also some limitations such as the speed of the process are eliminated(Schwab, 2017, p. 20) .

2.2.2.3 Advanced robotics; robots in rervices

According to Ray Kurzweil (2005), Advanced Robotics will be the embodiment of strong AI. The revolution of robotics will occur when the human brain will be reversed engineered, causing the human intelligence to be decoded and thus being able to be embedded in a machine in terms of information (Kurzweil, 2005). Martin Ford(2015) in his acclaimed book, the Rise of the Robots, elucidates that the surge in Automation in the near future will come from ROS (Robot Operating System) which was first created in Stanford University's AI laboratory. He explains that since ROS is open-source and free, it won't be long until programmers start to create a wave of new applications for robots. If a drop in costs for hardware is taken under consideration, we will see advanced robotics head into undiscovered territories. No more robots will be used just in manufacturing but also widespread in the service sector (Ford, 2015)

2.2.2.4 Digital presence and ubiquitous internet

Digital Presence refers to the digital space each and everyone occupies on the internet. If someone were to ask what digital presence was one decade ago the answer would be, owning a website. Right now, digital presence is our personal space in platforms like social media. While digital presence is not mutually inclusive with having an internet connection, researchers however believe that it's a good indicator. Moreover, Ubiquitous Internet refers to constant and omnipresent connection to the internet from any device[4]. Right now, based on ITU's current statistics report there are 3.89 billion active internet users[5] but there are some that believe that internet connectivity has surpassed 4 billion active users[6] as of 2018 and as for the social media users, currently there are 3.48 billion active social media users that account for 45% percent of the global population[7]. WEF believes the tipping point will occur in 2023 where digital presence will account for 80% of the global population[8].

2.2.2.5 Internet of things

According to ITU the IoT is defined as a *global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies* (ITU, 2012). The following three megatrends fall under the umbrella of IoT.

2.2.2.6 Vision as the new interface

Humanistic Computing traces back to 1998 when Steven Mann proposed that *a close synergy should be achieved between a human and an user-interface in order to signal processing hardware that is both in close physical proximity to the user and is constant* (Mann, 1998). That was the seminal concept for all wearable technology that was created since then. Smart glasses were one of the first to embody humanistic computing with some precocious steps being taken in 2009 by Google when it created the Google Glass project[9]. The most recent advancement was Microsoft's hololens 2 in 2019, which is described as a fusion of mixed reality, AI and breakthroughs in hardware[10].

According to projections the tipping point will occur in 2023 when 10% of reading glasses will be connected to the Internet[6].

2.2.2.7 Wearable internet

Wearable internet adheres to the same principal of human computing that was mentioned above and includes wearable devices with the capability to connect to the IoT. Smart-watches, fitness bands, smart glass, body sensors and body cameras all fall to this general category. A slow adoption rate is observed for intelligent clothing and smart garments (Hanuska et al., 2016), and its market share is 1% of all the wearable devices[11].

2.2.2.8 Smart home and smart cities

Smart Homes utilize devices connected to the internet in order to create an digitalized assisted living to its residents. Devices like that include personal assistants, such as Alexa or Google Home, smart thermostats, smart lighting, entertainment devices such as Smart TV's and so on. Their intent is to free the resident from menial tasks and to create an engaging environment (He, 2018). As mentioned before Smart homes operate in the context of IoT where everyday devices are now connected to the internet and controlled remotely.

Smart Cities are spaces that take advantage of the digitization, connectivity and other means physical or otherwise to improve quality of life, efficiency of urban operation, sustainability and competitiveness. Just like Smart Homes any combination of "smart" technology can make a city smart (Mohanty, Choppali, & Kougianos, 2016).

2.2.2.9 Big data

As it was mentioned in chapter 4.2, Big Data refer to enormously large sets of complex data, structured or otherwise with the ability to reveal hidden patterns. They are very hard to be analyzed by traditional means of processing (Taylor-Sakyi, 2016). Big Data were brought about by extensive connectivity and digitization and massive computing

power. By 2025 the connected devices are expected to reach the mark of 75 billion globally according to projections[12] and with that the amount of Big Data these devices are going to generate, is going to grow exponentially.

2.2.2.10 Blockchain: government and currency

Blockchain is described as a "distributed ledger" and is a secure protocol where a network of computers verifies a transaction (used in a broad sense, not just financial) before it's recorded and secured. This technology eliminates traditional intermediaries such as banks or other neutral central authorities and instead bases its operation on enabling trust and collaboration between a global network of miners and computers acting as nodes (Schwab, 2017, p. 22). Blockchain has a massive range of applications, from financial transactions using cryptocurrences such as Bitcoin or Ethereum to obtaining credentials from educational institutes (Holotescu, 2018) and creating smart contracts and even voting for national elections (Boucher, 2017).

2.2.2.10 Sharing and on-demand economy

These types of new economic models arose during the 4IR as a response to an increasingly digitised marketspace. Although many concider them to be very similar, in reality they have unique differences and interlapping areas. Sharing economy allows individuals to share the resources with others through online platforms. The idea is to create profit from under-used assets. For example, a flat owner can rent their unused apartment through Airbnb to earn additional income. In that way assets that occupy physical space can be rented out as services (PWC, 2015). The on-demand economy on the other hand is characterized by the use of platforms from where individuals can rent their services. For example, when one orders a ride through Uber's app, he is not renting the car; essentially he rents the service of being driven to his destination by an individual (Selloni, 2017). Other than the conceptual difference of these two models, another one is the price regulation. While in the first model the owner of the asset can independently set a price, in the on-demand economy the price is regulated by the platform. In simple words in Airbnb the price of the rent is decided by the owner, while

Uber sets the fee for the car rides.[13]

2.2.2.11 Designer beings

In 1990, the Human Genome Program was inaugurated with the goal of successfully sequencing all 3 billion base pairs of the human genome. The project is considered the biggest collaboration between nations in the field of biology. It took 13 years and 2.7 billion dollars in order for scientists to *"obtain nature's complete genetic blueprint for building a human being".[14]* Today, the development of new sequencing technologies have become available for commercial use and the acceleration has outpaced even Moore's Law, driving down the costs of human genome mapping as well (Munshi, 2012). According Schwab (2017) in the near future we will be able to edit our DNA sequences removing undesirable traits like genetic diseases or even adding desirable ones, thus augmenting the human cognition.

2.2.2.12 Neurotechnology

Neurotechnology deals with the inner workings of the human brain, which for the most part remains a mystery. Simply put, it is the science behind monitoring brain activity caused by external stimuli. To know how the human brain works, will lead to unimaginable paths; to paraphrase Peter Drucker's famous quote "If you know how it works, you can improve it". Decoding the human brain can lead to potentials for augmentation and also opens the way for humanoids with human-like brains embedded with strong AI (Schwab, 2017, p. 156).

2.2.2.13 Implantable technologies

In 1960's one of the first devices to be implanted into the body of a patient suffering with arrhythmia was a pacemaker (Koydemir & Ozcan, 2018). Since this first breakthrough, technology has come far; already in Sweden as of 2018 two thousand Swedes have implanted microchips to facilitate their daily lives, from storing train tickets to being able to access the company they work for. The allure of convenience

implantable technologies have is undeniable. Critics however have raised valid points against the mainstream implementation of these technologies, ranging from potential health issues to ethical and also privacy concerns (Graveling, Winski, & Dixon, 2018).

2.3 ARTIFICIAL INTELLIGENCE

In the previous chapter, the megatrends of the 4IR were presented. It is considered that the most disrupting of all is AI. This chapter will delve deeper on what AI is from different perspectives and why it was made possible today. A timeline of milestones will also be presented in order to showcase its gradual evolution until today. The last section of the chapter will address the classification of AI based on its characteristics and skills as well as the algorithmic learning process.

2.3.1 Definition

There have been numerous books written for Artificial Intelligence since its first inception as a field of study during the Dartmouth Summer Research Project on Artificial Intelligence, in 1956. Every academic author has some new insight to offer on how AI can be defined and what constitutes AI or not. Defining AI is no simple task. Although the basic idea is that of a "thinking machine" AI entails too many processes to be treated this lightly. Russell and Norvig, offer a table of definitions that have formulated through the years and from different authors, in which they categorize each one based on the four approaches of AI.

Table 2.2 Four Different Approaches of AI

Thinking Humanly	Thinking Rationally
"The exciting new effort to make computers think . . . *machines with minds*, in the full and literal sense." (Haugeland, 1985)	"The study of mental faculties through the use of computational models." (Charniak and McDermott, 1985)
"[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning . . ." (Bellman, 1978)	"The study of the computations that make it possible to perceive, reason, and act." (Winston, 1992)
Acting Humanly	**Acting Rationally**
"The art of creating machines that perform functions that require intelligence when performed by people." (Kurzweil, 1990)	"Computational Intelligence is the study of the design of intelligent agents." (Poole *et al.*, 1998)
"The study of how to make computers do things at which, at the moment, people are better." (Rich and Knight, 1991)	"AI . . . is concerned with intelligent behavior in artifacts." (Nilsson, 1998)

Source: (S. J. Russell & Norvig, 2009)

As it is showcased on the table, the row above deals with thinking processes, the bottom

with behavior, while the left column deals with how AI compares to Human Intelligence in terms of success and the right with rationality (S. J. Russell & Norvig, 2009, p. 1). It is evident that AI is as complex as Human Intelligence and has many different aspects to ponder upon when one is trying to understand its nature.

2.3.2 AI through the Context of the 4IR

For the purpose of this thesis, a more comprehensive and inclusive definition will be used in order to avoid delving into too much technical information, as the motive is to examine AI from the standpoint of economic and social impact and within the premises of the 4IR.

As formulated by Kaplan and Haenlein , AI is *defined as a system's ability to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation* (A. Kaplan & Haenlein, 2019).

The reason this definition is chosen for this thesis, is because it is considered to be inclusive of other megatrends of the 4IR. If someone were to dissect it into small bits of information and observe it through the prism of the 4IR, the resulting logical sequence would look something like this:

"....correctly interpret external data…":

External data= an incoming amount of data so vast that can create patterns, interpreted through algorithms and subsequently lead to conclusions; Big Data. Origin of these Data = Digitization, IoT ,wearables , sensors, and so on.

"....learn from such data,.."

Process: Big Data + Machine Learning= Artificial Intelligence

"*to achieve specific goals and tasks through **flexible adaptation**."* GPT= Artificial Intelligence is considered a general purpose technology. It can be applied practically anywhere in any industry and in every aspect of our daily lives. AI envelopes the core of the 4IR and represents all of its key characteristics, enormous computing power, digitization and combinatory nature.

2.3.3 A Brief History of AI

In this section, a brief timeline of AI will be presented from antiquity until now. In order to for the thesis to not deviate extensively, the most appropriate milestones were chosen in order for an evolution to be showcased.

2.3.3.1 Antiquity

When the general public hears of AI, the first thought that comes to mind is science fiction. But the idea of replicating human intelligence and infusing it into a life-like machine is one that humans have flirted with for a very long time. There are mentions of this concept in Greek mythology, in which Talos was the first intelligent robot given life by the god Hephaestus and through his veins, Ichor, the blood of the Gods was flowing. There are other stories of early mentions of intelligent automata scattered throughout antiquity and indeed the globe, like the story of king Mu of Zhou being present with mechanical men by an engineer named Yan Shi (McCorduck, 2004).

2.3.3.2 Inception and early years

But these are all fables, backed up by no scientific evidence. If one should pin a point in time when the concept of AI started to take off, that would be in the 1950's thanks to Alan Turing's test, which he used to call the Imitation game, where he described which capabilities a computer should possess in order to be considered intelligent(Turing, 1950) (S. J. Russell & Norvig, 2009):

1. The ability to process natural language in order to communicate (natural language processing).
2. The ability to retain memories of what it sees and hears (knowledge representation).
3. The ability to use the aforementioned memories to draw conclusions (automated reasoning).
4. The ability to form patterns and adapt in new circumstances (machine learning)

And the last two that would require sensory stimuli and physical contact,

5. The ability to perceive objects (computer vision)

6. The ability to manipulate said objects (robotics)

Turing created this test that had sparked countless philosophical debates on what constitutes true intelligence or the imitation of it, yet this test is relevant until today. Decades of research later and researchers still are trying to attain the exemplary intelligent machine that the Turing test is proposing (C. Smith, McGuire, Huang, & Yang, 2006).

Another milestone for AI was the "Dartmouth summer research project AI" in 1955 where eleven scientists from various disciplines gathered for a two-month brainstorming session to study the aspects of AI such as neural networks, the theory of computation among others(J. McCarthy, Minsky, Rochester, & Shannon, 1955). Admittedly, this seminal event laid the foundation of AI as a field of study (McCorduck, 2004).

Six years later, in 1966 a pioneering chatbot called Eliza was developed in MIT by Joseph Weizenbaum that was dedicated to the study of natural language communication between human and machine. The workings of this chatbot were pretty simple. When a user typed a sentence that contained a keyword, Eliza identified said keyword and replied using sentences that were transformed using a rule that was associated with that exact keyword. While Eliza gave off an air of effortless communication in the start of each session, the user soon came to realize the superficiality of the conversation (Weizenbaum, 1966).

Then in 1966 Shakey the Robot came, straight out of Stanford's Research Institute, and it was considered to be the first of its kind as it combined natural language processing, computer vision and robotics. But its most notable feature was its ability to reason with its surrounding environment and perform tasks based on its own reasoning[15](Nilsson, 1984)(S. J. Russell & Norvig, 2009).

2.3.3.3 The AI winter

By the end of 1960's however, the research on AI itself started to significantly slowing down, mostly because of unfounded optimism by researchers that its limitations would be tackled sooner, while only some limited progress was being made in a number of its

subfields. This deceleration had a serious effect on AI research; a notable reduced flow of funds from venture capitalists and government bodies. This event lasted well over two decades, with a recess between 1980-1987, where a significant progress was noted in the areas of expert systems and a new cycle of funding started in Japan for the Fifth Generation project and then spread to other nations as well. The event was named "AI Winter". The term appeared in AI magazine on 1985, in a panel discussion under the title "The Dark Ages of AI" where Drew McDermott stressed that the problem arose by the misperception of AI by consumers (businesses, military etc.) and the solution to this problem would require researchers to claim less about what AI is at the moment and to correct this mismatched perception of what is expected and what can actually be delivered (Mcdermott, Waldrop, Schank, Chandrasekaran, & Mcdermott, 1985). Ray Kurzweil, disagrees with the term as it would imply a measure of failure and proceeds to compare it with the Internet and the dot.com bubble; the Internet did not die after the bubble. He offers the technology hype cycle as an example; there is period of unrealistic expectations, follow by a period of disappointment and while growth continues a more mature and realistic transformation occurs (Kurzweil, 2005, p. 206).

2.3.3.4 The 90's until now

Deep Blue was created in mid 90's after years of effort by IBM to build a world-class chess machine designed to carry out chess game tree searches. Deep Blue could analyze through countless different scenarios on winning moves per second, could calculate probabilities and had a profound understanding of applied mathematics (Baker, 2011, p. 4). This computer chess system had two different versions, Deep Blue I and II. Deep Blue I competed in six games against Garry Kasparov in 1996 under tournament conditions and the result was 2-4 favoring Kasparov. Certain changes were made, both in hardware and software, based on observations of the original game and a rematch was set on 1997, where Deep Blue defeated Garry Kasparov by 3.5-2.5 (Murray Campbell, Hoane, & Hsu, 2002).

Then in 1998 MIT, introduced Kismet, an "emotionally intelligent" robot or else an expressive "anthropomorphic" robot that was able to determine a person's emotions and

natural social cues and react to it. Kismet was endowed with four color cameras, a total of twenty one degrees of freedom to allow motion in its gaze and facial features and two small microphones to process voice (Breazeal, 2003).

Fast forward to 2011 two major advances were those of Siri and IBM's Watson. Siri is described as the first commercially available, advanced weak AI created by Apple, marketed as *an intelligent assistant that offers a faster, easier way to get things done on your Apple devices[16]*. By "advanced weak AI" scientists refer to Artificial **Narrow** Intelligence, in which machines operate within the confines of the tasks they were programmed to do originally. In this case, Siri operates recreating elements of human intelligence by mimicking humanlike interaction while listening and fulfilling its user's requests ((Weaver, 2014) (Miailhe & Hodes, 2017)). IBM's Watson on the other hand is more of a business oriented AI platform that operates on IBM's cloud[17] [18]. Most people remember it as the winner in the famous TV quiz show Jeopardy in 2011. Jeopardy is renowned for its reversed questions that need to be reversed formulated into answers. The win for Watson would not be guaranteed were it not for its Deep Natural Language Processing capabilities (Beltzung, 2013). But one of the most significant early uses of Watson was that in the medical field. The machine could obviously understand questions, could access databases in nanoseconds and read and analyze through millions of medical papers, something that no doctor could achieve given a lifetime. Then it could offer hypotheses in the form of suggestions on a patient's condition that was based on calculated probabilities. The doctor then would assess the suggestions, strike those that were considered unlikely and follow through with the most reasonable ones (Baker, 2011, p. 108). Watson for Oncology went one step further by accessing the patient medical history and suggesting personalized cures for each individual based on medical evidence. Of course in the end, the final decision rests in the doctors' hands, as they have to apply their expertise in order to choose the most appropriate suggestions[19].

The next years saw to the rise of chatbots like Siri and Watson's. Amazon created Alexa that came with her own speaker device, Echo, and then Google with the Google Home. Their bid was to create a personal assistant for Smart Homes as both devices can control and collaborate with other Smart Home devices when given voice commands and they

can be programmed to follow certain routines. Another notable example is that of Microsoft's TAY that was equipped with complex learning algorithms and its language abilities were unmatched. Its responses included randomness and even humor. This chatbot was released in 2016 on Twitter's platform. It allowed for interaction with the users and its target was to learn from the conversations with them.[20] It backfired spectacularly. Microsoft hadn't taught TAY to distinguish between acceptable human behaviors and inappropriate ones. Since TAY was programmed to learn from the users, a vulnerability called "repeat after me" was found and exploited by "a subset of people during a coordinated attack" in which they fed Tay with a bile of inappropriate responses, thus messing with its learning process according to Peter Lee, CVP of Microsoft[21]. After 16 hours online and 96,000 highly inappropriate tweets with themes varying from conspiracy theories, hate speech, anti-feminism, anti-semitism and the list goes on, Tay was eventually taken offline. Its successor Zo, came out as a more politically correct version of Tay. It ran on most platforms until March 2019.[22] [23]

2.3.4 Evolutionary stages of AI

As it becomes apparent in the previous section, AI as of today still is considered an Artificial Narrow Intelligence also known as the first generation of intelligent machines. There are three levels of evolution for AI each characterized by its scope, capabilities and comparison to human intelligence (S. J. Russell & Norvig, 2009) (A. Kaplan & Haenlein, 2019). In this section all three steps of AI's evolution will be presented.

2.3.4.1 Artificial narrow intelligence

ANI or weak AI, is a machine that acts as if it were intelligent. It is specifically designed to fulfill a task, like Deep Blue was programmed to be a world class chess player, or it only applies for a specific area, like Siri that can recognize your voice and assist you but cannot drive your car for you. Google's search engine and Facebook's Newsfeed are both examples of ANI using sophisticated algorithms to track your preferences and offer curated and personalized results. ANI also is used in self-driving cars doing very specific tasks like controlling the brakes' function or turning on the headlights; all these little ANI's analyzing incoming data from dedicated sensors are called intelligent agents. Weak AI cannot solve problems neither make decision in other

areas that hasn't been specifically programmed for. Although it can outperform humans in its specific areas, like Deep Blue winning Garry Kasparov, it is still considered to be bellow human intelligence.

2.3.4.2 Artificial general intelligence

This is the next evolutionary step for AI. We haven't reached its threshold of machines actually thinking. AGI or Strong AI will have a wider scope comparing to ANI and it will apply to several areas. According to Kaplan and Haenlich if Siri were to evolve to this stage it would do so in the form of a humanoid robot with a wide range of abilities stretching from voice recognition to writing skills (A. Kaplan & Haenlein, 2019, p. 2). Russel and Norvig however state that in order to consider a machine as having Strong AI we would need to philosophically consider what constitutes a real mind and if it is separate from the body. They offer the arguments of dualist theory and the monist theory. Does the mind and body exist separately or the one is not separate from the other and a mental state is actually a physical one? Kurzeil disagrees however with the emphasis given to a physical presence because true intelligence is the main issue at stake, although he proposes that if an embodiment is required, that would come in the shape of Advance Robotics backed by nanotechnology.(Kurzweil, 2005)

2.3.4.3 Artificial super intelligence

ASI is the last evolution step for AI. It is when AI becomes self-aware and obtains consciousness. Kurzweil (2005) believes it to be a part of the inevitable Singularity. Human brain scanning will be exponentially improved, machines will have the prerequisite hardware and software to emulate not imitate human intelligence, machines will gain access to all the knowledge through the Internet and they will be able to pool their resources and memories by joining together and become one, they will have complete freedom of designing and engineering technology. Those are some predictions of what will be achieved in the following years. Kurzweil mentions that the age of Singularity is inherently neither dystopic nor utopic. The struggle will come from whether humans are ready to follow its trajectory (Kurzweil, 2005, pp. 36–38).

2.3.5 Types of AI based on skills

There is a classification of the types of AI that are in use now or will be in the future according to their use in businesses. Kaplan and Haenlein (2019) borrow from the management literature to classify AI based on the three skills that correlate with outstanding performance; cognitive intelligence which corresponds to pattern recognition reasoning and problem solving and others, emotional intelligence which corresponds to adaptability, achievement orientation, emotional self-awareness, and lastly social intelligence which in turn correspond to teamwork, empathy and others. Artistic Creativity, while included on the table below in the form of capability, does not relate with any of the three classifications and is reserved for human intelligence.

Table 2.3 Types of AI based on skills

	Analytical AI	Human-like AI	Humanized AI
Cognitive Intel.	✓	✓	✓
Emotional Intel.	✗	✓	✓
Social Intel.	✗	✗	✓
Artistic Creativity	✗	✗	✗

Source : (A. Kaplan & Haenlein, 2019)

Analytical AI is the most common type of AI use in businesses right now. Its characteristics correlate with that of cognitive intelligence. This type of AI has the ability to generate possible future outcomes based on knowledge obtained by past experiences. Almost a decade before, in 2008 Ross Miller published an article on the failing of Zero Intelligent agents to attain an efficient equilibrium in a simple two-season market. However in his conclusion he writes: "*The design of a special-purpose agent that can trade in the simple asset markets as well as, if not better than, humans seems clearly within grasp. Straightforward heuristics can enable the agents to **"shop around"** and **"plan ahead."*** (Miller, 2008) Now with the advances in AI such intelligent agents are used to for fraud detection etc.Human-inspired AI has capabilities drawn from both cognitive and emotional intelligence. This type can be found primarily

in research centers. Apart from analytical thinking, this type of AI is also able to understand human emotions and take them under consideration when it is making decisions. The last type is Humanized AI and has not been achieved yet. This type strongly relates with the two later stages of AI; AGI and ASI.

2.3.6 A.I. and learning process

Today the concepts of AI, Machine Learning and Deep learning are used interchangeably but they are not the same thing. When a trained agent acts in an intelligent manner, we refer to it as AI as a whole. ML refers to the ability of the intelligent agent to adapt to new circumstances and to detect and extrapolate patterns. The ML process entails using a predetermined set of rules called learning algorithms that has been given a considerable amount of data. Through this learning process derives the ability to make decisions. ML has three classifications based on the feedback they generate; supervised, unsupervised and reinforced learning. Supervised learning is the process where datasets containing features with labeled and targeted examples are analyzed by algorithms in order to create an association between a vector $\mathbf{x}$ and a value $\mathbf{y}$ and subsequently learn to predict $\mathbf{y}$ from $\mathbf{x}$. In unsupervised learning, algorithms analyze a large dataset and infer useful properties of the structure of the dataset without any intervention or guidance. Clustering datasets based on common values is a task performed by this method (A. Kaplan & Haenlein, 2019, sec. 2.2) The lines between these two learning processes are often blurred leading to the semi-supervised learning where some examples are labeled whereas others are not (Goodfellow, Bengio, & Courville, 2016, pp. 105–106). Reinforcement learning occurs through a reward or punishment method. The algorithm is trained by trial and error scenarios in order to discover which action will eventually maximize not only the immediate reward but also all the subsequent rewards after the initial action is taken. This method is becoming one of the most advancing research areas of AI in recent years (Sutton & Barto, 1998) (S. J. Russell & Norvig, 2009, pp. 694–695). DL or Artificial Neural Networks fall under the supervised Learning classification.

As mentioned numerous times in previous sections, A.I. uses obtained data to learn,

according to the needs of the task involved. This is one of the reasons why AI was be made possible during the 4IR. Big Data is the learning material and it comes from every device, sensor and measuring instrument connected to the Internet of Things. Big Data laid the ground, in order for AI to overcome the obstacles of statistical estimation and maximize its accuracy and efficiency. As of 2016, a supervised deep learning algorithm needs around 5 thousand labeled examples to function in a satisfying way and will be on par or even exceed human performance with 10 million labeled examples (Goodfellow et al., 2016, p. 20).

2.4 SOCIOECONOMIC DISRUPTION

In the first chapter, the definition, nature and characteristics of the 4IR were discussed. Compared to the previous Industrial Revolutions the 4IR will affect entire industries, societies and even humanity in ways that were never experienced before due to its size, speed and scope. Moreover, its megatrends were presented; AI considered the most disruptive of all. In this chapter, certain forecasts and predictions that exist in current bibliography will be presented, on how and how much AI will potentially disrupt economy and society.

2.4.1 Theoretical background

In this sub-section the broad definitions of disruption and social economics (socioeconomics) will be presented, in order to clarify certain issues.

2.4.1.1 Disruption

Disrupting Technologies were firstly mentioned by Clayton M. Christensen and Joseph Bower in 1995. The premise of the concept, in simple terms is that most established companies create technologies that cater to the next-generation needs of their existing costumers; this fixation however to the same process and incentives to achieve that goal renders them blind to new emerging technologies. There is also the scenario that those companies are actually aware of the innovation but are incapable to allocate resources in

order to adopt it or they deem that the technology is still in an early stage to be sufficiently profitable (Bower & Christensen, 1995). That leads to big companies being outperformed by small innovators and early adopters. But this idea seems limited to companies. Since then many have used the buzzword "disrupting" to describe something that has profound and rapid change on existing systems and processes. Klaus Schwab in his book "The Fourth Industrial Revolution" , **admittedly** applies the broader term of the word in order to explain the wider impact of the 4IR not only to industries but also to economy and society as a whole(Schwab, 2017, p. 158). In particular he determines disruption through the way it is going to impact several factors such as governance, economy and society.

2.4.1.2 Social economics

Social Economics is the study of Economics and Social Sciences. It focuses mainly on phenomena that appear between social behavior and economics and it examines factors such as public sentiment, consumer behavior, income inequality and others. It draws parallels from history and conclusions from current happenings, trends and political events

in order to deduce how much society and economy is affected. The follow section will examine the potential of AI to disrupt/ impact certain socioeconomic factors.

2.4.2 Economic Growth

Before 2008, the global economy was increasing by 5% each year. After the Great Depression happened this percentage fell to 3-3.5% even with all the technological advancements that have been made in the recent years. It goes to show that economic growth has many different aspects that can affect it like ageing and productivity. Schwab mentions that productivity is the number one determinant of long-term economic growth. Yet productivity has declined these past years with no signs of recovering. In the U.S. labor productivity had grown 2.4% between 1947 and 1983, 2.6% between 2000 and 2007 yet 1.3% from 2007 and 2014(Schwab, 2017, p. 34). If we consider that AI is a GPT, its growth would be most noticeable in productivity, yet

that is not the case. Academics call this the Solow paradox after Robert Solow, a Nobel Prize winning economist; his quote was in regards to computers *"the computer age is visible everywhere but the productivity statistics"*(Solow, 1987). There are three hypotheses at the moment on why AI hasn't boosted productivity and subsequently economic growth. The first one is the mismeasurement hypothesis that states that statistical tools that are being used today, fail to measure AI's true impact on economy. The second one states that it's not productivity's decline that is illusory, its innovation. Unlike GPTs that occurred in the past like electricity that change the route of our world, this view doesn't regard AI as a GPT and thus its impact wouldn't be sufficient to explain a rise in productivity, hence a rise in economic growth. The last view states that there is a time lag between innovation and implementation, meaning that AI hasn't yet been sufficiently integrated in industrial systems and has yet to reach its full potential[24] [25](Schwab, 2017).

In another research Aghion, Jones and Jones tried to forecast AI's impact in the context of automation. It is safe to assume that AI can be considered the latest step towards sophisticated automation. If current AI can be programmed to a specific task, has a vast amount of information to learn from and is supported by a massive computing power then it can outperform humans in not just repetitive tasks but in those that require cognition and analytical skills as well. For the past 150 years economic growth is driven by automation. From the steam engine to advanced robotics it seems that the automation of some features of production has always been the keys to economic growth. Aghion, Jones and Jones created a model based on Baumol's "cost disease" insight (Baumol, 1967) and Zeira's model of automation (Zeira, 1998). In this model they *introduced A.I. in the production function of goods and services and tried to reconcile evolving automation with the observed stability in the capital share and per capita GDP*. They used two sectors as a basis, manufacturing and agriculture because, as Baumol states, those sectors with rapid growths, as the aforementioned ones, often see their GDP decline. When AI is introduced in their model combined with Baumol's insight, under certain conditions one can get *overall balanced growth with a constant capital share that stays well below 100%, even with nearly complete automation.* Even if Baumol's cost disease leads to a loss in GDP in those sectors when they are automated this will be

balanced out by the increasing faction of economy that will get automated over time.(Aghion, Jones, & Gsb, 2018)

Accenture is very optimistic about the impact of AI on economic growth in the future. According to a report published in 2017 AI has the potential to increase productivity by 40% and economic growth by 1.6% in 16 countries of the developed world by 2035. The most impacted industries will be that of Information and communication, manufacturing and financial services. (Purdy & Daugherty, 2017)

2.4.3 Future of Employment

In 1930's the father of modern Economics, John Maynard Keynes, drew attention to the impact of fast innovation on labor. In his own words *"The increase of technical efficiency has been taking place faster than we can deal with the problem of labor absorption"* (Keynes, 1930). One of the most feared impacts of AI is the massive unemployment that has the potential to cause. In order to study its effects however one cannot regard AI as a single independent disruptive agent, but can only observe it under the collective prisms of the 4IR characteristics, automation and advanced robotics.

It is already been experienced in the previous industrial revolutions that whenever a new innovation was introduced, it would certainly disrupt employment in one way or another. One of the earliest examples of this disruption is offered by Gregory Alms; in his book "A Farewell to Alms, a brief economic history of the world" he describes how the horses lost their value and were displaced during the Second Industrial Revolution. Although at the start of the previous century their numbers had spiked to 3.25 million since they were used largely in agriculture and transportation, the discovery of internal combustion engine in the Second Industrial Revolution rendered them almost obsolete (Clark, 2007). Of course the contribution of humans in the workforce cannot be compared to that of horses. However, the analogy between them could still stand. The horses were substituted by the internal combustion engine, because they served the same purpose but the latter was more efficient, this begs the question; can humans be substituted by AI when the latter gains the abilities of the first and subsequently become

more efficient? There is a very frightening segment of a statement by James Hughes that summarizes the efficiency issue:

*"...we have reached a tipping point where humans are losing the race against the machine eventually even **having an employee with zero wages would produce less profit than owning a robot***...*"*(Hughes, 2014)

AI, in its form today, can complement human entrepreneurship and be used as a tool. But what happens when AI surpasses human intelligent? There are two divided opinions on what could transpire in the future; the optimistic and the pessimistic one. McCarthy believes that technology and job-creation always went hand-in-hand. He believes that the use of software creates new jobs and displaces some others, but the scale always tips to job creation in new industries. Nevertheless he acknowledges that this can create skill-based unemployment and stresses that it is the responsibility of policymakers to expand job retraining programs(M. McCarthy, 2014). However, Berger and Frey come to refute this statement, namely they state that in 2010 only 0.5% of the workforce in the U.S. was employed in jobs that did not exist a decade earlier. They also point out that the majority of that workforce was skilled workers with better education and most had a STEM degree (Berger & Frey, 2015). However, as far as short-term projections go, the WEF in rather optimistic. In its 2018 Report on the Future of Jobs estimates that while 75 million jobs will be lost by 2022, a total of 133 million new roles will emerge that will create a more distinctive work environment between humans, machines and AI.(Centre for the New Economy and Society, 2018)

Another reason would be that the new business model has changed in the 4IR. It doesn't require that much workforce for productivity growth or enormous scaling; Autor and Salomons after an extensive research, again using Baumol's hypothesis, found out that technologically advancing sectors with observed productivity growth had the tendency to shrink in regards to workforce (D. Autor & Salomons, 2017). Accenture in its 2017 report on AI and Industry Profits, names "Wholesale and Retail" as one of the sectors with the most boost on profits by 2035 due to AI and subsequent automation in warehouse management and streamlined inventory, a 36% rise compared to its current

baseline. However we don't have to wait for 2035 to watch that scenario play out; one of the very first automated warehouses is that of Ocado, a supermarket in England. Ocado utilizes robots in a structure called "the Grid" or ''the Hive", to sort through and prepare thousands of orders from its customers. Although said robots are not intelligent per se, they are coordinated by a central computer that maximizes their efficiency. But the most prolific characteristic is that; it doesn't matter if one breaks down, another one will fill its gap immediately. That subsequently means that the company has to have just one robot to design, manufacture and support and all the rest will just follow the original[26]. Of course there are still human employees working in the warehouse in roles that the robots **cannot yet** fulfill. The risk of unemployment stems from the ability of AI to automate processes needing little to none human intervention. Right now weak AI can only perform specific tasks for which it was programmed in the first place. However in the following years the world might see more and more skills being acquired by AI, probably rendering human labor obsolete.

Although there is no concrete evidence of that ominous forecasting, Osborne and Frey created a study with quantifiable data to examine how susceptible were 702 current occupations to computerization. According to their estimates 47% of total employment in the US is at risk. In order to draw their conclusions, they classified occupation by two categories with two branches each: routine and non-routine, manual and cognitive occupations. Routine tasks can be substituted by a machine rather easily because they follow a clear set of rules that a machine can learn. Non-routine tasks are harder than that because their complexity cannot be conveyed into computer code; they need critical thinking, flexibility and common sense, something that is innate in humans. This statement sums up Polanyi's Paradox "*we know more than we can tell''* and since these tasks cannot be translated into a distinct set of rules a machine can learn, AI can only complement these tasks(D. H. Autor, 2014). However, with the use of Machine Learning and Big Data this barrier is now lifted. They also point out that blue collar workers in low-skill and low-wage occupation will be severely impacted (Frey & Osborne, 2013). In contrast, Autor believes that there is a precedent of academics that overestimate the ability of new technologies to substitute human labor (he called the effect the "Automation Anxiety") and underestimate its potentially complementary role.

He believes that in the coming decade middle-skill occupations will have to make a fusion between using technology for routine tasks and using common sense, social skills and flexibility for non-routine tasks where humans have comparative advantage (D. H. Autor, 2015).

2.4.4 Society

Every effect taking place in the economy, its ripples are always felt by society. When one analyzes disruption in economic factors cannot exclude the impact it will have on existing societal structures. In the case of AI there are many issues to ponder upon; some of philosophical nature and others that are a direct consequence of economic issues that might arise in the future. However one can only speculate about some of them and the reason is that AI has not yet reached its full potential and might not achieve it for decades to come. Moreover, the impact of AI on society is much harder to imagine because of the so many aspects and components that make up our societies. How one can anyone discern beforehand what the full impact of AI will have on our lives? Regardless, there are some philosophical questions that give us a glimpse of how AI will possibly affect societies and some other that result directly from the disruption on economy.

2.4.4.1 Value of employment

Work has intrinsic value for humans and humans, in turn, define their socioeconomic environment mostly by their occupation. In the previous section about employment, it was discussed whether advancements in A.I. will lead to massive job-loss; subsequently this will lead to a fall of living standards for a large portion of the population. Although many researchers believe that A.I. will eventually drive down the costs for products and services, due to maximum efficiency and less manpower, the diffusion of these economic gains will mean nothing to the general population, previously employed in low or medium wage occupations, which either way will be unable to consume said products and services. Matthias Humbert (2007) shows that there is precedent; in his research for technology and workforce in the Information Age and the 4IR , mentions

the "trickle down technology" in the context of benefits in prices did not occur; in particular he mentions that the only thing that made Americans being able to continue to consume was consumer credit (Humbert, 2007). This can lead to increasing dissatisfaction, social unrest and inequality; opportunities will come across to those with access to A.I. technologies and will give them a comparative advantage against those with no access (Stone et al., 2016) (Microsoft, 2018).

The optimists, on the other hand, believe that increased automation caused by A.I. will make the world look like an Athenian democracy in its Golden Era. The working schedule will be diminished to some hours per week giving rise to leisure; the "Metics of the future" (intelligent machines) will shoulder the economy while humans will reap the fruits of their labor and be free to devote their time to other more fulfilling ventures (Churcher, 1991)(Makridakis, 2017a).

2.4.4.2 Ontological inequality

Inequality will not only stem from employment issues. While the Human-Machine gap closes, another form of inequality will arise; among those who adapt and those who resist.

Ray Kurzweil predicts that in order for human to compete with the machines, the former will resolve into artificially enhancing their bodies and minds; one of his predictions involve nanobots in our bloodstreams to enhance mental abilities(Kurzweil, 2005). Even if the costs for those enhancements will be driven down thanks to Moore's Law and thus become accessible to the masses, the question remains; what will happen to those who want to remain "pure'' humans or unenhanced? Will they be left behind, like a former evolutionary step?

2.4.4.3 Ethics of A.I.

Another rising issue of AI that will affect society and will raise concerns in the coming years is the matter of ethics. Until now ethics and morality prerequisited a level of consciousness; in fact, our whole legal system is based on that concept (Kurzweil, 2005,

p. 278).This begs the question; can we recognize consciousness by non-biological intelligence? And if yes, what kind of ethics and values will this intelligence uphold? Kurzweil (2005) believes it is way too soon to devise strategies in order to infuse a strong A.I. with human ethics. But inching towards a strong A.I., even if it takes years, with the ability to make decisions instead of humans for humans, without having a serious discussion on the really pressing matter of ethics will be harmful for society and the implications will perhaps be irreversible. Some researchers believe that business leaders, policymakers, academics and researchers from inter-disciplinary fields must collaborate to ensure that AI will uphold the following preliminary principals: *fairness, reliability and safety, privacy and security, inclusiveness, transparency and accountability*(Microsoft, 2018, p. 61)

i. *Fairness***:** AI should treat everyone equally, without biases and be able to act in the same manner for similar groups of people. One would think that since machines are purely logical that would be an easy barrier to overcome but this is not the case. In 2018 Amazon discovered that the algorithm they have been using to hire staff for technical positions had been discriminating against women. The reason for this was that the algorithm was trained using data from CVs that were obtained for more than a decade. Since STEM occupations are male dominated, the algorithm drew the conclusion that males are preferable for this type of job description and acted accordingly[27]. One of the challenges in the future will be using un-biased data sets and supervising over the conclusions algorithms draw upon.

ii. *Reliability and Safety:* In order for the public to accept A.I. based systems a level of trust must be reached. Reliability and safety are the top most priority in order for A.I. to be diffused. A.I. should be monitored and constantly tested not just for the normal circumstances but also for unexpected conditions, e.g. under the radar cyber attacks. The system cannot be flawless and thus needs constant supervising to ensure reliability, safety and consistency and to ward off potential bad actors. In a study conducted in order to predict the need of hospitalization for patients with pneumonia risks, through intelligent models for healthcare, an

astounding conclusion was drawn; people suffering from asthma had lower mortality rates due to pneumonia than those who were not suffering, thus leading the algorithm to assume that people with asthma would not need to be hospitalized. Although it was correct in its conclusions, the reason behind them was completely wrong. The intelligent model failed to take under consideration that the reason for that was that patients with asthma and pneumonia were not only admitted immediately to the hospital but went straight to the ICU thus lowering their mortality rates through aggressive care, in contrast to the rest of the non-asthmatic population. If the researchers hadn't notice the wrongly connected facts, the system would have suggested against hospitalization of people with asthma leading to a disaster (Sturm et al., 2015).

iii. *Privacy and Security*: In order to train AI algorithms to fulfill certain tasks, large data sets must be available. These data come from all the kinds of mediums; it's the era of extensive digitization. The need for privacy and security has always been a concern with technological advancements, however today guarantees of privacy are even more important. People are not inclined towards sharing their personal information, unless there are assurances of privacy and security that the information will not be used in a malicious way, directly or not. In 2016 European Union passed GDPR, to regulate the free flow of data across the Digital Single Market. It is meant to reinforce the rights of its citizens to their digital information, allowing them to have power over how, when and from whom their information are used (European Parliament and Council of the European Union, 2016). This level of commitment to privacy needs to be exhibited by corporations and businesses as well.

iv. *Inclusiveness*: Access to AI should be open to all humans giving them the same opportunities and empowerment. Designers should take under consideration of the needs, capabilities and expectations of the end-users, when designing AI.

v. *Transparency***:** In the book "The Hitchhiker's guide to the Galaxy", the Deep Thought supercomputer is asked the "Ultimate Question of Life, the Universe and Everything" and after 7.5 million years of calculations it gives the "Ultimate Answer", which is the number **42** (Adams, 2005) **.** No matter how comical this reference sounds, it presents a real issue with AI; it can become incomprehensible. When AI starts to make decision that affect people, those people will want to know how it came upon its decision; what was its logical sequence of conclusions that led to this decision? A failure to procure these explanations about the inner workings of AI to the people will result in general mistrust and eventually complete disregard on AI's verdicts when it is possible.

vi. *Accountability:* Another important issue that has raised concerns is the matter of accountability. Who is responsible for AI? Millar et al. (2018) mention in a discussion paper during the G7 Conference on A.I. that currently there are three types of AI's accountability in literature. The first relates to the accountability that lies within AI itself. In that sense AI is accountable to be audible and transparent; accountability is paralleled with explainability. The second type of accountability relates to the group of people or individuals will be responsible when an adverse effect occurs from an algorithm or AI itself. The last and most broad type is the accountability of the sociotechnical system that creates and deploys AI. One measure AI Now (2018) is proposing for combat accountability is the Algorithmic Impact Assessment framework.

2.4.4.4 Human spirituality and religious beliefs

Intelligence means more that the ability to think. It goes beyond knowledge and understanding .It is as complex to explain as the notion of love. Artificial means it is not natural. It comes from technology. It is man-made. Ray Kurweil's thesis is that if humans share their complexity and actual patterns of human brains (e.g. by neurotechnology,) then these future non-biological entities (e.g. AI embodied) will be able to display the emotional reactions of humans (Kurzweil, 2005, p. 338). William A. Dembski points out that this is "contemporary materialism". There is a spiritual side that subscribes to human capabilities and that is our aspirations. "*We long for freedom,*

immortality, and the beatific vision. We are restless until we find our rest in God. The problem for the materialist, however, is that these aspirations cannot be redeemed in the coin of matter" Dembski's criticism stems from what he refers to as the "hollowness" of machines. In particular he criticizes Ray's Kruzweil notion of spirituality in machines in the coming Singularity as it*"neglects such traditional aspects of spirituality as revelation, tradition, virtue, morality, and above all, communion with a non-physical God who transcends physical beings"* (Dembski, 2002).

This thesis will not delve deeper on this debate; there are many philosophical arguments on spirituality, transcendence, evolution of humans and machines and God in regards to AI. However, it must point out that if in the future machines surpass humans those questions will not only be asked in philosophical cycles. A connection to the philosophical debate and an impact of AI to society is going to be established based on two experiments. Harris et al. conducted an experiment on the neural correlates of religious and non-religious beliefs. The study wanted to establish a connection to how believers and non-believers evaluated facts. They used fMRI to measure signal changes on the brains of 30 people as they evaluated the truth and falsity of religious and nonreligious propositions. They have found *"**increased signal** in the precuneus, the inferior parietal cortex, and the medial prefrontal cortex when participants with strong beliefs about religion evaluated religious beliefs compared with nonreligious beliefs. This is consistent with the idea that the DMN is recruited when thinking about deeply held beliefs"*(Harris et al., 2009).The precuneus has been linked with processes of self-awareness and general consciousness as well as memory (Kjaer, Nowak, & Lou, 2002; Lou et al., 2004). The second experiment was conducted to study neural correlates of maintaining one's political beliefs in the face of counter-evidence. The motivation for the experiment was to explain why people discount evidence that challenge their deeply rooted beliefs. Again they noticed increased signals from the DMN(J. T. Kaplan, Gimbel, & Harris, 2016). One can see a pattern here, political views as well as religious ones are part of who we are as individuals. That begs the question, what will happen if the discussion of AI challenges these deeply rooted beliefs? The ramifications of this incompatibility on views will be felt quite deeply by society. Schwab (2017) offers a glimpse of the future struggle. In

particular he warns that if AI or the 4IR in general threaten the fundamental assumptions humans have it *"may exacerbate the tensions which exist between deeply religious societies defending their fundamental values and those whose beliefs are shaped by a more secular worldview. The greatest danger to global cooperation and stability may come from radical groups fighting progress with extreme, ideologically motivated violence''*.

2.4.4.5 Human interaction

According to Research Fellow Aku Visala[28], in the University of Helsinski, AI and robotics will change our perception on humanity and human relationships. Visala's standpoint raises a very valid point; machines will most probably replace humans in the labor market; why not also replace humans in their social duties as well? He uses the example of caring for the elderly. Children might find it very convenient to let intelligent robots care for their elderly parents while they continue their lives and careers. But this fact, he continues, will rob us from the chance to feel empathy and love. In particular *"If we outsource care to machines, we are denying ourselves and others the opportunity for moral growth and commitment. In addition, this may alter our concept of what is considered a morally worthwhile goal."*. Earlier Klaus Schwab had also reflected upon this ever entwining relationship between humans and technology and if such relationship will cost us our empathy and compassion.

2.4.4.6 Overdependence on AI and loss of our skills

According to a wide survey conducted by the Pew Research Center (2018) overdependence on AI is very worrying. AI will surely gift us with convenience but it will come at the cost of our independent thinking and of gradually losing our skills and talents. In this research people were asked to comment on the fears some researcher that we will gradually relinquish independent thought. Quoting Charles Ess, an expert on ethics, from the survey '*But convenience almost always comes at the cost of deskilling – of our offloading various cognitive practices and virtues to the machines and thereby our becoming less and less capable of exercising our own agency, autonomy and most especially our judgment (phronesis). In particular, empathy and loving itself are virtues that are difficult*

to acquire and enhance. My worst fears are not only severe degradation, perhaps more or less loss of such capacities' It is became apparent from the survey that more people share this fear. AI will be able to take better, informed decisions than us.

Its use in our daily life will provide us with much convenience but gradually will we surrender our independend thougth?

2.4.4.7 AI: a threat to democracy?

In June 2016 the vote for the Brexit Referendum occurred. Admittedly this day was a bad day for Democracy. Facebook and Cambridge Analytica were accused of targeting people, whose personal information were leaked, on the social platform that were deemed persuadable and bombarded them with "fake news" days before elections. Many accused this fact was what tipped the balance toward the "Leave" vote. The scheme was afterwards exposed by a whistleblower Chris Wylie and investigative journalist Carole Cadwalladr of The Guardian [29]. Facebook generated the " Fake news" using Facebooks ads which then targeted people that were identified as easy to be perasuaded.

In an interview conducted by Kare Hao(2019), Futurist and NYU Professor Amy Webb , believes that pieces of AI already have and negative impact on democratic procedures already. One example she utilizes is about the antivaxxer community. They misuse the freedom of speech Democracy affords them to spread lies that go against scientific proven facts. And social media algorithms help spread this lies because they are making the choice on editorial content. She compares the situation with what occurred with Facebook and Cambridge Analytica.

3. DATA AND METHOD

3.1 VALUE AND ORIGINALITY OF THE RESEARCH

Following an extensive desk research, it is evident that while researchers agree that AI will a great impact on many aspects of society and economy their general outlook of the future is very different. Makridakis (2017b) categorizes the researchers into four categories based on their perspectives and forecasts for the future : the optimists, who believe that AI will bring about an utopian future in which humans will ascent by harnessing the benefits of the technological advancements, the pessimists, who believe that dangers of AI and the 4IR will create complex problems and humans will be considered second rate beings, the pragmatists or realists, who incline towards the real possibility of a dystopian future but believe that with sufficient regulation and fail-safe mechanisms humans will be able to overcome problems regarding AI and lastly the doubters that do not believe General AI is possible and will not pose a threat to humanity.

The reason why AI's impacts are very difficult to be researched is because we have not witnessed yet its full potential. Although there are few examples that exist today and they are still considered to be still in infancy. Therefore we can only speculate how events will unfold in the future. However, it is a necessity to start preparing for the future today. Russel, Dewey and Tegmark (2015) stress on the importance of early research on how to maximize the benefits of AI while mitigating any adverse effects it might have in the future. This thesis firstly attempts to explore different opinions and forecasts for the future on important socioeconomics factors that will be impacted by AI such as the economy, labor market and society. Secondly, it will attempt to explore ways to avoid a possible dystopic future and offer insight on ways to adapt in the reality of the 4IR.

3.2 CONTEXT OF THE RESEARCH

In this thesis expert interviews were used in order to gain deeper insight on the subjects analyzed in the literature review. In the interviews, the worst case scenarios were presented in order to deduct whether the experts agreed or not and to discern if their outlook on each scenario was optimistic or otherwise and in general to distinguish between the AI hype and AI reality .On a second level, through the conversation, the experts offered their insight on how we can avoid potential problems for the future. Through the analysis of each answer, a deeper understanding on each topic is acquired and propositions are formed, wherever they are applicable. This thesis inspires to be a comprehensive guide that is meant to be concise and informative on the potential impact on employment, economic growth and to present ethical issues that already raise concerns for the future.

3.3 METHOD OF THE RESEARCH

For the purpose of this thesis, qualitative research through expert interviews was preferred. Labuschagne (2003, p. 3) mentions that the qualitative research produces a wealth of meaningful data from a smaller group of people and cases. It can also provide in-depth insight on particular subjects through direct quotation. Kvale (1994, p.174) an interview is essentially *"a conversation, whose purpose is to gather descriptions of the [life-world] of the interviewee"* in other words delve deeper into the knowledge of the interviewee to draw detailed conclusions. The subject of this thesis makes it imperative to conduct expert interviews. Kvale (2006) compares expert interviews to the Platonic dialogue where the interviewer must also confront his/her own perception on the research and through the dialogue both the interviewer and interviewee can increase their knowledge.

This thesis utilizes semi-constructed interviews. The interview consisted of a series of ten initial questions and some props that occurred during the interview. The interviews were semi-constructed in order to offer the interviewees the freedom to expand on each topic depending on their own understanding of the subject. Rubin and Rubin (2005, p.

88) assert that semi-structured interviews allow for an in-depth understanding of the researched subject as it allows the interviewer to expand the interviewees responses.

3.4 RESEARCH SAMPLE

The interviews were conducted with two individuals that are considered experts on the subject of AI. The first expert I interviewed on 22nd of April was Mr. Murat Sahin. He is currently the founder of Orijinal and his Curriculum Vitae reveals an extensive professional track. Among other things he is also a member of the World Future Society and the High Advisory Council of the Futurists Association.

The second interview was conducted on 1st of May with Dr. Mustafa Aykut. Among his current activities Dr. Aykut is a Vice Chairman at the Turkish Futurists Association, an ICT Sector and Regulations Working Team Member at the Istanbul Information Society Watch Group and a Lecturer of the School of Futurism at Kadir Has University.

The third interview was conducted with Dr. Mustafa Emre Civelek in his office at Ticaret University on 10th of May. Dr. Civelek is a scholar at Istanbul Commerce University and the Board Member of Technologistics Application & Research Center. Between 2012-2017 he was the head of the Ground Handling Services Management in Aviation Program. He holds a PhD in Business Administration

They were chosen because it was believed they could provide valuable and detailed insight regarding the topics that were discussed during the interviews. Their CV's prove that they are both expert futurists and have spherical knowledge on the predictions of AI's impacts on economy and society.

3.5 DATA COLLECTION AND ANALYSIS

The findings of this research derived solely through interviews. According to Bogner et al.(2009) interviews are very popular for social research. Interviews with experts are a more focused and efficient than gathering data through participatory observation or systematic quantitative surveys. In particular semi-constructed interviews are the best

method if one wants to narrow down to some topics but leaving the interviewee the freedom to expand his/her questions to the directions he/she wants within the premises of such topic. So an opening statement was formed and some general questions in order to incite a conversation were asked(Rabionet, 2011). The first interview lasted a little more than 30 minutes while the second took more than an hour. The interviewees were asked if they want to remain anonymous and they both declined. After that they were asked if they want their voice to be recorded and they gave their concent. These were necessary questions to avoid ethical implications. After the findings were collected, they were analyzed and certain patterns emerged. The themes that were deducted from the questions constitute the sections of the fifth chapter.

3.6 LIMITATIONS OF RESEARCH

One of the disadvantages of my research is that it utilizes the findings from a very small research sample. It is certain that if more experst were interviewed, there would be more opinions and predictions to analyze and a richer and detailed conclusion would be drawn. Another limitation that was realized after the interviews were concluded was that the extent of the interview with Mr. Sahin and Dr. Civelek was smaller in contrast with the second interview with Mr. Aykut. This occurred because both the interviewees had a pressing schedule and could not afford to spend more than 45 minutes for the interview. As it will become apparent in the next chapter Mr. Aykut's answers are more extensive and detailed than the other two.

A future research which would include more experts would provide more detailed and broad insight on the subject of the socioeconomic disruption of AI. Multidisciplinary experts would also provide an opportunity to compare different perceptives on the matter.

4. FINDINGS

4.1 ECONOMIC GROWTH

The first topic of the interview was on how AI will affect economic growth. As previously mentioned in the literature review presently there is no evidence of AI currently affecting productivity and subsequently economic growth. According to literature there are three main reasons that this fact would take place. Firstly Narrow AI used today is insufficient in creating an impact, secondly our traditional means of measuring productivity cannot factor for the impact of AI and the third is that AI is not sufficiently implemented in our industrial processes and the adoption rate is slow. However the projections for the future are very optimistic from the first two interviewees. AI is expected to have a huge impact across many industries. The respondents were asked on their opinion on how AI will affect economic growth. Mr. Murat Sahin offers his insight:

> *"I believe AI will create many strong opportunities. Today there are very few impacts, very few examples of AI but even though there is navigation, there are some simple assistants like Google assistant, Alexa and other we are getting help and the basic life is already changed. On the other hand if you look at finance industry or the medical industry there are so many examples affected by AI. Especially from the medical perspective and financial too there so many AI solutions that we already have today, especially for processing documentation, credit card applications new products and other things.*

> *(M.S.)*

The findings obtained from this question reveal that Mr. Sahin also corroborates the evidence that the impacts of present Narrow AI are not felt by the economy. He suggests that the reason for this is that there are only a few applications of AI today, except perhaps for the financial and medical sectors. He continues that it is still early to judge but his outlook is very optimistic for the future.

"This is just the beginning and it will help more businesses, that means most of industries, medical solutions, financial solutions, will be more profitable thanks to AI."

<div align="right">

(M.S.)

</div>

Both Mr. Sahin and the second interviewee, Dr. Aykut, believe that AI will have a very positive impact on economic growth for most of the industries. Through Mr. Sahin's answer it is discerned that first he believes it do be too soon and AI hasn't yet fully integrated with industrial systems. Dr. Aykut's perspective on economic growth is no different. He offers a historical analysis on the previous Industrial Revolutions to draw conclusions for the future. Indeed the three previous industrial revolutions are the reason humanity has come so far. Dr Aykut believes not only AI but in general all the advancements of the 4IR will benefit the global economy. Indeed the steam engine, electricity drastically shaped not only entire industries, but also the way of production.

"Instead of focusing on AI we should instead look for the wider perspective. AI is part of Industry 4.0 . When I say 4.0 this is a new type of industry. Maybe you know why we call it 4.0. Well starting going back to the 18th century, starting with the year 1760 we as human beings we started to use the power of steam, so transportation became very feasible, cheap and affordable. How? Because steam engines have been used for railways, trains. So you can move not only human beings but also goods from one location to the other one. That was a great revolution. The next century starting with 1870's something appeared in the industry which was electricity, it was a great invention. In my opinion, if you ask me what was the most influencing invention in human history I will reply a million times that it was electricity. You know electricity, increased the power of production so assembly lines for instance in 1886 there was the first assembly line established by Henry ford. And after 1960's there was another revolution for the industry which was semi-conductors, electronics, computers and Internet. So all they were kind of inventions in a path, that made a frog-leap in technology."

<div align="right">

(M.A.)

</div>

Dr. Aykut continues to the present, offering insight on how automation will shape whole industries. Of course he refers to intelligent robots. Automation of simple

processes already exist in the form of industrial robots, but a combination of robotics and AI will bring forth a new generation of robots, able to make decision and act in an intelligent manner.

> *"We are now at a shallow point to change the whole industry. Removing the human power, the raw power from the industry and putting the machines. Well of course I am talking about robots, robots that are using AI. Otherwise they will be just the machines doing all the time the same things. We call them industrial robots"*

> *(M.A.)*

Dr. Aykut continues with an example from the autonomous cars. He mentions that if the automotive industry is transformed it will cause a chain reaction to other industries that are connected with it such as logistics and transportation.

> *For instance autonomous cars are coming in couple of years. Elon musk had a press conference few days ago and he said that in the next 3 year the cars produced by Tesla will be autonomous cars and the cars will also be on demand. You will call the car itself. The car will come to you. You will open the door giving commands you will sit on your seat there will be no steering wheel no breaks no paddle nothing and it will take you to your destination and it will be controlled remotely by a machine. So, machine to machine communication will be the basis of this industry. That means the transportation will change dramatically and not only the economics of transportation but also the logistics. Production of automotive will change. It's a chain reaction. So things one by one, proceeding the previous one will be changed, not 100% in the beginning but in the next decade all of them. The same things will happen for any kind of production. So the machines having the intelligence will produce perfectly day and night in cold environment or a hot environment so you don't need to cool or heat the environment or put on the lights. We will see dark factories not far from today. In a couple of years they will be called dark factories. The machines will see even in the dark. There is this technology even today. That means, there will be a great abundance in the economy producing everything so much and so cheap and round the clock. So it will be accessible any product easier than today. But it depends. So we are going to talk how it will be depended on the production type on further questions. It is a*

big question mark, is it for everyone or the selected ones?

<div align="right">(M.A.)</div>

Dr. Aykut's perception is that AI and intelligent robotics will not be subjected to the same limitation of human labor. This will cause unlimited production as long as there are resources. It will result in greatly diminishing production costs and therefore lead to a great abundance in the economy. There is however the other side to the argument. Mr. Sahin and Dr. Aykut were very optimistic in their projection. Dr. Civelek represents a more moderate opinion. While he acknowledges that most predictions on the impact of AI on economic growth are optimistic, he warns that a chain reaction can occur due to increased unemployment. Indeed, widespread unemployment will lead to the loss of income and therefore the purchasing power will diminish as a result. Eventually demand for products and services will also fall as a consequence.

> *"According to some scholars, according to optimistic views, AI will have a positive effect on economic growth. But some scholars that are on the pessimistic side suggest that AI will have a negative effect on unemployment. Unemployment will increase. Therefore if unemployment rates increase the purchasing power of the consumers will decrease and the result of this will be less demand and general uncertainty globally, in the global economy not specifically in a country. Some countries will grow. For example American Economy today is going well, but what about other countries? According to some scholars, in the future, the global economy is expected to greatly increase to unprecedented levels because of AI. Also I think as an answer to your question there are two points of view, two schools of thought, some of them suggest that AI will have positive influence and some believe it will have negative. And in my opinion we need to consider both of them."*

<div align="right">(E.C.)</div>

Moreover Dr. Civelek poses the same question as Dr. Aykut; will AI's positive impact on economic growth occur globally or only to certain countries? Quick assimilation of AI into production systems seems to be the answer to this question. Countries that will swiftly adopt and implement the developments of AI will have the comparative advantage over those who do not act quickly enough.

*"For a country it is not possible to not implement such developments. If you do not implement such technologies in your country or in you production processes you will increase your costs. Therefore your competitiveness will decrease and you must implement those technologies in your production processes. Otherwise you start to import and go to bankruptcy. We see this even today. Holland has 1/3 of Turkey's size and yet agriculture production surpasses that of Turkey by tenfold and it's because AI and robotic technologies. And we (*Turkey*) import basic agriculture products from Canada, Mexico, and the Netherlands. But Turkey originally was an agriculture country but out competitiveness decreased and we started to import everything, basic products especially. We should implement AI and robotic technologies into our production process."*

(E.C.)

4.2 IMPACT ON EMPLOYMENT

One of the most discussed topics on the impacts of AI is as mentioned before the impact on employment. There is a very big debate on how AI will affect the labor market in the future. As stated in the literature review, there are various opinions on this subject. Drawing conclusions from the past, the technological advancements always rendered occupations obsolete but also created many others that did not exist at that point. Both the interviewees were asked if they believe AI will cause massive unemployment. Mr. Sahin clearly stated that he doesn't agree with this belief. Instead he corroborates with the aforementioned belief that AI will create more occupations than it destroys. Specifically Mr. Sahin responded:

'I don't agree with that because yes, AI so many jobs will be taken by machines and computers but on the other hand there are so many new jobs that we will have. The problem is the new jobs will need more education. Normally today people that are educated by high schools can find a job but in 20 years we will need more educated people more doctors for example, because most basic jobs will be taken by AI or machines. The problem is that education system has to change

47

drastically in 10-15 years. I see only problem about this situation is education. If education system is ready, if we educate more people about STEM we will have benefits from this situation. We need more people that know algorithms, machine learning, organ design, human body design, deep learning and general people that will work in computer industry.'

<div align="right">(M.S.)</div>

Mr. Sahin points out a potential challenge for the future, which is education. While he believes that AI will create many new opportunities for new occupations in the future it is evident that in order to be able to experience the benefits of this drastic change people should be educated more. The skill sets of people need to be changed to adapt to the coming future. For Mr. Sahin those skills fall under the umbrella of STEM education. So, technical education is going to play an important role in the future. Dr. Aykut also believes that AI will have a "creative destruction" effect on the labor market. Again, he draws conclusions from the previous industrial revolutions. He points out the initial panic and resistance of the workers to adapt to the new reality. But collectively machines brought abundance and mass production, paragons that were beneficial for everyone.

'Yes and no. Again, this is why I underlined three different industrial revolutions that have happened before the fourth one. If we go back to 18th century the steam engine appeared the first in England they used it not only for locomotives but also the textiles production. There was a big change in the industry so the workers didn't accept it easily; even they tried to stop those machines working with steam engines. They were wearing sabos, footwear made from wood. They were putting their sabos among the gears, to stop them, to break. That is the roots of the word sabotage. They had a great fear they were losing their jobs. What happened then? Everything was better that before. New jobs, new professions, more textile and haute couture. Change to the mass production. Today we are not going to a tailor. We are going to a shop. There was a great abundance so more factories more workers. The same happened with electricity. So they were selling candles and oil for candles. The oil was not chemical it was biological. They were hunting whales and they were using the fat of whales for candles. So, all those people, earning their money from that industry, were in a panic. But it was a great opportunity for everyone, for new kinds of jobs. They were

producing automobiles by hand. One by one. So, automotive industry employed so many people. Now they automatically do the same job. It is automated. But even though, they had more jobs and versatility of the jobs increased.

(M.A.)

Dr. Aykut states that AI will definitely take some of our jobs in the future. It is unavoidable for some. His answers bellow is, in my opinion, the single most important aspect of this debate. Dr. Aykut poses two important questions "How?" and "Why?". If an occupation answers to the question how, then it will be obsolete. "How" refers to how it is done. If the process of a job can be explained and defined with "How?" then it can be substituted by a machine. This is of course related to high routine-low skill occupations. He offers the example of pharmacies. If the pharmacy's only function is to sell to the clients the medicine they are prescribed by their doctors then this process can be substitute it by a machine; just like an ATM for medicines. In particular:

"Always these kinds of revolutions are creating more opportunities and possibilities for the people. So, people have some fears, that is normal. At the university where I am giving lectures, I am talking about this kind of novelties. Last time I distributed a question for a questionnaire "what is the most scaring technology in the future for you" I asked 19 years old kids, first years. 88% said that AI will take over our jobs. That is true. Unfortunately it's true. But if you do the same thing you do today in the future, your occupation will be more defined. For instance for pharmacy, even in Greece Germany or turkey you are bringing the receipt, put it on the table the pharmacist is reading it and saying yes we have or not. If it exists, they get the bottle and putting on the desk, getting your money and giving you the rest. That's it. It is the answer of a question "how". If your occupation is just replying for a question which is how? Then it will be done by a robot and AI. You should fear; it is scary." But if your occupation can be described by answering for a question which is why not how, don't fear. You can think about in the future all pharmacists will disappear and everything will be automatic, yes! Do you know what an ATM is? You're putting you card you are getting your money, you will put your receipt and you will get your medicine.

(M.A)

Dr. Aykut continues that if an occupation answers to the question "why?" then this

cannot be easily imitated by a machine. "Why" creates value, "why" envelopes cause and effect, reason; and that cannot be easily substituted by a machine. Dr. Aykut of course is talking about "Polanyi's Paradox" in which humans know more than they can tell. So his view is that not only low routine-high skill occupations will persist in the future but they will be complemented by AI. Moreover medium skill occupations will become more defined in the future, they will evolve. He continues with the example of the pharmacy. In order to evolve from "how" to "why", a pharmacist's job will have to go from supplying the medicine to deciding on the dosage of precision medicine after following up on our individual measurements.

> *But is pharmacy only this? No, of course not, in the future. Because the precision medicine is coming, precision medicine is personalized treatments, personalized cure, who will do it? Doctors? No of course not. Because personalized means your medicine will be produced fitting to your need. The best fitting or combination of the contents of medicines will be defined person by person. So with some wearable equipment on your body or in your body the pharmacist will follow the results for the effect or the impact of the medicines on that person, if it's too high they will decrease if it's too low they will increase. Who will decide for this medicine? Again the doctors. But who will follow it up? Pharmacists. This is the answer to the question why. "Why are you increasing dosage? Because it's inadequate." So very shortly, it is very normal that people have fear that AI and robots will take over our jobs and we will be useless, for some of them it's true, but the majority will keep their occupation still but it will be more defined.*
>
> (M.A.)

On the other hand Dr. Civelek is completely pessimistic about the future of labor. While the previous interviewees both recognize the disruptive force AI is in the context of employment they both believe that AI will create more occupations than it destroys and moreover low routine-high skill occupations will retain their importance and AI will compliment their processes, Dr. Civelek believes automation will cause such erosion on labor that will renter people redundant. He warns that AI can take many forms and not all of them used for the betterment of mankind i.e. autonomous weapons. In particular:

> *"Technically General AI will not be able to completely substitute human labor. But there is not only general AI, there is machine learning, deep*

learning, those are very dangerous for humans. I am very pessimistic in the context of this issue. I think that AI is our last masterpiece. We cannot produce anything greater or more sophisticated after that, because AI can and will replace completely humans at some point and we will jump in another step of evolution, in the other side of evolution. We will create a more intelligent creature than us. It's very dangerous and especially the ethical side of AI. Some people, some scholars do not see this side, but there is an unethical side to AI , like autonomous weapons for example. Also another problem AI will continuously replace human power and at the end of the day humans will be redundant. And with redundancy our skill will perish. Humans will turn to aimless beings. Keynes's wrote an article regarding 'this issue, one hundred years before. According to the Keynesian approach we are living in the age of leisure. He also mentioned the abundance economy and leisure times but he stressed that it is a decease that will infect humans. Redundancy is decease, an infection for the humanity because humans will have no purpose"

(E.C.)

To sum up both Mr. Sahin and Dr. Aykut believe that while AI has the capacity to substitute for human labor it will also create new opportunities and occupations in the future. Existing jobs will have to evolve with the use of the new technology. AI will cause unemployment if we do not adapt to the new circumstances in the following year. Mr. Sahin highlights education as the number one factor of adaptation in this New Age. People will have to acquire technical skills to become more competitive. Dr Aykut on the other hand highlights meaning, the value of one's work contribution. Manual occupations will be the first to disappear, but those that are based on human's innate cognitive abilities will not be substituted so easily. Offering personalized services to the people will be an important theme in the future. AI will help to eliminate high routine processes and instead give humans the possibility to cater to more defined needs. In other words the optimistic scenario revolves around AI complementing the work of humans. However Dr. Civelek warn us that as we progress and in the end, there will be no need for human labor causing humans to become redundant in a world that automation produces everything. In this pessimistic scenario people will no longer have a purpose or aim in life and we will be doomed to idleness.

4.2.1 Policies to mitigate the effects

The next topic I discussed with the interviewees was about policies in order to mitigate the effects of massive unemployment and its subsequent inequality that can cause. Although in the previous topic, two of the respondents, Mr. Sahin and Dr. Aykut initially answered that AI will not cause massive unemployment and both believed that AI will create more jobs than it destroys, it became apparent through the course of the discussion that in order for this to happen certain conditions have to exist. That means that if things remain unchanged humanity will be looking at an outcome that will have a finality it is going to be beyond our level of comprehension. Dr. Civelek however categorically believed that AI and extensive automation would be the end of human labor. The interviewees were initially asked what can be done to mitigate the effects of AI on unemployment and inequality. This question was then divided into three themes. The first one was about government policy; what should governments do to protect the workforce. The second was about the change in education and which the ideal skill-set of the future is; as it became apparent from Mr. Sahin and Dr. Aykut that education will play an important role. Bellow, are their responses:

> *'Governments always try to protect human labor on the other hand if there is an election every five years the government and parties the politicians promote this kind of things but it is not sustainable. If a company will find a solution with an AI system or any solution companies will prefer to work with a machine.'*
>
> (M.S.)

Mr. Sahin is not confident on the power of the governments to regulate AI in the context of employment. He was asked whether taxation on the companies that do not employ humans will deter these companies from utilizing exclusively AI and he believes that it will always be preferable to work with a machine so any kind of determent or incentive in contrast will not have any effect. However he continued:

> *"But on the other hand every company needs some technical people in their teams. Today traditional companies doesn't need engineers, software engineers, computer engineers but in 10 years all the businesses will be computerized and that means all the companies will*

need computer engineers like they need accountants and sales peoples. Computer engineers will be a traditional team member of any company. If you look at the last 20 years only companies that produce something technical, need computer engineers or software designers but in 10-15 years all kinds of companies will need them."

<div align="right">(M.S.)</div>

Mr. Sahin stressed again the importance of education. Indeed, in the past companies that were not on the technical industries did not utilize that much technical stuff. However, already now but more importantly in the future, technical people are becoming assets. This is the effect of digitization and the 4IR.

Mr. Aykut also agrees partly with Mr. Sahin on this subject. At first he acknowledges that there are certain policies as example today. He mentions UBI which stands for Universal Basic Income. The concept is that every citizen in a country will take a minimum wage that is universal for everyone regardless of socio-economic background. This might be an emergency measure in a future where the population is afflicted by permanent unemployment; it is merely a measure to mitigate inequality and doesn't guarantee employment. Dr. Aykut also agrees that any company that relies on manual labor will prefer AI over humans. However, in contrast with Mr. Sahin, he believes that social and emotionally intelligent skills will be more valuable in the future.

"There are some examples in the world. But, different programs, one of them is UBI. So if you lose your jobs because it's very physical, you are using the power of your arm, definitely you will lose your job. Because the machines will do it better than you, cheaper than you not asking for income or insurance, so they are preferable. But for instance soft skills will be more important than today, relations, respect, and understanding, listening to others, sharing and teamwork."

<div align="right">(M.A.)</div>

Furthermore Dr. Aykut also shows little to none confidence in the ability of the governments to create policies for the future. That is mainly because bureaucracy is a very slow moving mechanism that cannot catch up with the racing technological

advancements. It becomes apparent that the reaction time of each government will be important in the future. This will be the determining factor of who will be the leader and who the follower in the future.

> *"The industry is moving very rapidly. In 2020 or '21 we will be able to see quantum computers. This means a 100 million times more processing power. So nobody knows what kind of probabilities they will have and what kind of problem they will solve. To get ready for this kind of reality, it's not so easy because the public policy of governments is very slow. There are legislation laws, agreements, regulations treaties a lot of red tapes. It is not possible to change from today to tomorrow. They will always follow it from behind. But some of them will be quicker and the gap will be less than the others. So the governments they see the danger, a big portion of people will be useless if they don't adapt them to the 4ir. So they are trying to make them ready with education with salaries, with new types of jobs and similar programs."*
>
> (M.A)

However Dr. Aykut raises a very good point. If a country starts preparing early for the future, through policies which help the middle class grow, regulations that protect human employment, laws which protect its citizens from inequality, this country will become a very attractive place for citizens of other countries that do not offer these kind of social perks. Massive immigration will occur. This is why Dr. Aykut stresses that whatever measure and policy will be decided as best in the future will need to apply globally, otherwise we will end up with a world that does not move with the same speed into the future. A consensus must be reached between all the countries in the world; otherwise no measure will work eventually. We need to understand that we are not alone in this. A global authority that precedes over the matters of technological advancements needs to be created. Dr. Aykut believes that while this is a necessary step but a very difficult one because conflict and antagonism draw more people in than synergy.

> *"But there is no consensus across the world. We need a consensus to do these kinds of thing. If one those countries is proceeding further and quicker than the other ones it will be very attractive for the other countries people. So people will try to move to this country they will try everything to be part of that society, because they will feel safe. This is*

54

another danger. Unfortunately the governments are talking a lot but are not doing enough. Even the Scandinavian countries they are not ready. The change in the industry is quicker than their movement. They are not able to do because they are alone. So it should be a consensus among all the countries. There is no such an institution or an organization deciding for that, neither in the UN nor in UNESCO. That is the reason why they do not prefer to have cooperation; they prefer a competition, even the trade wars. If you are ahead of me I will kill you. It is a very primitive instinct. This is not the salvation of the world."

(M.A.)

Lastly Mr. Sahin also believes that life-long learning will be the norm for the future and with that our life cycle will be changed. Indeed while now we are living a very linear, a very tactical life with little deviation from the beaten path, in the future life is going to be a never ending race to knowledge. Circumstances will require people to be constantly ahead of the curve if they want to be competitive and employable.

Life-long retraining programs will be of much importance. If you look at the past, we have been educated ten fifteen or twenty years from the age of six to twenty-five and then earning our livelihood for the next forty-fifty years but today all our lives are changed . People studying at 6 till the end of their lives. All the things, all the methods all the algorithms are changing drastically and because of that we need to study for the remainder of our lives.

(M.S.)

As it is observed from the first two respondents, they hold little to no confidence that governments are able to follow the rapid advancements of the technology and therefore any policies that they will try to implement will be overdue. Moreover the fact that there is no consensus in policies on a global level makes it very hard for governments to implement mitigating measures. Furthermore a shift in education will be of outmost importance in the future, according to Mr. Sahin and Dr. Aykut. Education models needs to change to facilitate the creation of the Worker of Tomorrow. Also this process will need to last a lifetime in order for humans to be able to enter the workforce in

different times of their lives due to skill based unemployment. Interestingly enough, Dr. Civelek does not believe we should invest in trying to make people employable for example through Education, it is a futile endeavor. Instead governments ought to implement a UBI for each citizen as a measure against income inequality. However he too recognizes as Dr. Aykut that such policies that create a good social welfare system for a country's citizens might make said country a target for massive immigration.

> *"According to my point of view we should not try to find jobs for the humans in the future, we will not need human power. The need for human power will decrease. Therefore government should not try to find jobs for redundant people, neither try to make them employable. It is useless and time and resources consuming endeavor. Instead of this they (*Governments) *may pay UBI which is Universal Basic Income and people will stay at home. Therefore in some countries government pay more money to the people while some rare skillful people will continue to work. This is the only solution according to me. Because of this of course immigration will be a big problem."*

> (E.C.)

It is apparent that Dr. Civelek does not believe that there is not a solution for the future massive unemployment but there is a solution for income inequality and that is UBI. In order for the people to feel the effects of the "trickle down economy" there should be abundance and economy growth. In the previous section about the economic growth, Dr. Civelek expressed his skepticism about the optimistic scenarios that exist. Regardless, he too believes economies can achieve abundance if governments implement the following five steps.

> *"In my article written on 2018 I suggested five mitigating measures against the rise of AI. First one government should invest in logistic infrastructure and increase the efficiency of the logistic ecosystem. Secondly investments should be made to nuclear energy and renewable energies in order to provide the energy to the production companies freely. Also third, governments should fund and attract investments with regards to AI, because AI will maximize efficiency in production processes. The fourth measure is that capital should be minimized as production factor; this will help relief the profit pressure on products.*

And finally the fifth, which is the measure the government, has to take to bridge the gap in economical divide like UBI as I mentioned."

<div align="right">(E.C.)</div>

Unlike the previous interviewees, Dr. Civelek does not express his lack of confidence in the abilities of the governments to implement measures and policies in order to fight the adverse effects of AI. The goal of his five step plan is to mitigate social unrest that will result from inevitable income inequality. Giving the tools to companies to boost their production, maximize efficiency and productivity will result to economic growth and in turn governments will have the resources to built better social welfare system for the citizens. Moreover Dr. Civelek also believes that the current economic systems are not sustainable in the long run and warns against spasmodic and short-lived measures like issuing fiat money. Specifically he mentions:

> *"But countries cannot continue with the existing system, completely capitalistic economic models will collapse and also monetary systems. First unemployment will rise, yet efficiency will rise, production will increase but purchasing power will decrease and at the end of the day, government will try to issue money, fiat money, without any equity and inject the economy in order to create growth. But this is not sustainable solution. Also since 2018 crisis American Federal Reserve Bank has continuously issued money and injected the economy and also other countries. There is lots of money in the economy right now but with nothing to back this up like gold etc. Third problem is trade wars that are triggered by President Trump. Countries cannot continue with this economic model, they must move to another system that depends exclusively on production. Like the Middle Ages , people produced things and gave a share of their production to the government and money were redundant, money were only used in government transactions but regular people produced and traded with products. And now we go again back to production and we have to produce with zero marginal cost with decreased energy costs, decreased taxes, decreased logistic costs. Government should not impose taxes on production. We should move to a global sharing economy model."*

<div align="right">(E.C.)</div>

Dr. Civelek believes a sustainable economic model for the future will be the sharing economy since production can be virtually unlimited. Trading products with products was a system utilized in the Middle Ages when money was not widely circulated between the population. This will prevent the existence of currencies not backed up by physical assets thus leading to inflation.

The third question of this topic derived from a personal hypothesis. In the literature review it was mentioned that a possible measure for the future will be lowering the working hours, thus creating extended leisure. People will have an awful lot of time in their hands and a declining personal contribution to society in terms of labor. My hypothesis revolves around volunteering. What if people, through the right incentives, found new meaning in volunteering or simply being in their best behavior? So I asked the interviewees if the Social Credit Score system that China already enforces or some form of it, would give the incentive to people to start contributing in other ways to the society. Their opinions differ. Mr Sahin initially criticizes the system as being against personal freedom but a necessary feature for the future. However he doesn't believe leisure will condemn us to inertia as we will have more time to pursue our interests.

> *Yes, the credit score is not good for people. I believe it creates competition everywhere even in neighborhoods, in order to buy something, go somewhere or travel somewhere. It's kind of against freedom at the beginning, but in the end it will be a necessary feature. On the other hand we need to change our behavior regarding working hours yeah i believe the working hours will be six or five hours per day, but it will affect so many businesses, if we work five hours per day that means we will have more time, we will go to school, we will get extra training, new skills and also travel more. On the other hand it will affect behavior at work. Nowadays most of the people physically go to the offices every day, this will also change. We will work from whenever we are. Maybe one time we will work three months from Greece, then Istanbul maybe then six months from Mexico.*

(M.S.)

Dr. Aykut is totally against the use of this system. He condemns it for limiting personal freedom and believes people will not accept it because AI will outline a version of our

individual character that might not exist.

> *"Social credit score is a disaster. Because, for social credits, Chinese government is using AI. I am sure people will resist being defined by the machines and having bias about their personalities, their characteristics, skills, capabilities, their weaknesses and strength .they will not accept that. Today it is a model in china. They are not doing anything but they are unhappy. If it spreads out across the world they will be protest and they will stop it."*
>
> (M.A.)

> *"This social credit system means extinction of privacy and this means extinction of being human anymore. You will turn completely into a robot. Government will control all of your activities, all of the aspects of your life and according to your score they will give you food and then you will continue to collect credits. If you don't have enough credits, it's game over. This is not a life. This is dystopia. It's very dangerous. Privacy is already removed today through smartphones, our digital presence but social credit system goes beyond horrible."*
>
> (E.C.)

Dr. Civelek also agrees with Dr. Aykut that this system will be the end of privacy and personal freedom. Social control will maximize on citizens and being unable to collect scores will deprive citizens of basic necessities.

4.3 FORMS OF FUTURE INEQUALITY

The next subject was about inequality. I asked the respondents which forms inequality might take in the future. In the previous section the interviewees indirectly were asked about ways to mitigate the effects of the subsequent income inequality. In this section they were asked directly to identify in which forms inequality might manifest in the future. Mr. Sahin doesn't believe income inequality will occur if we are prepared for it. In his opinion if we are prepared to adapt and to utilize all the benefits of AI, people will experience the effects of the "trickle down" economy. That means that we will have a rising economic growth, more production, more supply, and more financial benefits for the people. But in the end it all ends up on preparedness.

"I don't believe AI will increase inequality. Most of the research shows that with AI global economy will rise, it will be bigger. That means people will have more products to buy, more to sell. But yes there could be a problem , it's not going to be an equal life especially at the beginning because some of the countries, some of the companies, some of the people are not ready for this kind of future but with a good strategy, if the people will be ready there will be less unemployment and thus less inequality. 80 % of the population is not ready for this challenge. But some countries especially Northern European countries they are preparing themselves for this kind of future. And also China."

(M.S.)

Dr. Aykut identifies inequality between those with access to AI and those without. Essentially it will start as a power struggle between countries of the first world. Having access to AI will give immense power both to nations and individuals. Those who will be left outside of this technology race, risk being left behind or even go extinct.

"Yeah inequality is the most significant issue for humanity. I believe its going to be a disaster for humanity. Maybe humanity will be besieged from this fact. Human beings are very selfish and this generation in particular and subconscious they have fears they don't know about. That is the main reason there is a fight between China and the US, because they see each other and they know who can the best AI before the other one. They don't want the other to have a better AI before them. Not only to have a better AI, they don't want the other to have any AI. But later something will happen, some countries will have this technology and they will not allow the other ones to have. If you don't have this technology in the future you will be useless. You will live like in Stone Age. You will do nothing. Whatever you do will be worthless. You will try to produce something; it will be very expensive, very slow and in limited number in quantity. You will not be able to sell it. So you will stop. Whatever you try to do, you will meet the same reality as a very wild shock. So some, I am sure first Africa, some countries in Asia, even some in Europe and Latin America; their societies might go extinct. And that applies to individuals as well, not only on international level. I am talking about access to AI and also human augmentation.

(M.A.)

Mr Sahin corroborates the opinion of Dr. Aykut by saying that the access to technology will be available to those who can afford. Much like the struggle between the nations and the eventuality of the gap between the developed countries and the underdeveloped in terms of AI, the gap between those with access to the technology and those with no and in extension between augmented humans and non-augmented will increase.

> *Yes i think we are the end of human 1.0. This will be the last generation of 1.0. In 20-25 years humanity will split into biological and non-biological humanity. Because most of the people who afford it, they will have some chips or extra processors inside their bodies that means there will be a new future for humanity I think.*
>
> (M.S)

As mentioned in a previous section Dr. Civelek believes that unemployment will reach unprecedented levels worldwide therefore income inequality will be guaranteed in his opinion. But according to him the most important aspect of inequality will be that of ontological inequality or else "The Biological Divide". He corroborates what Dr. Mustafa Aykut and Mr. Sahin already mentioned previously. For him the general Divide is a consecutive process that started with the inability to access technology, called the Digital Divide. This inability robs individuals of the opportunity for financial growth, hence leading to the Economical Divide. And in the end those who can't afford access to the advancements of nanotechnology, genetics and implantable technologies will not be able to live longer or potentially augment their bodies in order to compete with the machines.

> *"I already mentioned that with the increase in unemployment, purchasing power will decrease. Therefore we will experience massive income inequality in the future I believe. But more importantly there is another phenomenon; in my book "Internet Age Dynamics" I call it the biological divide. In this book I define this problem, this is a consecutive process. Firstly it start with digital divide; inequality in reaching the technology. Digital divide leads to economical divide, economical inequalities; if you experience income inequality you cannot reach longevity and augmentation. Ray Kurzweil mentions Singularity and some scholars think that he exaggerates and most he depicts a very*

dystopic future but at I agree with some of the views he holds."

<div align="right">(E.C.)</div>

4.4 ETHICAL IMPLICATIONS

In this section the interviewees were asked about the ethical implications of AI and the challenges AI Ethics will pose in the future. As mentioned before the ethics of AI is the most elusive concept in AI's research partly because it is hard to reach a consensus on morality and ethics and how to infuse those concepts in an intelligent machine.

Dr. Aykut presents the ethical problem in a very comprehensive way. In particular he states that AI will inherit its ethics by its creator. What is unethical for one society might be ethical for another and AI will be a reflection of these ethics upon its creation. This fact can create a lot of problems in the future. As Dr. Aykut mentioned industrial spying through smart robots might be something acceptable or fair play for China (as long as it is not done to them) but some companies, people or even countries will be victims of this behavior of AI and might even constitute casus belli.

> *"This is of very importance. Morality is individual but Ethics is for society. An average of moralities in a society is ethics. In ethics there is also tolerance up to a point. This society draws the line here; in another the line is shorter. It depends. For instance, in Arab Countries the understanding of ethics is different than in the European countries. If you live with four wives in Europe, it is not very ethical. It is very strange and unethical. But in Arab countries it is ethical. But AI will not have its own ethics or moral. Human beings will define ethics for them. It depends. On who? On the decision maker, the one who will be the producer of AI. Today the most advanced AI is being produced in China. That means China is defining the ethics of AI. That is the reason why the US is claiming that is not ethical. "You are putting AI chips in the machines and you sell them to Amazon, Google, Facebook, you are collecting the information from those companies, you are making data analytics in your country and getting in a comparative advantage" Yes, for the US this is unethical, but China is doing that. So it is going to be a big problem for the future. There will be no consensus for ethics of AI. It is maybe human beings much much easier than AI's ethics. There 193 countries all over the world registered at the UN. There is a consensus for human beings all over the world and societal ethics. For AI there is not. For instance corruption, bribery, theft, humans have consensus. But*

for AI it is a big risk. And AI will be invisible; we will not understand if it is doing something unethical."

<div align="right">

(M.A.)

</div>

Dr. Civelek also agreed with Dr. Aykut that AI will inherit the traits and ethics of its creators and so it is in our power and will to form either a beneficial AI or an AI that will prove our enemy. However through his example it is evident that he believes that AI will fairer in its decisions because emotions or self-ambition will not cloud its decision that will be based on facts.

"I think humans are already not ethical. I think machines will be more ethical that us if we want them to be. Another point is that if you right an algorithm, in a ethical way, a machine will behave in an ethical way. I want to ask you something, do you prefer a human as your manager? Self-interest people as manager? Or a machine that makes decision based on determined criteria? Perhaps most people will prefer a machine manager in the future. I frequently ask people this question and so far everyone would choose a machine."

<div align="right">

(E.C.)

</div>

Privacy and machine bias is also a very important topic. We already have issues with our personal information used irresponsibly by third parties and even worse used for nefarious reasons by bad actors. Digitization and constant connectivity has made most of the population gradually sharing more and more about themselves and every aspect of their lives. Dr. Aykut believes that AI will pick up on our digital footprint and it will create a profile for each one of us. Sometimes it will infer more things about ourselves than we care to admit or even subconsciously we do not understand. This is a problem not only for privacy but also machine-bias. Who can correct AI if it is wrong about you? There are no mechanisms to control this information and stop them from leaking to unwanted parties.

"Do you remember Cambridge Analytica? They were claiming something; give me 65 messages, whatever it is email, Messenger whatever it is. I will define your fears. You know who you are but you don't know about your fears. They are subconscious. You are not aware of them. You can define yourself but you can't define your fears. And

that has been analyzed from Cambridge Analytica. That means there is a big risk for machine bias. Investigating your message footprint the machine will decide who you are and it will share this information with some institutions, government, security, with school, doctor and with many different parties. Who will check this result that you are absolutely that person, or if there is a mistake? if you are not? There are not such mechanisms. So machine bias will create big problem in the future."

(M.A.)

Mr. Sahin is very pessimistic on that account. Privacy will not be a problem in the context of AI because there is no privacy to speak of already. He used a very important phrase "we give up on privacy". This is a very crucial remark. We, as humans, have traded off privacy with convenience. In particular:

I believe there is no privacy anymore. We are leaving our digital footprint everywhere. If we are using an ATM, if we are using GSM, if we are using any kind of loyalty cards to collect miles from Turkish airlines, we give up on privacy. Today banks already know that a couple will divorce in 18 months, they know before they divorce, because they are looking the behaviors, the credit card payments, expenditures and everything and they can assume that this couple will divorce. I don't believe there is privacy anymore.

(M.S.)

In regards to machine-bias Mr. Sahin is very realistic. Indeed, researchers believe that since the world we live in is flawed, how can we expect AI to be fair when the data sets that will be used to train algorithms are innately flawed and biased? In the literature review the example of Amazon and its biased hiring process was explained. But overall Mr. Sahin believes life with AI will be safer and more transparent. Humanity, through AI, will gain foresight on possible dangers and will have time to react. In particular he states :

"Today is the world fair? i don't believe life is fair. It won't be fair in the future. It is against life. But on the other hand the problem is the regulation is not fast as technological improvement. In the past years technologic improvements were kind of slow if you compare it with today

and the regulation could reach them in the end. But today regulation cannot keep up with the technological advancements and that means I believe there won't be a fair situation for humanity. But life will be safer with AI. Thanks to AI we will have information on what will happen, what kind of dangers or possibilities exist in front of us. Life on earth will be safer. Life will be more transparent."

<div align="right">(M.S.)</div>

Regardless of machine-bias, as well as Dr. Civelek stated before, Mr. Sahin believes that a machine will be fairer in its decisions than a human. Humans are also highly subjective on their decisions when feelings are involved and this can lead to misguided and faulty decisions. Machines base their decisions on hard data. And whether or not a decision is well liked it is irrelevant if it is fair and based on facts.

"I will give an example from the work place. Today most of our complaints especially for business people comes in relation to our manager , coworkers, our colleagues and most of them are due to feelings, they all make decisions based on their feelings, they like someone, they love someone etc. if some decisions are made from AI they will be more fair decisions because AI will only look numbers productivity and results. And I believe that because of our behavior and actions we are doing so many mistakes and this will be less in the future."

<div align="right">(M.S.)</div>

Another issue that both the interviewees feel positive about is transparency. Dr. Aykut believes that through AI we will be able to monitor bad actors more easily. We will have to be able to see the signs of unethical behavior and AI will offer the tools for that to happen. He specifically believes that monitoring unethical behavior will be a valid occupation in the future.

"But-on the other hand everything is not very bad. There are some good things as well. If something happens which is unethical and people catch it and it is something that in not unknown but common knowledge, there is not chance to survive. One of them as an example is Cambridge Analytica. Today they don't exist. They shut down, disappeared. But do you think that there is only one company in the world like Cambridge Analytica? There maybe thousands, hundreds of thousands. That will be

another business, to catch them, to hunt those companies in the future.”

(M.A)

All in all the ethical implications of AI will be become a huge challenge in the future. As all technological advancements, AI too can be used either for our benefit or become a tool for our downfall. AI is innately neither good nor bad. It is in our power and choice to create a friendly AI, one that will help ascent mankind to a purer state of being.

4.5 IMPACT ON RELIGION

In the world we live today religious tensions still exist, in fact they are getting more intense in recent years. It is 2019 and we have yet to put our differences aside. It poses a valid question, if AI challenges in any way what we as individuals or, collectively, as a society believe in, will this fact reignite possible religious tensions? Mr. Sahin believes this is a viable scenario. The solution he presents is reformation of religion. As all aspects of society will evolve and adapt around AI, religion and its teachings will have to adapt to the new circumstances as well.

> *"I believe the religion issues needs to be changed. Like all the other technological issues there should be a drastic change because all the technological improvements are helping people to create new life forms and everyday humanity is closer to immortality. And we think we are close to immortality that means we are kind of Gods. That means there should be a new challenge on this issue in order to not be hard regional activities in the future. It is not easy, maybe it takes 50 years but I think religion should change also. Religious behavior should change. Religious reformation will solve this issue."*
>
> (M.S.)

While Dr. Civelek disagrees that A.I. will have a direct impact on religion and its functions for humans, he too as Mr. Sahin recognizes that the strife will be a consequence of our future longevity, body augmentation and a global biological divide. While Mr. Sahin believes that a reformation will be necessary, Dr. Civelek is more

radical in his opinion as he believes current religions will stop existing or new ones will be created.

> *"I don't think machines will create a problem for religion in the future. Religion is a function for human brains; it comes from our evolutionary process. The Invention of the religion was about banding together and we created fictions and we believed them, created followers and spread. This is related to the leadership process of the human being. Other creatures, animals don't have any religion. We have set up big groups from smaller social ones. Machines cannot interfere with this process. I think that AI and religion are not closely related, I don't believe AI will have a direct negative impact to religion. However AI in the future will be closely related with longevity and biological divide and those will be problems for religion. If some people start to live longer than other people, some religion could collapse completely. Originally no one wants to die for the sake of a religion. Most religious behaviors of the humans depend upon the social control mechanism. Maybe in the future new religions will pop up. No one knows."*

<div align="right">(E.C.)</div>

Dr. Aykut believes that AI will be beneficial for religion. He too, as Mr. Sahin, agrees that an evolution is necessary but it will rather come from religious institutions instead of religions itself. In the era of extensive digitization all the religious knowledge will be Available to AI which will substitute for clerics and it will offer a personalized experience for every individual seeking advice through his/her religion.

> *People whatever they believe in, God Buddha or even atheists, they believe somewhere, in reality, the truth, science etc. no one will say I have no idea. Everyone has some idea. So they need a belief, to feel comfortable to feel safe and hopeful. Life is not consisting only of destiny and the things that affect you in a good way or bad way. You need hope. Today there are clergymen preaching about religion and about right and wrong. They are deciding and they tell you. They are getting this information from the books, from history, the early learnings. And this is knowledge. AI is based on knowledge. So if it knows you and if it knows your problem and needs, AI will reply in the best way to make you feel comfortable, relaxed in the context of each religion without exceeding its limits. It will be very helpful. So you will turn on your AI and ask about your belief and hopes, what to do, you will be able to get an advice and act on it or not. You are flexible. But instead of a human being, a virtual*

clergyman will appear as AI. And it is going to be very very useful. The quality will increase. They will be virtual, but more efficient, more reasonable, more transparent and not having bad results. Because a human will know you very limited, AI will know you better than yourself. So for religion it is going to be good.

(M.A.)

Dr. Aykut believes that AI will minimize the risks of wrong interpretations of religious texts and more importantly it will be reasonable. This will indeed prove very beneficial for mitigating the effects of future religious clashes.

4.6 OVERDEPENDENCE TO AI

For that topic interviewees were asked whether AI will render us depended on it leading to the loss of the ability to think for ourselves and loss of our skills and talents. In this case the respondents gave two different opinions. While Mr. Sahin agrees that this is indeed a valid point, he views it as a fair trade off. The convenience and the spare time AI will give us when it will fulfill daily menial tasks in our stead, will allow us to do more meaningful things. In particular:

Today we are getting help from navigation systems, we are getting help from personal assistants like Alexa, and yeah we can say we are losing some of our abilities, some of ours skills. But on the other hand there is a benefit also inside this relationship. While traveling somewhere, from office to home, if there is an autonomous car, I can read something; I can learn something during this time. For example for this conversation, I am sitting in my office and I am talking to you. If I have an autonomous car, during this interview, I can go somewhere from point A to point B. Overdependence will not be a problem from my point of view.

(M.S.)

On the other hand Dr. Aykut reveals a personal experience with the already occurring dependence. He explains that his son resides in a smart house that is connected to a smart assistant. That allows him to control some aspects of his house through voice commands even if the physical action in order to do this task might take minimum effort. He goes on to explain that it is not just for the sake of convenience, it feels like a

game. It is the gratification of knowing that something else is doing a task instead of you.

> *"This is a big danger for youth. I have two kids and they live in New York and they are both using Amazon's Echo and Alexa. Especially my son has changed many instruments in his flat, the outlets, the oven, the lamps, door locks, TV etc. everything is connected to Alexa. And he is communicating with Alexa for example he is saying "Alexa, turn on the TV, I want to watch CBS" or " Alexa, I want to order toilet paper" etc. Why is he not doing it physically? He is just sitting across the TV, he has the remote controller he can do it himself by just pushing the button. He is depended, an addict. He loves it, he is happy to do that. If we are sitting together he is using Siri and Alexa more than communicating with me. This is absolutely dependence. Why this happens? It is very joyful, like an entertainment, like gaming. So if the abilities of AI expand year by year, not only for this simple activities, but also doing the business for itself, cooking, deliveries etc dependency will increase too."*
>
> (M.A.)

In the end Dr. Aykut also raises a very good point; the capabilities of intelligent agents are not so expanded and yet he already witnesses the dependence on them. If in the future these capabilities expand are we doomed to inertia? Both opinions are sides of the same coin and the common factor between them is convenience. Either we will put the spare time into good use or we will become sloths. Dr. Civelek also corroborates Dr. Aykut's view. He firmly believes that we will become overly depended on AI and that will cost us talents and skill we have been using until now. Aimlessness and convenience will lead us to inertia.

> *"Human skills will surely perish because of AI, because of the machines; people will turn to aimless being as I said before. These systems will also turn us into machines; our behavior will be machine-like. I categorically believe that."*
>
> (E.C.)

4.7 HUMAN INTERACTION

For this topic the interviewees were asked if AI will cause erosion in the already

declining human interaction. Again they disagreed. Mr. Sahin believes that the notion that we, as humans, drift away from each other gradually while immersing ourselves in a virtual social life stems from people of older generations that cannot comprehend today's social interactions. Our interaction today might be digital, but it is interaction nonetheless. In fact our generation might even have a larger social circle than our parents.

He believes that what we consider normal about relationships will also change like every other aspect of society. Things that were considered taboo in the past now constitute normality and in the future it won't be rare for people to have relationships with intelligent robots.

> *"Yes there is declining human interaction in some ways because most of the critique comes from old behavior. Our fathers say yeah, they were more interactive with their friends, their neighbors, but on the other hand most of the young people have more friends on social media. They are communicating with more friends from social media. People aged 60-65 have no idea about their preliminary school friends. But people today they know what they are doing. That is why there is more interaction with other people because of the technology I believe. In the future I believe people will also have relationships with robots. There are some changes also, if you look at 50 years before, people could not accept marriage between muslims and christians, they couldn't accept same sex marriage. In 50 years time people will be able to say they are married to their robots and who they love."*

<div align="right">(M.S.)</div>

On the other hand Dr. Aykut believes that human interaction will decline even further than it is today. In the previous section on dependence he mentioned that even in his presence his son will communicate more with his assistants Siri and Alexa than he would have with his father. And that applies to a large portion of the population.

> *"Especially for developed countries, this is very typical. You see a family in the restaurant, parents and two kids, sitting around a table eating and everyone has a handset in their hands and they are in social media or taking pictures. They are not communicating with each other anymore. I offered the same example before with my kids. Loneliness is getting more problematic day by day. They are living within an artificial world.*

Communication is not physical anymore it's digital."

<div align="right">(M.A.)</div>

Dr. Civelek recognizes that there are signs today that show erosion in human interaction. He too believes that the model of communication has shifted from physical to the digital sphere. However he stresses that even though we have indications on what might happen in the future, nobody really can answer what will actually happen. There is a strong possibility that we will continue on this course, but humans may also balance or even reverse to a more physical interaction as well.

"Face to face communication will continue to decline. People already use digital communication more than physical communication. You know number of people living single has increased globally. This is an indication. In Japan we already witness people getting married to computer systems, some robots. Maybe in the future people will not need face to face interaction. Nobody knows how this will turn out. Maybe people will completely reject all of that and return to more traditional means of communication up until a certain point."

<div align="right">(E.C.)</div>

Still the evidence on that subject is inconclusive. While the respondents disagree on the topic, in the end both of them are claiming the same thing. Communication has changed, from physical to virtual and will continue to change when AI will have more abilities; if this is a good or bad thing is depended on our subjective point of view.

4.8 A.I. AND DEMOCRACY

As it was presented in the literature review some researchers believe that AI will be a threat to Democracy. Already AI was used to influence the Brexit referendum by targeting people that were previously identified as "persuadable" with "fake news" ads on Facebook , tipping the scale towards the "Leave" vote. Mr. Sahin and Dr. Aykut disagreed that AI will be a threat to Democracy in the future but each of them had a different perspective as to why. On the other hand Dr. Civelek, while he acknowledges the positive scenario, stresses that he feels very pessimistic for the future. Mr. Sahin

believes that AI will help transform political system from the root. Democracy will be more direct in the future, as AI will monitor our opinions, suggestion and perspectives on various subjects that will concern the public opinion at any given time. Moreover Mr. Sahin believes that the political scene of the future will not include human politicians, only people that will formulate policies, laws and regulation using AI as their tool. In that way bribery, foul play during elections and generally meddling in a bad way with democratic procedures will not occur if no one is sitting on a "chair".

> *"No, I believe the political systems have to be changed because of AI. Today we have twitter and other tools and we can declare our perspective every minute. The traditional system says we need to go to election every five years. I don't want to give my opinion every 5 years, I want to do that every minute. If AI is a part of our cities, part of our countries, part of our life it will collect data every minute, every second and it will help those who execute. I am not talking about leaders; I am talking about executive people (policymakers), that means we don't need presidents, chairmen, ministers. It will be a direct democracy. About the Facebook scandal, if there are human politicians it can happen again in the future. But democracy and countries, if they are operated by AI there won't be this kind of thing. If there won't be elections for a presidency, there won't be any cheating."*

> (M.S.)

Dr. Aykut also believes AI will not be a threat to Democracy. In contrast, just like the religion topic, he also believes it will be a good tool that will offer transparency in democratic procedures. In his opinion AI will assist us in making information for different events available to us and thus help us make more politically conscious decisions and also organize us better for the future.

> *"AI is not a threat to Democracy. Actually like religion, AI is a very good instrument for democracy. Not only AI but the 4IR completely will be a tool for democratization of production and distributing the products to people and transparency. This is very critical, transparency. Today there are many happenings that we don't know, we are not aware of the facts or the reasons. For example Arab Springs, look at the consequences. Many countries have been changed rapidly. In the future, it will be easier than today to understand the intentions of the rulers*

using AI, what are they actually trying to do. So that will create transparency, more political consciousness, more knowledge and more capability to be organized, to stop or to resist not only on national but also international level."

<div align="right">(M.A.)</div>

Dr. Civelek offers the most pessimistic outlook starting with the rhetoric question if there is actually Democracy today. While he mentions the optimistic view other scholars hold for the future, he expresses a very dark prediction for the humankind.

"I want to ask you a question. Do you believe we have democracy today, in any country? Elections perhaps will continue to exist but elections do not guarantee democracy. However in the future, when machines rise and humans become redundant maybe democracy will increase, because we will turn to sharing-economy and there will be abundance. According to optimistic scholars we will adopt a more democratic model, like sharing economy, individuals will share resources peer-to-peer, blockchain technology will help with that also and this will be another step towards democracy. You will have no need to trust third parties or central authorities. There is a major wave between scholars that support the rejection of central authorities and maybe this is a sign that we will have more democracy in the future because of AI and the technologies of the 4IR. But I don't agree with them. I think new species will arise in the future and I am expecting a big war in the world, a big challenge because of depleting resources, overpopulation etc. I don't see any good future."

<div align="right">(E.C.)</div>

Two out of three respondents' views on the subject were positive for the future. Mr. Sahin believes that a transformation of the political system will occur, one in which corruption will have no meaning and where citizens will be able to exercise their political rights every second of the day through online platforms. Dr. Aykut perception highlights transparency and better understanding of current events through AI, thus strengthening the institution of Democracy. Dr. Civelek acknowledges the predictions that through abundance, the sharing- economy and technological advancements like blockchain technologies true and direct Democracy will be achieved but he retains a

very pessimistic outlook that includes wars, depleting resources, overpopulation and general social unrest.

5. DISCUSSION AND CONCLUSION

For the purpose of this thesis, I have conducted intense desk research on the various forecasts and predictions that circulate among both academic and business circles alike. Three experts, Mr. Murat Sahin, Dr. Mustafa Aykut and Dr. Emre Civelek were interviewed on various subjects regarding the socioeconomic disruption of Artificial Intelligence. Through the interviews, the most important conclusion that can be derived is that there are many predictions on the subject of AI that hold distinctive differences between them. While the respondents seemed to agree on certain matters at points, most of the time they were expressing completely different approaches. Based on the four general categories regarding predictions on AI I characterize Mr. Sahin's approach as optimistic, Dr. Aykut's as pragmatistic leaning to optimistic and Dr. Civelek's as pessimistic.

Mr. Sahin and Dr. Aykut most optimistic forecast was naturally on Economic Growth. Although it is widely accepted that at this moment the global economy has not seen a rise in productivity, which is the most important index of economic growth, even with all the advancements of the 4IR, both the respondents were very optimistic for the future projections. Although Mr. Sahin acknowledges that today we have few and very limited examples of AI he believes that when AI will diffuse many opportunities for growth will arise. Dr. Aykut on the other hand draws conclusions from the past Industrial Revolutions. It is true that we owe our present abundance to our past technological advancements and it is only logical to believe that the 4IR and AI in particular will follow the same trajectory. AI has the capacity to transform entire industries by maximizing efficiency and production and minimizing production costs. Even if some limited amount of industries does not get affected directly by AI a chain reaction will occur between industries that will propel economy forward. Dr. Civelek acknowledges and reaffirms the optimistic predictions that exist, however he doesn't align his opinion completely with those. The reason behind he stresses is that in order for economic growth to occur countries need to be quick to implement AI and robotics into their production processes in order to remain competitive. Failure to do so will result in being left behind. Therefore he raises a very valuable point; will Economic

Growth be global or for selected few? Dr. Aykut also corroborates Dr. Civelek's opinion on this matter. In a following section Dr. Civelek presents his five steps in order for governments to boost abundance, efficiency, productivity and subsequently economic growth. So it becomes apparent that AI by itself will not directly cause economic growth unless certain conditions exist.

Nevertheless the shrinking of production costs involves certain pitfalls for humanity as it includes high levels of 'intelligent' automation and thus subsequent unemployment. Mr. Sahin's and Dr. Aykut's initial response was negative as they believe that the disruption of AI on the labor market might indeed destroy many low-skill high-routine occupations but it will create many more new ones that do not exist right now. Manual labor is the most threatened occupation at this moment but also middle skill jobs as well. Both categories involve simple processes that can easily be taught to a machine. Regardless middle skill jobs have to become more defined, versatile and meaningful in order to survive. It is imperative that we start preparing from today for the future. On the other side Dr. Civelek is completely certain that AI will render humans redundant in the context of employment and therefore aimless. From the opinions I have gathered, I believe there is some short of middle ground between them. As advancements in the field of AI continue, AI will be used to gradually automate more and more occupations but between now and total automation there will be a transition that nobody knows how long it will last. While Mr. Sahin and Dr. Aykut offer a vision of the future 25 years from now or less, Dr. Civelek's vision might be the culmination of all the future advancements in the field of AI, also known as Singularity. Therefore their predictions are not mutually exclusive, thus both can occur on a different point in time.

In regards to measures and policies in order to mitigate the effect of future unemployment, one theme that I kept encountering during a portion of the interview was the change of the Education system. As of right now, not all skills people acquire will make them employable in the future. In order to effectively encounter a future problem of unemployment we need to create an educational system that caters to the job market of the future. The respondents had a different perception on what will constitute a valuable skill-set in the future. Mr. Sahin believes that STEM education will be more

advantageous, since in ten-fifteen years from now every company will need engineers even if the company is not related to any technical sector. Also with the rapid technological advancements scientific personnel will be a valuable asset to any working environment. On the other hand Dr. Aykut believes that social or "soft" skills will be more important in the future. That is because those skills cannot be easily imitated by AI. AI's impact on employment has also the capacity to permanently bar entrance to the workforce due to skill-base unemployment. Lifelong learning and retraining programs will supply people of all ages with the necessary skills in order to re-enter employment and this will disrupt our linear lifecycle as well. Education will be a continuous state and not a portion of life that last from childhood to early adulthood.

However, as Dr. Civelek believes that massive unemployment is inevitable, he discards any investment in education and subsequent opportunities for employment. In turn he believes governments should be responsible in creating the foundation for abundance and economic growth in order to support a strong social welfare system with policies like the Universal Basic Income in order to support the citizens that will become redundant. Unlike Dr. Civelek, a common ground between Mr. Sahin and Dr. Aykut was their lack of confidence that the governments are flexible enough to keep up with the advancements in the technological race. Unfortunately governments, and the bureaucracy they entail, always follow change from behind. Measures that are considered today like taxation, as punishment, or incentives, as a reward, for companies that employ humans are only half-measures and will not be viable in the long run and that is something that Dr. Civelek also agrees with. Both the respondents believe that given the choices, companies will always prefer to work with a machine. Dr. Aykut pointed that there is no consensus of policies between nations and that can create its own set of problems. Countries that will adapt quicker than others to the new reality will come face to face with a wave of immigration due to their better social benefits. This is a limitation of a strong social welfare system that Dr. Civelek also mentions. Dr. Aykut continues to say that policies need to be applied globally but there is no global mechanisms capable to enforce them.

There is a possibility that a lowering in working hours will occur in order to employ

more people. Leisure and underemployment will be on the rise. There will come a time when we will need to reconsider the value of work in terms of contribution to society. Interviewees were asked if they believe that a social credit score, as the one China enforces, will give incentives to people to volunteer or be in their best behavior if they knew they would be rewarded for it. Respondents agreed that it is a system that will vastly reduce personal freedom; Mr. Sahin accepts that it would be a potential necessary feature in the future, while Dr. Aykut and Dr. Civelek believes it would be a disaster and that people will resist such a system.

Inequality will take many forms in the future. While Mr. Sahin disagrees that AI will increase income inequality, as the benefits of the economic growth will trickle down to everyone, he too believes that in the beginning there will be inequality mainly due to unpreparedness on behalf of both governments and individuals. Dr. Civelek on the other hand is certain that income inequality and the loss of purchasing power will be a serious issue in the future and that is why he stresses that policies need to cater to these needs .Dr. Aykut on the other hand emphasized the inequality that will occur between nations with access to AI and those without. He stresses that those countries that don't have access to AI might as well vanish from the map. They will be incapable to compete in the global market; a point that Dr. Civelek also corroborates. He then continues to parallelize it to individuals. Access to AI should be guaranteed as a common good accessible to everyone in order to avoid further Digital Divide. Another form that Mr. Sahin and Dr. Civelek both identify is the one between augmented humans and those who are not.

The ethical implications of AI are another very important issue that we will encounter in the future. Dr. Aykut and Dr. Civelek stress that AI's ethics will be defined by AI's maker. However ethics have not a global consensus on many issues and will inherently make AI unethical if she is produced in one place of the world and operates on another. Other issues that will arise are machine bias and privacy. Although Mr. Sahin believes we have already sacrificed privacy for convenience Dr. Aykut believes it can still get worse than today. AI will be able to follow anyone's digital footprint and create an outline of this character, preferences, dislikes, political affiliation. But there are no

mechanisms to stop AI from sharing this information with third parties or even check if AI's deductions are wrong about the people. Mr. Sahin believes it will not be a fair world especially because governments will be too slow to act to protect us from the adverse effect. However, they both mention that life will be more transparent than today. It will be easier to look for and reveal bad actors in the future thank to AI.

Like many other sectors of life that will have to improve and evolve, religion also will have to reform. We are witnessing a growing religious strife all over the world in recent years and it will be more exacerbated if we don't address the philosophical questions AI will pose in the future. Mr. Sahin believes that a reformation of religion is necessary in order to avoid hard regional activities in the future. Dr. Civelek believes that AI will not directly come in conflict with religion but longevity and human body augmentation will. He mentions that this will probably cause religion to collapse. On the other hand Dr. Aykut believes religious institutions will adapt to the new digital age. AI is based on knowledge and thus it can substitute for clerics and it will provide better, more reasonable, more personalized connection of people with their religion.

There are fears that we will become depended on AI. While all respondents agree that this will happen, Mr. Sahin views it as a fair trade off. He believes that while AI will fulfill menial and time-consuming tasks in our daily lives, we will have time to pursue more meaningful interests. Dr. Aykut and Dr. Civelek on the other hand believe this dependence might makes us addicts to AI and doom us to inertia.

Another very important topic is the decline in human interaction. The evidence on this subject is inconclusive as well. Although all respondents accept that there is a decline in human interaction, Mr. Sahin believes that the communication transformed from physical to digital. Dr. Aykut however believes that loneliness is getting more problematic every day. Dr. Civelek is not entirely sure how this scenario will evolve in the future. Perhaps the divide between people will grow or maybe humans will decide to return to more physical interaction in the future.

Lastly, Mr. Sahin and Dr. Aykut do not believe that AI will be a threat to Democracy

and democratic procedures, but rather a powerful tool if it is used the right way. Mr. Sahin believes that AI will be able to monitor political trends and preferences through the social media and citizens will be able to voice their opinions and objections constantly and not wait for the elections. AI will make Democracy more direct. Also Mr. Sahin believes that we will avoid scandals like the ones with Facebook and Cambridge Analytica because in the future there won't be any politicians to benefit from meddling with elections or referendums, rather AI with policymakers and regulators will consist the body of the government of the future. Dr. Aykut also is optimistic for the future of Democracy. His view is less utopic than Mr. Sahin's. He believes AI will bring transparency to procedures. Furthermore AI will help understand political happenings, the intentions of the people in power and thus we will become more politically conscious citizens and more engaged to the public life. Lastly Dr. Civelek acknowledges the potential of the optimistic scenarios in regards to Democracy due to the sharing economy, decentralization of authority due to blockchain however he raises the question if we even enjoy Democracy at this moment. He insists that he is very pessimistic for the future of mankind and expects military conflicts, depletion of resources overpopulation etc. conditions in which a Democracy cannot easily survive.

In conclusion, AI can be the greatest gift or the greatest threat to humanity. It will be all depended on how we decide to deploy this technology and if we are fully prepared for every scenario. Multidisciplinary scientists, policymakers, business people have a responsibility to the world and need to work together in order to deliver the most beneficial form of AI for the betterment and evolvement of the human race as a whole.

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APPENDICES

Appendix A.1 Interview Questions

1) Economic Growth

- How do you think Artificial Intelligence will affect Economic Growth?

- Productivity is inextricably linked with Economic Growth. However since 2008 productivity fell to 3-3,5 % even with all the technological advancements of the fourth industrial revolution. Moreover there is no measurable evidence that Artificial Intelligence has had an impact on productivity so far. Can you please give some insight?

2) Technological Unemployment

- One of the most feared impacts of AI is the massive job loss it can cause. Do you believe the panic is with good reason?

- What are your thoughts on the ability of intelligent machines to automate   human labor? Will they substitute completely or complement it?

- Are those jobs high routine- low skills? Or Low routine-high skill?

3) How to respond

- In your opinion what is the best ways to mitigate the uncertainty and likelihood of massive unemployment?

- Should Government offer tax reliefs and incentives to companies employing humans? And vice versa tax companies that do not?

- Is there a downside to this policy?

- Another issue is job displacement. Workers that lose their jobs cannot re-enter the workforce due to lacking skills. Should governments be responsible for life-long retraining programs in order to combat skill-based unemployment?

- Should the working hours be decreased in order to create more shifts to employ humans?

- Should our Educational System change completely, in order to create the workers of the future? What skills should the new Educational System promote?

4) Form of Inequality

- If Artificial Intelligence leads to a massive unemployment, the living standards will also fall for a large portion of the population. This will lead to increasing inequality. Name some ways on how can we combat this effect?

- Up until now the value of a human was largely measured in terms of occupation and earnings. If a large portion of the population is unemployed, do we need to redefine the contribution to society in terms of labor? For example through volunteering for our communities? Or through the social credit score China already enforces?

- Inequality will also arise among those with access to AI and those that have not. Please comment

- Another form of inequality will be that of ontological inequality.In order to compete with AI people will resolve on enhancing their strength and intelligence among others leading to Humans 2.0 . Do you believe this is a viable scenario?

5) Ethics of AI

- What are the ethical implications of the development and use of A.I.?

- There are some basic ethical principles that AI should adhere to. Which of them do you believe will be the most problematic to enforce?

6) Religion

- There are philosophical debates already happening about AI, what it means to be human and our uniqueness in our communion with God. There is a possibility that if our deeply rooted beliefs are challenged by AI it would exacerbate tensions which already exist between deeply religious societies. Do you believe this is a possible scenario? If yes is there any way we could avoid this pitfall?

7) Overdependence and loss of our skills

- There are fears that people will over-depend on AI in the future and this will lead to the erosion of our ability to think for ourselves and take independent action. Moreover it could lead to the loss of skills and talents acquired from generations before. What can be done to ensure this will not happen?

8) Human Interaction

- Relationships between people are often hard and need effort to build. Furthermore recent studies show that the youngest generations suffer from more loneliness. Do you believe AI will gradually cause erosion in the already declining human Interaction? Example -> the growth of "Lovotics"

9) Democracy

- Do you believe AI is a threat to Democracy?
- If yes, in which ways do you believe it can attack democratic procedures? Example, in digital voting AI can hack digital ballot boxes.
- Can it influence the electorate body through unethical ways? This already happened with facebook and US elections and Brexit.
- How can we ensure Democracy in the future?