



# **The Effects of Artificial Intelligence in the Future Economy**

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Bachelor Thesis for Obtaining the Degree

Bachelor of Science

International Management

Submitted to Marion Garaus

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## Affidavit

I hereby affirm that this Bachelor's Thesis represents my own written work and that I have used no sources and aids other than those indicated. All passages quoted from publications or paraphrased from these sources are properly cited and attributed.

The thesis was not submitted in the same or in a substantially similar version, not even partially, to another examination board and was not published elsewhere.

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## **Abstract**

As the influence of technology is growing and the economy shifting to a more digitalized system, this thesis examines the extent to how artificial intelligence (AI) is utilized in the current economic system and the different perceptions it receives. The predefined research questions are as following:

- 1. How will the development of artificial intelligence influence the current economic system?*
- 2. What are the prevailing speculations of the society (positive and/or negative) towards the implementation of artificial intelligence?*

The research was orchestrated through a qualitative online survey which identified personal data, opinions and the level of usage of artificial intelligence technology. The author applied the judgement/purposive sampling method as a foundation to obtain participants who can provide considerable data. Additionally, a variety of research was conducted to further the understanding of the implications of this study. The literature review section of this thesis explores the effects the labor markets may face with AI increasing its capabilities. It also examines to what extent artificial intelligence applications are applied in the various industries such as manufacturing, and e-commerce.

As the objective of this research is to identify common themes and opinions, a qualitative content analysis was conducted to categorize and interpret the results of the participants. Results indicate that there are already existing implementations of AI in business operations such as forecasting and data analyzation. Although many have indicated that the usage of AI applications is rather high, the perception towards such technology is dominantly negative. Regarding the opinion of artificial intelligence technology, there was a common consensus among the participants that there is fear of human employment replacement due to rapidly growing smart devices completing tasks faster and more accurately.

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## **1 Introduction**

With technology advancing daily, businesses are always looking for the next new innovative project. The advancement of a self-sufficient program, a system with cognitive capabilities, is on the rise in the developed nations. The effects of modernization and automation of the economy will change the foundation of how businesses will evolve. Amazon CEO, Jeff Bezos stated that he believes we have entered the “golden age” of AI that allows us to solve the problems that once were the realm of sci-fi (Marr, 2019). Google co-founder Sergey Brin is another representative of the development of Artificial Intelligence by expressing that “AI is the most significant development in computing in my life” and Microsoft CEO Satya Nadella calls AI the “defining technology of our times” and the “ultimate breakthrough” (Marr, 2019). These are significant individuals of our current economy who seek to invest in the development of AI. Artificial intelligence has been a major topic and research content all over the world. The most important questions in this context are: How will AI shape our business world? How has it shaped our business world so far? Will it replace all jobs? AI is the reproduction of human intelligence conducted in machines and it continues to attract considerable publicity (Pomerol, 1997). It is the attempt to assimilate computer technology with human physiology by formulating computer programs to make computers smarter. The input of human thinking into machines was a proposition in the 1950's and has been in development ever since. During a conference in the mid1950's a computer and cognitive scientist named John McCarthy, composed the term “artificial intelligence” (Copeland, 2018). He is the pioneer who started evolving the field of AI. As it continues to grow, many industries are seeking for possible opportunities to invest in robotics and development of “thinking” computer systems. According to Jatin Borano, the purpose of artificial intelligence is to outperform human capabilities (Borana, 2016). The current economic state of modernized countries is already adapting to the new AI featured services, such as airport support (robots in Korean airports) and online chatting help desks. Some industries specialised in customer relations sectors are diving deeper into employing AI to enhance customer service. The involvement of artificial intelligence has proven its advantages to several industries around the globe.

The merging of considerable precision and fewer computation time makes artificial intelligence a revolutionary innovation. Distinct industries already rely heavily on the advanced technology for analyzing customer algorithms such as Amazon and Alibaba. These companies prove that they are dependent on their algorithms to attract more consumers and increase sales through the collection of primary information about their target market/consumers.

It is imperative to state that the developments on artificial intelligence generates both positive and negative perceptions. Technological advancement enabled the possibility of replacing human labor in manual and cognitive routine tasks (Petropoulos, 2018). Humanity is constantly striving for modernization and solutions to obstacles but due to computers becoming smarter and AI governing, our society needs to conservatively consider how this may or may not affect future employment in various industries.

With artificial intelligence developing and its increasing awareness, the thesis will examine the possible effects of the expert-systems and elaborate on the already existing influence it has on the current economy and the potential future it will have on the society. The observation of the expansion and functionality of AI and the positive/negative aspects towards adaptation of the new programming established the following research questions.

- *To what extent is artificial intelligence utilized in the current economic system?*
- *What are the prevailing society's perceptions (positive or negative) of the implementation of artificial intelligence?*



## 2 Artificial Intelligence

Artificial intelligence, also known as an expert system is the theory of machines imitating the ability of cognitive thinking (Kaplan & Haenlein 2019). AI is the science of building intelligent machines from large volumes of data and learning from experience to perform human-like tasks. The concept of a neural network was first introduced by John Mccarthy, who is also known as the father of artificial intelligence (Nilsson 1998). The implementation of natural human intelligence into machines has been considered by many well-renowned individuals as one of the most important changes in mankind. Understanding how artificial intelligence influences the current economy and potential changes it might bring is recognizing the different types of AI (see Figure 1).

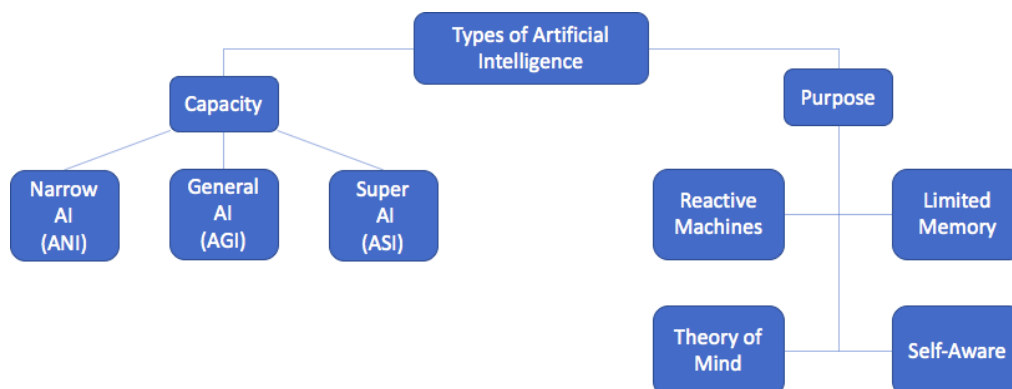


Figure 1. Types of artificial intelligence (Joshi, 2019)

The capacity levels of Artificial intelligence are divided into three groups, Narrow, General and Super AI. Narrow AI, also referred to as weak artificial intelligence, has limited capabilities. It can only execute one narrow task and cannot operate beyond its limitations (Kaplan & Haenlein 2019). The usage of such systems is becoming increasingly common in our day to day lives. Examples of Narrow AI have been implemented into the current society such as Google Assistant, Google Translate, Apple Siri, and Amazon Alexa are examples of Narrow AI (Jajal, 2018).

General AI is the hypothetical intellectual capacity of a machine that has the ability to comprehend or learn any complex tasks that a human being can perform (Kaplan &

Haenlein 2019). The potential abilities of general artificial intelligence are predicted to solve dilemmas, planning, usage of prior knowledge for decision making, and cognitive reasoning under uncertain circumstances (Jajal, 2018). The current technological advancement only allows for a faster process of data. The full ability of thinking independently, and critically thinking for different solutions are still decades away from being achieved.

Super AI is a theoretical expert system that exceeds human capabilities (Kaplan & Haenlein 2019). It will be a machine performing and surpassing tasks of a human. All this would include knowledge, problem solving skills, and even creativity. Brundage (2015) defines Super AI as following: “any intellect that greatly exceeds the cognitive performance of humans in virtually all domains of interest” (Brundage, 2015, p. 33). This system will change beyond human measures and many are worried about what the changes will bring to human society.

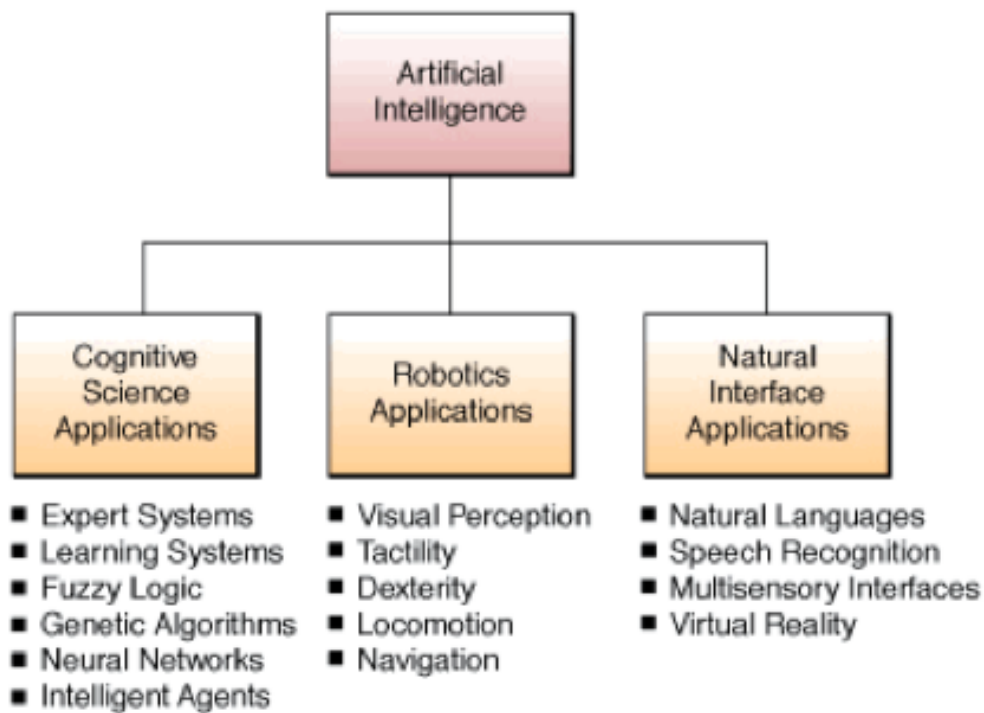
The second column in Figure 1 indicates the types and purpose of AI. There is an excessive amount of definitions and terms which often makes it difficult to navigate through the content. In AI there are some major types which are shown in the Figure; reactive machines, limited memory, theory of mind and self-awareness. AI developments strive to enable machines to perform like humans or even outperform human skills. The extent to which an expert system reproduces human capabilities is used as a parameter for the classification of the AI types. Reactive machines are simple types of artificial intelligence which only function with existing data and do not possess cumulative collectives to process information (Joshi, 2019). This is the method that only uses the recent situations - hence the term “reactive”. The reactive machines have no concept of the world and their system does not function beyond how they are programmed (Joshi, 2019). A common example of a reactive machine is the Deep Blue, a chess playing supercomputer created in the mid 1980’s by IBM (Joshi, 2019). This system was programmed to play against a human competitor. It understood the predictions and possible moves it had to make in order to play. Reactive machines are activated to do the now and here, but are not programmed to do beyond that. It is also said that there is no growth that comes with it because it is only developed to act on recurring behaviors/actions.

The limited memory type learns from acquired data to compose an action (Joshi, 2019). As it can learn from the past data, the experiences gained is limited as they cannot add it to their processors. Autonomous vehicles are a good example of the limited memory type. Self-driving car programs are main users of this principle because it practices the combinations of observation and pre-programmed facts in order to operate a car from running (Reynoso, 2019). In order for an autonomous car to drive it needs to observe and understand the environment, patterns and possible reactions. There are all factors that will be programmed in and this helps AI to determine how to best react by pulling together information that has been injected into the program.

The theory of mind is an approach which allows for the machines to understand human behaviour (Joshi, 2019). The existence of self awareness in machines is still hypothetical. Many researchers are on the rise of building machinery that resembles the theory of mind. The closest function to a theory of mind are machines that have decision making ability that would come close to a human mind. Voice assistance, such as Google Alexa and Apple Siri are best examples of commonly used devices that demonstrate humanlike capabilities, although it is still not close to maintaining a full real human conversation. Robot Sophia is also another example of research getting a step closer to the theory of mind concept. Sophia is a humanoid robot created by Janson Robotics and what distinguishes it from voice assistance is its ability to respond to facial expression (Retto, 2017). This product has the ability to recognise images of human expressions but for the theory of mind to really work, it still requires immeasurable research until a machine would be capable to reproduce humanlike emotions. A self-awareness type of AI would carry a human level consciousness, which currently does not exist, but through more and more advanced research it may become the breakthrough of the most advanced form of AI known to the human kind.

### 3 The AI Involvement

Artificial intelligence plays an enormous role in certain industry sectors. Many businesses are implying and adapting to the new norm of making work more efficient and cost effective (Marr, 2019). The smart AI machines interact with customers and also improve cognitive strengths to help employees with their work in many industries. These new updates are reasons for leading tech companies to continue to develop advanced AI features. Recent research and experiments are shaping our future.



*Figure 2. Overview of artificial intelligence (Borana, 2016)*

Jatin Borana states as seen in Figure 2 - that artificial intelligence in the form of neural networks and expert systems has applications in almost every human activity (Borana, 2016). Artificial intelligence is involved in various industries that are adapting to the digital transformation. As Figure 2 displays, applications of AI are separated into their section of capabilities due to its limitation of performances.

Cognitive science applications are programs that resemble human intelligence. In order for an AI to be recognized as a cognitive science application it requires a learning system, neural network, expert system, genetic algorithm, and intelligent agent (Borana, 2016). For the intelligent program to be fully involved in diverse sectors, it still requires an extensive amount of testing and research.

The manufacturing sector deploys artificial intelligence with robotic applications for assembling and packaging processes to reduce costs and for higher accuracy. With the combination of artificial intelligence and virtual perception systems, more complex tasks can be completed without the assistance of human labor. The well-known virtual assistant such as Siri (voice assistance) operates under these technological functions, speech recognition and natural language processing to interact with humans in a more natural way. The human-like ability of artificial intelligence is becoming more desirable, to the extent where it is being implemented in many industries including the customer service division. The involvement of AI is very evident in many corporations and also in daily human surroundings. Innovative artificial intelligence is at the beginning stage of shaping the fundamentals of business operations. The more AI develops and grows, the more influential it becomes in changing the future economy and society (Feijóo, & Kwon, 2020).

### **3.1 Collaborative Innovation**

Digitalisation has rapidly changed the way of communication and the way of operation. Co-creation is another factor where businesses gain insights on making improvements on services and operations from consumers (Sanders, & Stappers, 2008). The increase in easier accessibility to the world wide web enabled the rise of customers to become more involved with the design process of products (Sanders, & Stappers, 2008). The exchange of words between two entities creates the potential of data becoming more available, resulting in the modification of long established business procedures. Artificial intelligence can be formulated as an expert system that shows potential capability to perform functions that emulate human cognitive skills. Gathering data from consumers and potential consumers is crucial to improve one's service and decision-making (Devine, Srinivasan, & Zaman, 2004).

Artificial intelligence approaches challenges in order to produce the optimal results or in the event of ambiguity, the most beneficial solutions. AI implementations pursue answers to detailed and organised issues that demand the application of logic (Paschen, Paschen, Pala, Kietzmann, 2020). An example is IBM's Deep Blue. It applies logic to win against the best human chess player in the world. IBM's Watson is a machine learning system that analyses vast amounts of structured and unstructured data with its natural language process to predict the optimal solution. Structured data sets are information in numerical form and unstructured data are information from various sources that can not be categorised in a numerical form such as images and videos. These AI applications are used for a limited process and are considered to be narrow AI as it is programmed for one specific task. To utilise the benefits of co-creation to its maximised potential, companies have implemented artificial intelligence applications for the advantages. Firms that rely on the service sectors depend on the competence of extracting valuable data from consumers. As the involvement of AI increases in various industry sectors, and the accessibility of data is becoming more uncomplicated, algorithms are therefore constructed on the foundation of inputs to function in the process of producing solutions. The expert system can support the decision making process on a new product development by analysing inputs and patterns from previous insights from consumers. Artificial intelligence obtains the capability of integrating resources between service providers and beneficiaries, enabling an improvement in personalized services (Paschen, Paschen, Pala, Kietzmann, 2020). A person to person service is the interaction between two entities. Whereas one of the entities is a service provider acting as an information system. Implementation of artificial intelligence enhances the process of personalised customer service and its vast and detailed information savings. The competence of artificial intelligence in collecting, analysing external/internal structured/unstructured, and the interpretation of data, led to the increase of implementing computer systems that may have an major impact in the future of possibly outperforming human abilities (Feijóo, & Kwon, 2020).

### 3.2 Growth Potential of Innovative Technology

Microsoft co founder Bill Gates quotes, “Innovation is moving at a scarily fast pace” (Brynjolfsson, Rock, & Syverson, 2019, p. 24). Vinod Khosla, the founder of Khosla Ventures mentioned, “the beginnings of rapid acceleration in the next 10, 15, 20 years” and Eric Schmidt, former CEO and executive chairman of google and former executive chairman of Alphabet Inc, believes that “we are going to see a new age, the age of intelligence” (Brynjolfsson, Rock, & Syverson, 2019, p. 24). The assertions of technology leaders and venture capitalists indicate the rapid progress of information technology (IT) in various sectors. Increasing computer power/capabilities and developing improved cloud infrastructures (Brynjolfsson et al., 2019).

Machine learning is the backbone of artificial intelligence (Marwala, 2018). Most computer programs were created by human intelligence inputs and outputs. On the contrary, machine learning applications are able to identify solutions with large data sets and work on its own without human intervention. As data resources have grown meticulously, AI has made remarkable strides in perception and cognition, which are important attributes for implementation into the labor environment (Pramanik, Pal, & Choudhury, 2018).

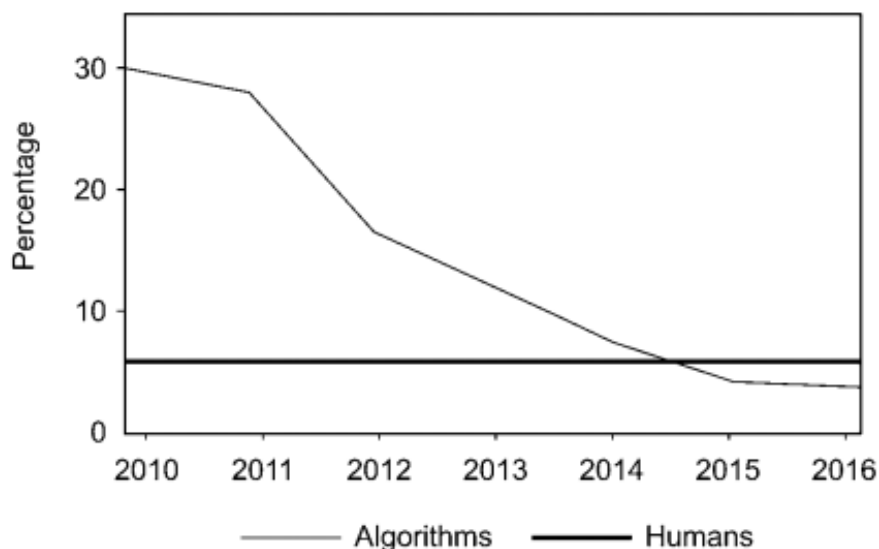


Figure 3. AI versus human image recognition error rates (Brynjolfsson et al., 2019)

Figure 3 displays the rapid improvements of artificial intelligence in image recognition error. In 2010, AI displayed a 30 percent error rate in categorising over ten million illustrations. As time progressed and technological advancement increased, the error rate was down to more than five percent in 2016, lower than the human error rates (Brynjolfsson et al., 2019).

Such indication displays significant milestones in technological advancements. This actively demonstrates that the foundation of economics might potentially become influenced with new conveniences for increased value of a business and reduction of operation costs. Eye catching achievements of Facebook's use of neural network, conducting over 4.5 billion translation each day has established positive perception on the capabilities of artificial intelligence (Brynjolfsson et al., 2019). Creating a large flow of investments from influential and highly valuable companies such as Apple, and Amazon for further developments of artificial intelligence technology. As stated by CB insights (a market intelligence platform), global investment in AI-focused private firms has accelerated much faster, from \$589 million in 2012 to more than \$5 billion in 2016 (Brynjolfsson et al., 2019).

### **3.3 Innovators building the future**

Well-known innovators, who actively seek improvements of our world have changed our world through their inventive ideas that often seemed impossible. It requires breaking through the status quo to invent something that seems unrealistic. Starting from determined dreamers to studious scientists, they have all contributed to great innovation and continue to help make special attributes to advance our society. Several new Innovators emerged in the context of AI in the last decade (Brynjolfsson et al., 2019). Artificial intelligence will have a great impact on the efficiency of the future economy (Cockburn, Henderson, & Stern, 2018). Therefore, influential innovative firms identify the potential of the expert system as the technology that will advance the prospect of the world. The success of artificial intelligence not only depends on the development process of companies that seek innovation and technological advancement, but it also depends on the level of intelligence within



technology (Manu, 2012). Achieving a long lasting competitive advantage is one of the factors that drive companies to reach higher goals (Kaplan & Haenlein, 2019).

### **3.3.1 Alexa and Siri**

Innovation in today's society is created by programming smart devices that support smart living. Many companies face competition in the production of convenient softwares that can increase comfort in people's lives. Smart devices are computer appliances that are capable of communicating, exchanging and engaging with users and other smart devices (Terzopoulos & Satratzemi, 2019). These operations are conducted through the connectivity of wifi networks and wireless technology. Voice assistant is a prime example of how smart devices are used to support the interaction between the user and other smart devices. Amazon's artificial intelligence product, Alexa is a virtual voice assistant capable of understanding the needs of the consumers. It is not only to connect with its consumers but also develop a new level of convenience throughout the home. Once connecting Alexa to other smart home appliances, the device can execute tasks through voice demand. Consumers can connect Alexa to TVs, light bulbs and even allow it control the temperature in the house through a simple demand. Voice Assistance is another tool that was created to enhance the capibility of a device influenced through AI.

An aspect of our modern society is our communication with machines (Jones, 2014). When talking about Voice Assistance, Apple Siri is another prime example of technology capable of understanding the request of the human voice to execute its demand in the best capable way. We speak to a digital assistant on our phone and these tools are transformed for consumers to use as a constant channel for conveying a message. Siri is a voice based artificial intelligence that was introduced in 2011 by Apple with one of their iPhone series. During the initial press releases it was described as "an intelligent assistant that helps you get things done by just asking" (Apple, 2011). It is a program that allows the consumer to ask questions, and Siri would then quickly gather all types of information to answer the consumer with the most accurate content or even execute commands to call a specific contact. Siri also assists with scheduling meetings and reminders. The way consumers used this program was very

close to a human assistant. Both the Google Alexa and Apple Siri represent the advancement of technology and the usage of voice assistance.

### **3.3.2 Autonomous Vehicles**

It was once a vision, now it is becoming a reality. Vehicles that can drive autonomously was once believed to be a goal still far away from being reached. Now we are seeing more autonomous vehicles (AV) cruising through the highway with less to almost no efforts from the driver. It is inevitable to say that AV is shaping the future of mobility. Autonomous vehicles are technology that can bring a person from point A to point B with no human interference. As artificial intelligence progresses, the field of transportation is influenced by new changes. Implementation of AI systems and sensory technologies enables autonomous vehicles to navigate through complex circumstances (Cunneen, Mullins, & Murphy, 2019). The approach of using advanced artificial intelligence is identifying solutions and processing on the data collected by sensors, and by camera systems which has brought car companies closer to fully achieving autonomy in their vehicles. There are many innovative companies that are coming closer to fully achieving the technology of autonomous transportation. One of the factors that promote the need for such technological development is to assist human driving skills, prevent human mistakes, and inattention (Papadoulis, Qudus, & Imprialou, 2019). The combination of artificial intelligence and Internet of Things sensors (IoT), which is a system that collects data and transfers it to a software to be processed and create scenarios, enables the accuracy of predicting the movements of everything (Krasniqi & Hajrizi, 2016). With AI becoming more capable of processing and delivering accurate solutions, the involvement of AI in the transportation and automotive industry will only increase in the future.

### **3.4 E-commerce**

New technology is disrupting and maturing the customer experience in the retail industry. Many industries are facing the adaptation of advanced technology. Identifying artificial intelligence applications in any market field will mostly stimulate a change or a redesign in the business model. The full implementation of AI into any industry is still at the beginning stage despite its advancement in recent years

(Oosthuizen, Botha, Robertson & Montecchi, 2020). The clear understanding of the importance of artificial intelligence in the retail industry will produce an advantage in the future. The capability to operate with large quantities of data is crucial to a successful enterprise and data driven decisions are becoming decisive measures in a supply chain (Oosthuizen et al., 2020). The reliance on processing and analysing information decides the outcome of efficiency and profitability. Technology with AI has prospered into a powerful tool to amplify sales growth and enhance electronic commerce operations. Companies currently present AI in e-commerce through search/recommendation engine and optimal pricing.

### **3.4.1 Alibaba**

For example, Alibaba Group is a Chinese multinational company that conducts the biggest e-commerce network in the world. The Alibaba Group has access to a large population with web-portals that contain customer data to help establish a suitable groundwork for the development of artificial intelligence (Marr, 2019). Alibaba's sophisticated AI monitors the customers' traffic on their websites in order to understand their needs, rhythms and most importantly the patterns of why the customer makes a final purchase. It is also an opportunity to analyse and understand why customers leave with no final purchases. Many e-commerce businesses use recommendation engines steered by algorithms to identify the target audiences for their products. The recommendation engine saves each action of the customers to be interpreted and once a pattern has been identified, the algorithm then plays a role in pulling up content that most interests the consumers. It is also a major tool in readjusting website content to draw in the consumers. We are often not aware of the fact that algorithms are omnipresent in our lives. Algorithms are data processing calculations that start with an equation but can get very complex in its functions (Moschovakis, 2001). Leo Hickman, who was a journalist at *The Guardian* writes, "The National Security Agency (NSA) revelations highlight the role sophisticated algorithms play in shifting through masses of data. But more surprising is their widespread use in our everyday lives. So should we be more wary of their power?" (The Guardian, 2013). Some experts recognize its dangerous trend despite its important roles in many industries. It is also increasing because computers are an important component of our

lives that can not be disconnected. Algorithms are a big method many e-commerce use in order to enhance their website to increase the probability of a purchase. Showcasing the preferred price range and the favoured items. The access to an extensive amount of data created the opportunity for Alibaba Group to obtain an automated content generator. Proposing millions of products across its sites, such a system was heavily invested into by the company. Artificial intelligence also uses natural language processing algorithms to operate on deep learning neural networks (Marr, 2019). The content generator therefore can produce 20,000 lines a second that would benefit the users search (Marr, 2019). The factors of massive amounts of data from customers and the large number of people in the country enabled the algorithms to have access to various consumer behaviours to develop optimal solutions.

AI advancement not only processes big data but it's also capable of automating pricing for a large number of products. It gathers information from multiple sources for optimal pricing of the product which is very difficult in a large market (Jianhong, 2019). With the continuation of advanced technology learning algorithms, AI continues to evaluate competitive market dynamics to solve the problem of optimal pricing (Jianhong, 2019). Profit maximisation is the key goal of a business while sustaining corporate social responsibility. Forecasting future demand, automation of store operations, consumer engagement, customer personalisation and price optimisation are all sectors that artificial intelligence can improve and support (Pillai, Sivathanu, Dwivedi, 2020).

### **3.4.2 Amazon**

Artificial intelligence is considered to be one of the most prevalent topics CEO's, engineers, innovators and researchers deliberate on. Alexander Manu, who is a strategic innovation consultant, as well as a professor states that "Innovation is not a process, but the outcome" (Manu, 2012). The approach for innovation and convenience drove individuals to create results for smarter and advanced machines. Companies such as Amazon are one of the important trailblazers in innovative technology within e-commerce. Amazon is the world's largest multinational technology company that focuses on e-commerce, cloud computing, digital

streaming, and artificial intelligence (Amazon, 2020). Offering its services via B2C, B2B and C2C. The company's mission statement is to serve consumers through online and physical stores and focus on selection, price, and convenience (Amazon, 2020). With the constant improvement of a reliable artificial intelligence system, it provided Amazon the technology needed to become more customer centric and offering unique/innovative services to its consumers. *Amazon's Go and Just Walk Out Shopping* is an expert system that has been ingrained into our shopping experience.

Amazon Go is the brick and mortar store of the future (Business Insider). With the technology implemented into the store, the shopping process is simple. The concept of entering a store, grabbing whatever you want to buy and leave without a register was made possible by Amazon. The merging of cameras and sensors keep track of where items are located. The combination of computer vision, deep learning algorithms (AI) and sensor fusion enabled the company to open up a store with no cashiers or checkout stations needed (Ives, Cossick & Adams, 2019). Creating a whole new meaning of what convenience is.

### **3.5 Products**

Considering the market trends are volatile, it is safe to claim that products face constant adaptation in favour of their consumers. The development of artificial intelligence induced products is on the rise. AI is beneficial for businesses to manufacture more intelligent products to offer to their customers (Marr, 2019). The demand for products that contain some sort of intelligent feature are becoming more popular in the developed and modernised nations. Smartphones with applications that reduce complexity, automobiles with assistance in driving and home devices that create a more comfortable atmosphere are outputs with rapid demand. The offering of smart products is a fairly new concept but it is visibly increasing.

Tesla is known for its technological advanced self driving cars. According to Tesla, their cars are applied with cutting-edge research to train deep neural networks on problems ranging from perception to control. The neural network analyzes raw images to perform semantic segmentation, object detection and monocular depth estimation (Eberhard & Tarpinning, 2006). Tesla offers electric vehicles with the

functionality of self driving features. The demand for such cars was high but the production capability was limited. According to Yahoo Finance (finance.yahoo.com), Tesla's stock price was at 83.67 adjustment close on December 1st 2019. When the announcement of new manufacturing facilities were confirmed, the stock price of Tesla skyrocketed from 83.67 on December 1st 2019 to 567.60 on October 31st 2020. It displays that low stock prices were due to the limited production capabilities and the high demand not being met. The statement of expanding the production facilities, provoked the high increase in stock prices of Tesla. Such a drastic event demonstrated that advanced cars with implemented artificial intelligence technology is at high demand from customers and it will only increase as technology innovates. Needs and wants of consumers in the near future will transform. The willingness to exchange from products with low technological advancements to high technological advancement will change the satisfactory level and the needs and wants of consumers (Soni, Sharma, Singh & Kapoor, 2020).

## **4 Manufacturing**

The beginning of the first industrial revolution brought countless benefits to the global economy by increasing production capabilities. The production capacity have increased through the implementation of AI in several sections of the manufacturing processes. A concentration of facilities specialised in the production of specific goods enabled for the overall growth of manufacturing capabilities and efficiency in operation. Employees clocked-in and out at exact times to fill and avoid any pauses in productions. The manufacturing sector is a key role in a company's supply chain network and the global supply chain. The rise of demand requires facilities to increase its production capacities. To become and maintain a lucrative manufacturer in today's exhilarating competitive global economy requires determined innovation to achieve higher levels of productivity (Belton, Olson, & Crandall, 2019). An innovation that can determine an optimal outcome are the additional applications of artificial intelligence. As smart manufacturing, "integration of sensors, controls, and software platforms to optimize performance at the production unit, plant, and supply chain levels" (Belton et al., 2019) is on the rise, applying intelligent software becomes less complicated to

integrate. The development of manufacturing assets integrated with sensors, computing platforms, communication technology, control, simulation, data intensive modelling, and predictive engineering creates a foundation for the assimilation of artificial intelligence applications (Kusiak, 2018). With everything becoming more connected, the manufacturing industry experiences the significant data availability, thus enabling for an imminent change in their operations (Wuest, Weimer, Irgens, & Thoben, 2016). An analysis conducted by Paturi and Cheruku (2020), the utilisation of technology has expanded expeditiously in manufacturing from the past two decades and the process of operating several examinations can be avoided with the aid of machine learning techniques in the production process. Artificial intelligence can be applied to various parts of the manufacturing process. With an advanced visual perception technology, the quality inspection sector can be modified. There are currently automated quality inspection systems that exist in the manufacturing industry, yet they are custom designed for one particular inspection task and unlike the human counterpart are unable to be easily retrained (Belton et al., 2019). Due to the success of automated inspection systems, there are plans of implementing artificial intelligence applications, such as machine learning to widen the capacity of its functions. Developed nations such as the United States of America, established a concept called the *Industrial Internet of Things*, which can integrate smart equipment, humans and data to become more connected and are able to make even more accurate data analysis which would lead to better decision making processes (Li, Hou, Yu, Lu, & Yang, 2017). Modern manufacturing facilities need an updated manufacturing operation network. As global competitiveness becomes more challenging to handle and companies seek efficiency, sustainability and increase of profitability, corporations are shifting to focus on long-term collaborations with advanced technology to have a greater possibility to reach the desired objective of becoming a leading enterprise.

The process of the production of complex goods is time consuming and enabling the full functionality of software systems with advanced artificial intelligence applications can speed up the operation. As the deployment of artificial intelligence becomes more of a reality and the adaptability of such systems into a significant amount of industrial

activities is increasing, the consideration of modifying manufacturing facilities is expected to grow (Szczepański, 2019). AI in the production sector is believed to increase due to the development of automated learning processes (Szczepański, 2019). The dependency on human labor can be reduced with the implications of artificial intelligence in repetitive tasks. The functions of AI that can be applied in the manufacturing process that are listed as such: Quality inspection, predictive maintenance, generative design, and augmenting human capabilities (Belton et al., 2019). Quality inspection is a computer vision that can outperform humans by conducting the analysis faster, more accurately and efficiently. The system can eliminate standard variations from different human inspectors because of its applied fundamental quality standards (Belton et al., 2019). Predictive maintenance is the analysis of the historical performance data of machines to anticipate the expiration date, limit the time of non operation and identify problems when occurred (Dilda, Mori, Noterdaeme, & Schmitz, 2017). The cost of maintenance takes a compelling percentage from the total operating costs of the production process. The maintenance cost for heavy industries represents up to 60 percent of the whole production costs whereas for the agriculture related industries, the maintenance cost takes up to 15 percent of the cost of goods produced (Mobley 2002). With the implementation of artificial intelligence, the system can monitor manufacturing equipment precisely with networked sensors that gather slight changes (in particular vibration or machine noise) which may indicate forthcoming breakdowns. It can potentially increase cost efficiency for companies in the manufacturing sectors (Belton et al., 2019). Generative Design is the process of developing outputs virtually before manufacturing it physically (Belton et al., 2019). Artificial intelligence can simulate how the newly developed product would perform in the real world. The application of this technology then iterates using human intuition and computational AI to identify relevant solutions and modify the design for an optimal output (McKnight, 2017). The many benefits of implementing a generative design system into the production process can improve performance with minimum material usage, reduced time consumption, and increase credibility (McKnight, 2017). A research conducted by the Harvard Business Review states that collaboration between artificial intelligence and humans achieved the most significant performance improvements



(Wilson & Daugherty, 2018). Indicating that collaborating humans with AI can potentially operate better and more efficiently than either individually, augmenting human capabilities (Belton et al., 2019).

As global industries are on the rise of becoming more competitive, constant challenges accrue which force companies to seek and maintain efficiency and sustainability. The full utilisation of advanced technology can enable the increase in profitability for companies with long term goals of implementation. The German automobile manufacturer Bayerische Motoren Werke (BMW), applies artificial intelligence systems along their production line. Replacing human labor conducting repetitive tasks such as inspection of product quality with automated image recognition. A database containing previously composed outputs, enables BMW's artificial intelligence software to evaluate segments of illustrations in ongoing production and compare them to the images in the dataset faster than any human can perform. Another influential company that implements artificial intelligence is the Airbus multinational aerospace corporation (Petrescu, Aversa, Akash, Corchado, Apicella, & Petrescu, 2017).

As the world economic demand is shifting towards efficiency and a smaller carbon footprint, aircraft manufacturers are undergoing pressure of identifying possible outcomes to meet the appeal of the buyers (McKnight, 2017). Airbus applies generative design technology to manufacture the next generation of aircrafts. Generative techniques analyse potential game changing outputs, such as developing aircraft parts that are significantly lighter than those designed by humans (Belton et al., 2019). As AI would not approach the problems the way human engineers would, it would instead explore the variants that are beyond what is currently possible (Noor, 2017). Such technology may sound futuristic but it has been involved with the development of one of the most high profile and expensive products in the world, the Airbus A320 aircraft (Noor, 2017). According to Business Insider (businessinsider.de, 2019), the Airbus A320 is the world's most popular plane surpassing its competitor, the Boeing 737 despite its release 20 years earlier. It indicates that by using AI applied technology can provide a significant advantage to the outcomes of the products, increasing the market share of the industry. It is reasonable to believe that

technological advancement provides many beneficial factors for not just the manufacturing industry but the overall economy.

## 5 Labor Market

The labor market is the supply and demand of the workforce. It can be seen as the employees providing the supply and the employers contributing to the demand. Factors like globalisation and technological advancement have forced the population to either adapt or get left behind. It is known that throughout the decades, progress eliminated jobs but also created new ones. Developments in mechanization in the late-nineteenth and early-twentieth century automated much of the physical labor performed by humans (Korinek & Stiglitz, 2017). Transformation of the workplace and the effects on job creation and job elimination can be dated back centuries, even before the well known industrial revolution (Manyika et. al, 2017). When the demand for certain types of jobs decreases and the supply remains with no change, disruption in the economy, poverty and unemployment are possible outcomes. The era of digitalisation has opened up many new opportunities for the upcoming labor force. As information availability becomes more accessible over time, the labor markets flexibility increases, meaning that the ability of the markets to respond and adapt to the developing economic conditions become more possible (Beatson, 1995). Automation and artificial intelligence create optimistic outcomes of productivity and economic growth but may have negative effects on millions of people in the world having to seek for other occupations or upgrade their skill sets (Manyika et. al, 2017). The complete transformation of operations may leave many in concern for their future. It has sparked a dilemma and disagreements among various individuals. A 2018 analysis conducted by the Massachusetts Institute of Technology (MIT), Technology Review demonstrates that there is no mutual agreement among the global experts in the field of economics and technology, whether the implementation of artificial intelligence into the economy will have a positive or negative effect on the labor market (Winick, 2018). The forecast ranged from promising to disastrous with estimated number differences of millions. Despite the disagreements about the

influence artificial intelligence has on job creation or job destruction, the enforcement of AI will disrupt labor markets in the majority of its sectors (Korinek & Stiglitz, 2017).

## **5.1 Adaptation**

The widespread implementation of AI, robotics and automation across global economies provides the contingencies of job establishment but also job extinction. The possible impact of artificial intelligence institutes a dilemma concerning many of the developed and several developing nations. Acemoglu and Restrepo (2018) stated that “AI is the “most discussed automation technology”. The concern of artificial intelligence accelerating the advancement of automation technology, provoking the increase in unemployment puts fear into the minds of the ones with lower skill sets (Frey & Osborne, 2017). The introduction of new innovation establishes a separation of adapters and non adapters. Adjusting to new situations can prevent a disruption of the overall economy. The skill set of a human being is determined by the education that is provided to them. The demand for workers with non-routine cognitive skills will increase while for other groups, the possibility of decreasing demand is most probable (Petropoulos, 2018).

As artificial intelligence is not advanced enough to replace many human jobs completely, it is not a question of how but when it will change the labor market environment. The labor market flexibility plays an important factor for companies for the easy adaptation to changing conditions (Beatson, 1995). It will require firms to reevaluate their operations and look for possible ways on how to maintain a stable management with new technology becoming part of their company. Such a process will change the way future business will be conducted and there is no denying that many people that do not have the necessary skill set will be left behind (Frey & Osborne, 2017). The adaptation level of the labor markets to different conditions are important to consider because they are a large factor of the economy (Beatson, 1995). With the shift of economic standards, traditional business operations face the implementation of new strategies for potential benefits and increasing its profits. As the quality of human capital plays a significant role in the economy, the ability of individuals to cooperate with technology for the growth of their own productivity

level requires them to develop specific digital skills with well designed policies (Petropoulos, 2018). The cooperation with technological advances indicates that learning appropriate tools to ensure that labor markets are going to adapt and become prepared to hinder disruptive forces is crucial (Lane & Saint-Martin, 2021).

## **5.2 Employment**

Advancement does not always lead to an increase in unemployment. In the long term, there are speculations of technological advancement establishing employment growth. There is a probability that artificial intelligence could upsurge by 38% and new jobs by 10% by 2022 assuming that adequate investment is continued in smart technologies and human-machine collaborations (Ghimire, Skinner & Carnathan, 2020). The potential of artificial intelligence transforming the industries will take effect on businesses that will try to implement expert systems into their working environment. Innovation increases of information technologies in the mid- to late-twentieth century automated much of the structured data processing/analysis that used to be executed by humans (Korinek & Stiglitz, 2017). Past industrial revolutions indicate that in the short run, the displacement of many workers might dominate but in the long run, labor markets may eventually adapt to major changes, increasing the productivity level and gaining a positive impact on employment (Petropoulos, 2018).

There are cases of countries gaining from technological advancement. As an example, the South Korean economy during its economic reforms and constant strive for innovation, shifted its agricultural dominated economy to an industrialised dominated economy, focusing on shipbuilding, steel, car manufacturing and electronics. A positive labor market flexibility can contribute to the establishment of new jobs and to the enhancement of social and economic position of a country (Galik, & Båk, 2020). As stated by the Massachusetts Institute of Technology, there is no consensus among the experts on artificial intelligence increasing or decreasing jobs in the future (Winick, 2018). It can be theorised that AI will not completely eliminate jobs but will make them unattractive to the labor market requiring specific skills.

### 5.3 Replacement

In the past years, many concerns were consulted about automation and digitalization replacing the jobs that are currently performed by humans. The introduction of automated machines into the economy has provoked the perception of an increase in the unemployment rate. The fluctuations of the economy-wide equilibrium unemployment is influenced by the proportion of unskilled and less educated labor in the entire economy (Pi & Fan, 2020). Although technological advancement typically enhances production and improves labor productivity, it also increases the chances of unemployment in the economy by removing a large number of employees (Ghimire, Skinner & Carnathan, 2020). New innovations could potentially disrupt the labor market by expelling a significant percentage of employees with lower skill sets or with no higher education. The term low skilled labor are those with routine tasks jobs which can be replaced by technology and high skilled labor are the ones whose productivity level is comparatively appreciated by technological innovation (Petropoulos, 2018). Studies done by Frey and Osborne (2017), follow an occupation-based approach which assumes that whole occupations rather than single job-tasks are going to be automated by technology. Authors such as Autor, Levy & Murnane (2003) strongly stated that technology can and will replace human labor that consist of routine tasks. Tasks such as airport check ins and supermarket cashiers are occupations that can be performed by technology. As many modernised and stable countries become more technologically savvy and the development of artificial intelligence gaining more popularity, the number of routine task jobs in various industries will face the threat of replacement by innovation.

The impact of artificial intelligence on the labor market may create uncertainty amongst the population. As stated in Petropoulos (2018), the demand is rising for high skilled jobs that require non-routine cognitive skills and low skilled jobs with non-routine manual skills. Relative to such rising demand, the need for middle class jobs which typically require routine manual and cognitive skills will face decline, developing job polarisation which is the disappearance of middle class jobs (Petropoulos 2018). Darvas and Wolff (2016) conducted a research considering these following European countries: France, Germany, Italy, Spain, Sweden and the UK. All

these countries mentioned, presented results indicating that the number of higher education occupations such as engineers, managers and health professionals is increasing, while the middle education jobs such as machine operators, assemblers and clerks are decreasing. Whereas lower education occupations like shop workers which require non-routine manual skills are growing in numbers (Petropoulos 2018). The growing numbers are an indication of workers whose occupations require non-routine based tasks who may be required to perform unexpected cognitive thinking with manual skills. For example, cashiers are an occupation as stated previously that have been increasingly overtaken by machinery due to it's repetitive procedures that makes it easy to be replaced. The concerns of replacing all humans to automated machines will increase but knowing that there will also be cognitive problem solving tasks that can not be replaced holds a strong statement that change will not happen as rapidly as it may be portrayed.

Many industries have shown AI adaptations which raises concerns for employees of possibly being completely replaced. The graph represented by Genesys ([www.genesys.com](http://www.genesys.com)), surveyed how employed Americans responded to artificial intelligence in various workplaces. With the fear of AI possibly taking over their jobs. The percentages shown in Figure 4. indicates the population believing that there may be a possibility of machines taking over their jobs in the next

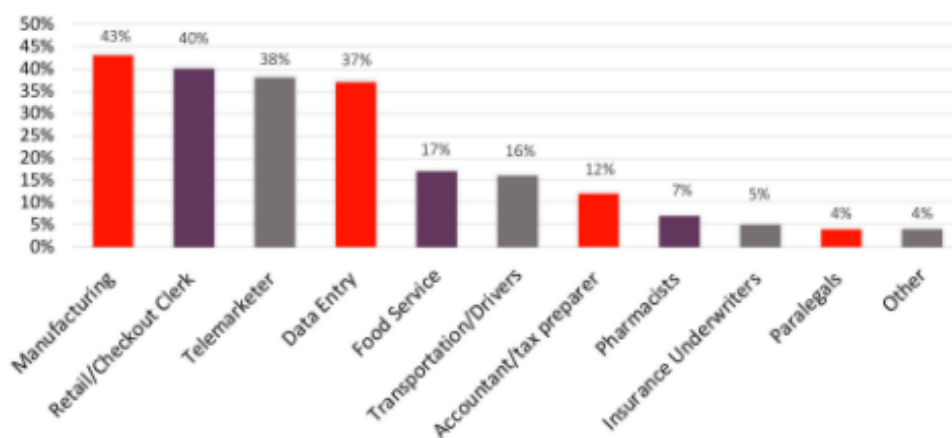


Figure 4. U.S. employees' perspectives on the jobs most at risk from artificial intelligence in the workplace

10 years. The workforces in industries such as manufacturing, retail, telemarketer and data entry fear the potential impact of artificial intelligence. On the other hand educators, nurses, doctors, and caregivers are the least afraid of AI possibly taking over in the coming years. Frey and Osborne (2017) claimed to believe that 47 percent of the United States jobs were at risk of being automated in the near future. Another author named Bowles (2014) estimated the risk percentage for the European labor market and came to the conclusion that 54 percent of EU occupations are at risk of computerisation (Petropoulos 2018). These authors considered the occupation based approach for the calculation of the estimate percentage. All the numbers mentioned depend on the approach an author takes for the estimation of threat. There is the occupation based and task based approach for the estimation of future job loss. Deriving on predictions that occupations are being threatened by automation rather than single tasks of a job (Petropoulos, 2018). When considering the task based approach, at an individual level, the number would estimate a lower result of 9 percent of US jobs becoming automatable (Petropoulos, 2018).

#### **5.4 The Rise of Robotics in the Economy**

The law of demand dictates, when the price of a product decreases, quantity demand increases. According to the International Federation of Robotics (IFR), the price for industrial robots between 1990-2005 has approximately fallen by about one half in several developed economies and with quality improvements considered, the decrease in prices can be observed as even lower (Michaels, & Graetz, 2015). The interpretation of industrial robots according to the International Organization for Standardization (ISO) are an automatically controlled, reprogrammable and multipurpose machine with either a fixed or non fixed placement (Michaels, & Graetz, 2015). The following three questions below can determine if a machine can be classified as an industrial robot (Petropoulos, 2018).

- “Does it have multiple purposes?”
- “Can it be reprogrammed to perform another task?”
- “Does it require human control for performing its task?”

The IFR states that the deployment of industrial robots worldwide will increase to an approximate number of 2.6 million units by 2019 (ifr.org). Such accelerated decline in the price of robots has provoked the growth of robot densification and robots employment (Petropoulos, 2018). 70 percent of the automated machines operate in the automotive, electrical/electronics, metal and machinery sectors (ifr.org).

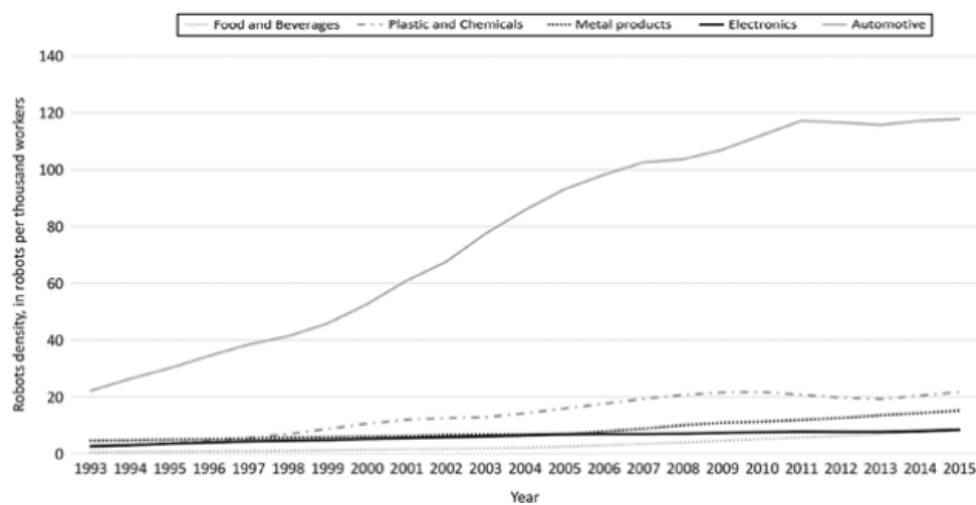


Figure 5. Robot density in several industries in Europe (Petropoulos, 2018) Source: Datafrom EUKLEMS (2017), IFR (2016).

Considering the European economic landscape, Figure 5 demonstrates the industrial robots distribution in several sectors per thousands of human workers (Petropoulos, 2018). The increase of industrial robotics usage in the automotive industry is very distinctive compared to the Food & Beverages and Plastic & Chemicals economic sector. Indicating that the implementation of automation in the production process is experiencing a rapid growth.



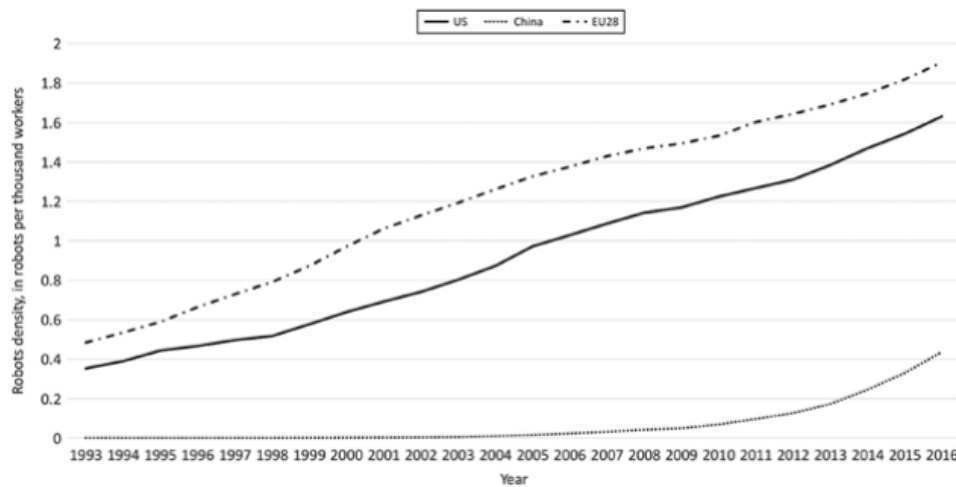


Figure 6. Robot density in China, EU and US. Source: Data from International Labor Organisation (2017), IFR (2016). (Petropoulos, 2018)

Figure features three economic powerhouses of the world, the United States of America, the European Union and China. The European Union displays the most use of robots per thousands of human workers compared to the US and China. Analysing the graph, the growth of robot densification can be clearly seen and indicates that the expansion of automatisisation is becoming more prominent as the price of machines is decreasing. As robot densification increases, nations with high numbers of robotics implementation have observed a significant difference in their labor productivity and value added per worker (Michaels, & Graetz, 2015). With growing numbers of utilising robots and striving innovation into the working environment, people fear that the employment rate will decline and create unfavourable economic conditions as it happened in the past (Nuvolari, 2002).

## 6 Psychological and Ethical Challenges

One important question is whether empathy and artificial Intelligence can coexist. It is evident that AI has interfered and will continue to evolve in many aspects of our lives but will it be able to perform emotional intelligence and ease people's perception of robotic enhancement. Health systems and psychiatrists are already experiencing a high demand in their field and it is predicted to only increase. According to the US

National Council for Behavioral Health (<https://www.thenationalcouncil.org/>), a 2017 report indicated that there will soon be a shortage of over 15,000 psychiatrists in the upcoming years. We are now in the year 2021, experiencing a world Pandemic with strict lockdowns that has caused many mental distress from young to elderly people with limited help to guide them through these uncertain times. AI scientists and proponents have shown their abilities to possibly impact and help mental health practitioners. Although psychiatry is a human operation field, requiring emotional intelligence, many experts detect that AI could play an enormous role impacting this specific sector. AI could help with the ability to pick up on patterns, analyse data and even signs of concerns from humans to avoid health emergency situations. A research professor at the University of Colorado Boulder, Peter Foltz (Ducharme, 2019) says, “Patients tend to be remote, it’s very hard to get appointments and oftentimes they have to be seen by a clinician once every three months or six months.” Therefore, AI would be an effective way to incorporate for clinicians to best help and care for their patients. It could possibly be the bridge between the gaps, to access and assist patients more accurately. AI-aided data analysis could help identify patients’ diagnoses more rapidly by starting with specific treatments. Professor Foltz also states that incorporating AI apps could allow for doctors, psychiatrists, and clinicians to monitor their patients remotely (Ducharme, 2019). The accessible information could save the lives of many patients who have mental distress. This is not to replace the human psychiatrists and the basic human interaction that many patients need. These AI procedures are to provide data and insights that will streamline treatments effectively but not to eliminate the human element of medicine.

When speaking of AI and how it could psychologically have an effect on our society, Sophia, the social humanoid robot can not be excluded. Sophia raised many people’s attention when it was presented in 2016. This unique robot has sparked attention all over the world and has gained recognition world wide. It also raised many questions about what this means for our future. For now, it may be a new innovative creation where engineers look to enhance but the question remains how this may change and shape our future. The concept of communication between artificial intelligence and humans establishes distinctive opinions amongst influential people (Guzman & Lewis,

2020). Ginni Rometty, the executive chairman of IBM quoted “Some people call this artificial intelligence, but the reality is this technology will enhance us. So instead of artificial intelligence, I think we'll augment our intelligence.” Stephan Hawking, on the other hand who was a theoretical physicist and cosmologist had negative speculation on artificial intelligence (Larsen, 2005). He stated that the advancement of a full artificial intelligence could cause the extermination of the human race. To better illustrate the quotes, from a business point of view, implementation of artificial intelligence would increase productivity and decrease costs. For theoretical scientists or people generally disliking the thought of technology altering everyday life are of course subjected to negative opinions towards artificial intelligence. It also raises the question of all the ethical challenges. With AI having more control over systems and algorithms it may become more difficult to detect information that is being misused. Also, another altering challenge would be tolerating advanced autonomous systems making ethical decisions without guidance and supervision of humans (Wallach and Allen, 2009). Many developers and engineers are adapting to systems that show the ability to make ethical decisions for machines (Dennis, Fisher, and Winfield, 2015). These are associated with computer ethics that were given to machines for guidelines to help machines identify ethical frameworks for decision making skills (Anderson and Anderson, 2011). Ethical issues are very serious and too multidimensional for robotic systems to solve on their own. It is an uneasy concept to fully digest and understand but it has also shown that whether we are all ready for it or not, AI will continue to advance and have a psychological and ethical effect on our nation.

## **7 Methodology**

A methodology is a “contextual framework” used for research (Gergen, 2015). There are multiple methods of gathering valuable answers to make a particular research credible. The objective of this part of the thesis is to identify how artificial intelligence has been utilized in the current economic system and what the prevailing speculations are towards the further implementation of artificial intelligence technology. The following sections will also help identify if firms are currently operating with AI applications and whether they are planning to implement AI in the future. The first steps of gathering results are through choosing a research method that best represents the outcome. Once the research method has been identified, survey design for data collection as well as sampling are the next steps that need to be taken in order to best prepare for the data analysis/results.

### **7.1 Research Methods**

The necessity of choosing the right methods for the collection of various data is of high importance as it can be essential for determining how and what type of information is needed. Research methods are the process, techniques and strategies used in gathering of information for the analysis and interpretation in order to enlarge a better understanding of the phenomenon (Williams, 2007). Within a research method, there are three different fundamental forms, quantitative, qualitative and mixed methods. Each design serves its purpose and is used, depending on the factors of the research paper. When considering which of these methods suits the most for the thesis, it is imperative to understand the difference because of the various strategies and tools used for the collection of data. The formulated research questions will support a better understanding of the topic of the thesis.

- *To what extent is artificial intelligence utilized in the current economic system?*
- *What are the prevailing society’s perceptions (positive or negative) of the implementation of artificial intelligence?*

The quantitative research approach assembles numerical data that can be ranked, estimated or classified by statistical analysis as it presents results in quantities or numbers (Patten, & Newhart, 2017). It supports the exploration of habits or correlations and to make standardisation. This form of research is effective for discovering the different values in numeric forms. There are two main designs in a quantitative research approach, the experimental design and the non-experimental design. The experimental design segregates the established phenomenon in controlled or non-controlled surroundings and monitors the circumstances under which the experiment takes place (Rutberg, & Bouikidis, 2018). The researcher examines the treatment of procedure in the sample population and then tests the effects of the treatment (Williams, 2007). The quantitative research non-experimental design describes the phenomena, identifies the existence of a relationship between the factors and the influence dependent variables have on independent variables (Williams, 2007). Such design provides researchers the necessary information to study the relationship between independent and dependent variables. Researchers operating the quantitative research method conduct structured surveys/questionnaires with an objective format or experiments for the collection of numeric data (Rutberg, & Bouikidis, 2018). Such data collection tools can produce information that can be easily translated to numbers (Patten, & Newhart, 2017).

The qualitative research approach is the collection of discussions of trends and themes based on statements and not in a numeric form that can be analysed in a statistical method (Patten, & Newhart, 2017). Qualitative research collects information on personal encounters, feelings or attitudes and the interpretations that people provide. It enables researchers to develop a deeper understanding of abstract ideas, social trends or cultural phenomena. The usage of qualitative research design can be useful in answering the questions how it occurred or why things have occurred, for the interpretation of events and determining certain attitudes. Qualitative research methodology is mostly utilized where the topic is not entirely understood and there is an existing urge to investigate the problem extensively (Rutberg, & Bouikidis, 2018). According to Creswell 2014, the qualitative method indicates the use of ethnographies, case studies, narrative research, phenomenological research and

grounded theory (Creswell, 2014). Ethnography is a design for identifying common behavioural patterns, language, and actions of an established cultural community in a natural environment over a significant period of time (Creswell, 2014). Case studies is an approach where researchers analyse a scenario, event or process of individuals by a specific time limit (Creswell, 2014). Narrative research is the collection of personal stories from individuals (Creswell, 2014). Phenomenological research is a design to support researchers in understanding the participants' point of view from an experience for identifying the central underlying meaning (Creswell, 2014). Grounded theory is an approach where the theory is created from collected information (Creswell, 2014). The tools used in the quantitative approach for collecting information are open-ended questions, observations and conducting interviews in a natural environment.

The mixed methods research approach is the combination of both, quantitative and qualitative research strategies in a single study (Williams, 2007). It is the collection and analysis of not only numerical data from the quantitative research method but also narrative data from the qualitative research method (Williams, 2007). The mixed methods research approach displays the possibility of enabling researchers to gather two sets of data with the potential of combining the information and drawing conclusions from the results (Rutberg, & Bouikidis, 2018). This approach therefore uses the same methods used in the quantitative and qualitative research approach for the collection of data.

When conducting a research, the quantitative approach is chosen when the research questions demand numerical data and the objective is to investigate the correlations among variables. The qualitative approach is selected when the research questions require the interpretation of events and in text information. The mixed methods approach is applied if the research questions appeal for both textual and numerical data. As this study aims to identify how utilized artificial intelligence is in the current economic system and whether the speculations of the society of AI is either positive or negative, the author of this thesis has decided on the usage of the qualitative approach. This particular research had limited research available due to its fairly newest developments, hence the research is exploratory and aims at understanding

the various applications and impact. The research questions of this thesis demand the insights and experience preferred sample population have regarding AI. The author has utilized open-ended questions for gathering information, as it is often applied for measuring public opinion (Geer, 1998).

## **7.2 Survey Development**

A survey is a research tool utilized in gathering data from a sample of a population to obtain insights and information of a chosen subject. The central objective of this survey is to answer the research questions of the thesis. As the nature of this paper and its research topic requires a phenomenological approach, the online survey was created to explore how influenced artificial intelligence technology is in the current economy and examining what the perceptions are towards it. The first part of the survey includes close-ended questions for only collecting demographic factors to identify the background information of the participants. The main part of the survey contains open-ended questions to best collect the participants' experience and perception. Open-ended questions provide the participants the opportunity to share their responses in their own words. This survey was done through a qualitative questionnaire instead of a personalised interview due to the current COVID-19 pandemic regulations.

The close-ended questions of the survey tries to identify the age, gender, current location and the highest educational degree they have received. Qualitative research ought-to collect demographic information in spite of whether diversity is desired in the research (Patten & Newhart, 2017). It also requires the participants to state if they are employed or not and in which industry and position they work. This is an important factor for answering the next part of the survey, the open-ended questions as it requires the participants to answer their experience with artificial intelligence in the current workspace and what their perception is towards it. The level of accessibility for artificial intelligence applications and devices do affect the survey's result depending on the participants location as technological advancement varies amongst countries. It was very important to have a pre-evaluated audience in the particular field for the survey to be most effective.

Another section of the survey consists of questions that investigate the participants level of knowledge on AI technology, experiences and influences. For these questions, the respondents are asked for detailed descriptions of their working experience, perception of and the familiarity with artificial intelligence technology. The first subsection of the main part of the survey asks the familiarity and experience the participant has on integrated artificial intelligence devices. This inquiry helps the author identify if the usage of AI technology is increasing. The subsection also determines what the utilisation volume of AI applications is in the workplace of the participant. It establishes the level of efficiency such technology has in the current economy. The second subsection of the main part of the survey looks into the perception the participants have towards AI technology. It asks for opinions of the respondents on how AI can increase productivity/efficiency of certain industries and what the potential dilemmas it may produce.

In the beginning of the survey, it states to the participants to provide answers as detailed as possible to avoid superficial responses. In the introduction of the survey a brief explanation is written in order to clarify the project to the participants. Although the respondents are all located in Europe and more specifically in German speaking countries, the online survey was created in the English language to avoid the alternation of answers and opinions when translating. The online survey is available in the appendix.

### **7.3 Sample**

The author of this thesis determined that the judgement/purposive sampling method is the most suitable one. The purposive sampling strategy is the selection of certain individuals who can contribute substantial information (Patten & Newhart, 2017). The research questions of this thesis demand a sample of a population with some knowledge on artificial intelligence. As the objective of a research is to extract a great extent of information, the criterias to part take in this survey were, the participant must have completed secondary education or above, must be currently employed in a corporation and have little to some knowledge on artificial intelligence technology. Once sample population have been identified, the respondents are approached



through various channels. First, a mass email was sent out to those with contact information available which were 23 potential participants, Secondly, social media platforms such as WhatsApp, Instagram and Facebook were used for follow up messages and reminders for participants to fill out the qualitative survey. In addition, another group of participants are those who currently are in the workforce working for specific companies with exposure to AI applications. These particular respondents often have 9 to 5 pm job and are constantly on a look out for the next new and innovative creation. Applying the judgement/purposive sampling method allowed for a detailed sample of a population rather than making statistical references.

#### **7.4 Data Collection**

In order to reach out to the participants, a google form with a link was utilized to send out the online survey. It was created with simple structures and instructions that were easy to follow in order to avoid any complications. In an effort to reach the qualifying respondents, multiple email reminders, text messages and phone calls were diligently executed in order to acquire all participants to fill out the survey. The online survey was sent out between the 29<sup>th</sup> of March and 12<sup>th</sup> of April through email, Whatsapp and Instagram, a social media platform. The closing of the survey was on the 27<sup>th</sup> of April giving the participants almost a month to complete. The survey was estimated to take approximately ten minutes. The survey was sent to 23 participants and 17 completed the survey. The data is collected through an excel sheet provided through the google form suite.

#### **7.5 Ethics**

The respondents voluntarily answered the questions of the survey. The purpose of the survey was explained in the introduction. There were no questions asked about their personal information such as names or emails, to maintain the anonymity of the answers. There is no intention on sharing the collected primary data to any other organizations or any third parties. The participants were also asked to sign a general data protection regulation (GDPR) at the end of the survey, giving permission to the researcher to use the answers for research purposes only.

## 8 Results

In the following chapter of this thesis, the collected and analyzed primary data will be showcased. The purpose of this paper was to gain enough information to answer the research questions. In this thesis, the researcher investigated the questions: *To what extent is artificial intelligence utilized in the current economic system?* and *What are the prevailing society's perceptions (positive or negative) of the implementation of artificial intelligence?*

The first section of the chapter's results will be reviewing the demographic factors of the participants. The age, gender, location and the highest educational accomplishments. The second part will display the results of open-ended questions regarding the influence and perception of artificial intelligence technology. All the statements and answers of the participants will be thoroughly examined in this chapter to best summarize the content.

### 8.1 Sample Characteristics

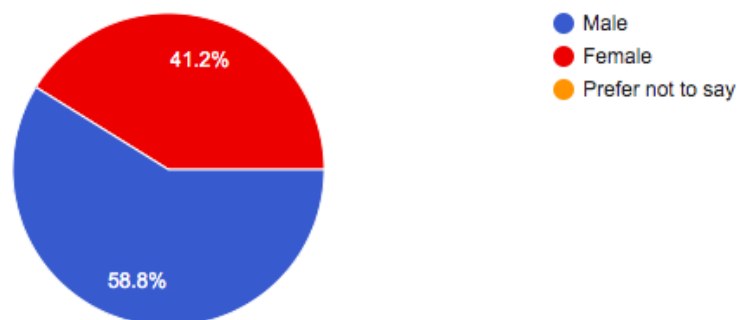
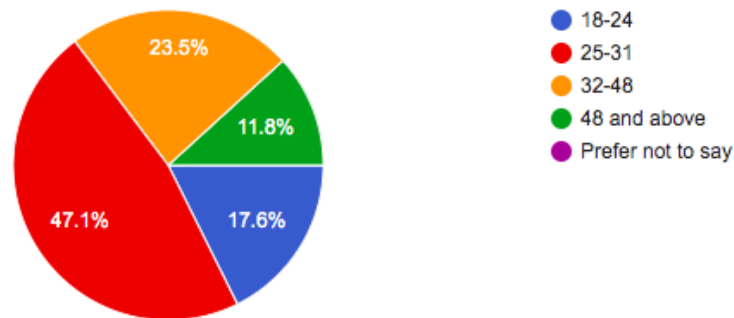


Figure 7. Gender distribution of participants

A total of 17 have participated and completed the extended qualitative survey. In Figure 7, the collected information displays that 58.8% of the participants are male and 41.2% are female. None of the participants chose the option 'Prefer not to say'. Figure 7 indicates the overall participants of both male and female of the entire survey.



*Figure 8. Age distribution of participants*

In Figure 8, the age distribution of respondents displays that none of the participants chose the category 'Prefer not to say'. 17.6% of the respondents are aged between 18-24, 47.1% are aged between 25-31, 23.5% are aged between 31-48 and 11.8% are aged 48 or above. Figure 8 also shows that a large majority of the participants are young adults aged between 25-31.

The demographic factor regarding the participants current resident location was another criteria for the survey. The current resident location was important to acknowledge due to different acknowledgement of AI integrated devices in various counties. An additional criteria was whether the participant had some standard knowledge of artificial intelligence. This would be a crucial part of gathering valuable information because if participants came from countries with less accessibility to high functioning computer systems and smart phones this survey would result in a halt for the particular participant. Therefore, people having knowledge of AI applications were more likely to continue and contribute to the completion of the survey.

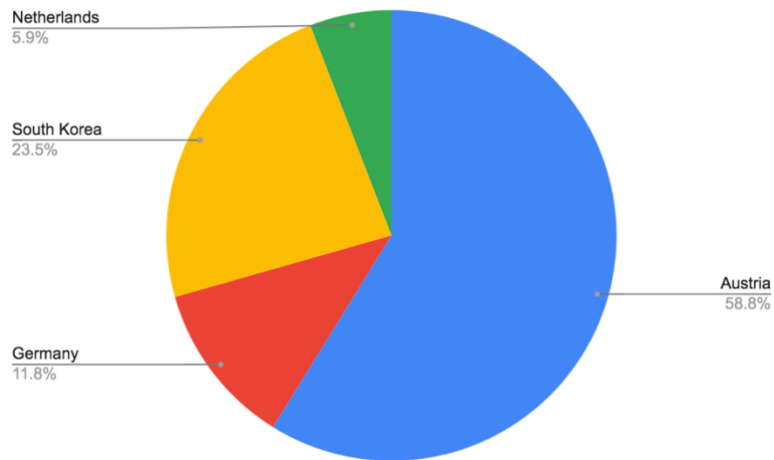


Figure 9. Location of participants

Figure 9 displays that a significant amount of the participants, 58.8% are currently located in Austria. 23.5% are located in South Korea, 11.5% in Germany and 5.9% in the Netherlands. The countries listed in Figure 9 are regions with accessibility to artificial intelligence integrated devices.

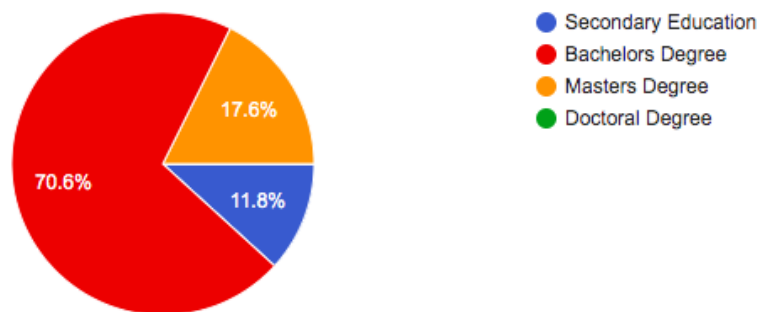


Figure 10. Educational achievement of participants

One of the criterion's to partake in the qualitative survey was to have a minimum secondary education completion. Figure 10 indicates that none of the participants have completed a doctoral degree and that more than half, 70.6% of the respondents have achieved a bachelor's degree. 11.6% of the participants have completed the secondary education and 17.6% have received a master's degree.

## **8.2 Data Analysis**

The selecting and organizing of the collected primary data was conducted with a qualitative content analysis. The content analysis is utilized for identifying messages and themes, therefore the approach was considered by the researcher (Mayring, 2004). As the qualitative research concentrates on the interpretation and recognition of the gathered information, it was crucial to best analyze the written answers given by the participant. The approached method and content analysis for each completed survey was adequate for this thesis. The qualitative content analysis method establishes themes from the in-text or communicated data (Mayring, 2004).

### **8.2.1 Level of Influence of Artificial Intelligence**

Identifying how influential AI is in the current economy was one of the questions that was asked through the open ended question survey. The researcher then identified a common theme amongst the participants. When analyzing the collected primary data, many of the participants encountered artificial intelligence integrated devices. The respondents shared common experiences such as Alexa or other AI voice assistance and chatbots. From the 17 respondents, the level of familiarity of artificial intelligence applications does not vary significantly amongst the participants. There were several respondents that have higher cooperation's with AI technology. From the detailed analysis of the collected information, participants who work with innovations technology have a well-rounded knowledge and often worked directly with artificial intelligence applications, compared to participants working in non-innovative departments. There were also tendencies where respondents who work more frequently with AI in their working environment displayed higher usage of artificial intelligence integrated devices in their own homes. It was a clear theme that was recognizable amongst the respondents. Additionally, another common theme that was evident came from the question *"How would advancing AI grow efficiency in certain industries?"*. The common answers to this question were e-commerce with high data processing analytics and the acceleration of the manufacturing processes. These answers were identified because most respondent's comprehension of efficiency was built on the foundation of AI robotic machines working more effectively for faster results. Many of the respondents have also stated that the company they

work in apply artificial intelligence applications such as demand forecasting, data prediction and chatbots for customer inquiries.

### **8.2.2 Perception of Artificial Intelligence Technology**

To further contribute to the topic of this thesis and to best analyze the research questions *'What are the prevailing society's perceptions (positive or negative) of the implementation of artificial intelligence?'*, this chapter is dedicated to identify the positive or negative perspectives the participants have towards AI applications/technology.

Experiencing and witnessing the influence of artificial intelligence in the overall economy, participants have constructed certain opinions towards innovative technology. One of the open-ended questions asked in the qualitative survey was *"What are potential dilemmas with AI becoming more evident in our current economy?"*, which answers did not vary amongst the respondents. Many have stated that the growth of artificial intelligence technology can disrupt the employment rate and decrease the need for human capital. Most of the answers provided by the respondents have a dominant negative aspect towards AI. Replacement and job loss are the two main common themes that were identified in the responses. A concern from a particular individual stated that the advancement of artificial intelligence can improve and make deep fake technology appear more legitimate, which can alter digital media, making it more difficult to separate real information from fake information.

Another participant mentioned that some replacements of jobs have already begun. Jobs that do not require a higher level education or long training hours are being overtaken by automation. At grocery stores, self-checkout machines are a prime example of human labor replacement. Although such technology does not require artificial intelligence applications, it was an example given by the participant when the question was about potential dilemmas. Amongst the 17 participants of the survey, the ones already working with AI technology displayed a positive outlook on the possible future modifications of AI and were less fearful of the unknown changes that

artificial intelligence could contribute, due to their already existing interactions with AI.

While analysing the content of the qualitative survey, some of the respondents had more of a positive outlook on AI increasing efficiency of the economy. One of the respondents stated that artificial intelligence “would cut outdated jobs but again would create new jobs in the future”. This statement acknowledges that there is no consensus on AI creating or eliminating jobs in the future as stated in the above content of this thesis (Winick, 2018). It is well received that there will be new jobs created that will require varieties of skills and training but this was not of enormous concern. Overall, the responses indicated both a negative and positive outlooks on the implementation of AI. Although the development of artificial intelligence technology continues to evolve, a small fraction of the participants saw the overall potential of its growth for efficiency in our economy.

## **9 Conclusion**

The aim of this thesis was to identify how utilized artificial intelligence is in the current economic system and what the society’s perceptions are towards the implementation of such technology. The researcher conducted secondary research to recognize the impact level of AI and the various concepts (positive and negative) it may have created. Innovation has been a factor that allowed for optimistic and/or pessimistic opinions. Although artificial intelligence is a program that can result in increased efficiency in various industry sectors, it also displayed a concern in the disruption of the labor market.

Technology as advanced as AI can potentially eradicate repetitive work, which can eliminate the need for unskilled jobs. Corporations such as Amazon and Alibaba have applied artificial intelligence in data analyzation to understand customer behavior and to increase customer traffic. Tesla employs AI in their vehicles for autonomy and Airbus utilizes AI in designing the next generation aircrafts. The Bayerische Motoren Werke (BMW) uses artificial intelligence in the manufacturing process and quality

control by reducing the need for human labor. A major conclusion that can be remarked on is the high level of utilizations of AI in the current economic system. Another finding through this thesis was that advanced technology being implemented in companies with initiative training were less fearful of replacement and participants who were worried of AI possibly replacing employment proved to have less interaction with artificial intelligence in their work environment. The data gathered from the qualitative survey with the particular questions on “how utilized AI is in the current economy” and “how the AI implementations are perceived”, has supported the literature review. Regarding the utilization of AI, it is proven through the literature review, as well as the survey that participants experienced and witnessed the reinforcement of AI functions in some business operations. Also, the results on participants replacement fears were expected due to the rapid growth of AI. The survey served as a validation to the already expected speculation that people were fearful of the new changes (Frey & Osborne, 2017).

With technology gradually changing the labor market, it will require different skill sets and training for new employees to adapt to AI implemented applications. People have already been exposed and experienced AI in various industries and it is only a matter of time for AI to multiply in its functions. Society will always have either a positive or a negative perception of AI implementation, therefore it will always be important to make changes that will not be skewed too much from our common equilibrium.



## **10 Limitations**

This study encountered a limitation during its research. The research was conducted during the Covid-19 pandemic, forcing regulations and lockdowns. Such continuous regulations and lockdowns prevented the author from conducting in-person interviews for more in depth results. The author utilized open-ended questions as an alternative to receive answers. Online interviews were the initial instructions to conduct a one on one interview for a more detailed and personal outcome. During the early stages of navigating the process, the challenges were that participants did not have enough time or were overwhelmed with their current workload that they often cancelled a zoom meeting. Soon after recognizing the limitations for having enough participants, the research was conducted through an online open-ended survey.

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## Appendices

### Appendix 1 - Qualitative Survey 'Artificial Intelligence'

Dear Participants,

Your opinion is of importance to us.

The aim of this survey is to explore the world of artificial intelligence (AI). As AI continues to grow its awareness and capabilities in our economy, we would like to hear your experiences and opinions on this matter. We would really appreciate your time to partake in this open-ended survey with as much details as possible. Thank you once again for your valued time.

1. How old are you?
    - 18 – 24
    - 25 – 31
    - 32 – 48
    - 48 and above
    - Prefer not to say
  
  2. What is your gender?
    - Male
    - Female
    - Prefer not to say
    - Other
  
  3. In what country are you currently living in?
-

4. What is the highest educational degree you have received?

- Secondary Education
- Bachelors Degree
- Masters Degree
- Doctoral Degree

5. Are you currently employed?

- Yes
- No

6. If yes, which industry do you work in and what is your current position?

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7. How familiar are you with artificial intelligence integrated devices? Can you please share your experiences (e.g. chatbots, Alexa, other voice assistance, etc.)?

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8. In the company you currently work in, how utilized and efficient are AI applications? Please give detailed examples.

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9. How would advancing artificial intelligence grow efficiency in certain industries?

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10. What are potential dilemmas with AI becoming more evident in our current economy?

---

11. Have you experienced or witnessed the influence technology has on certain industries? Please explain.

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12. Is there anything else you would like to share about your experiences with AI?

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- By answering and submitting this survey, you are giving permission for your answer to be used for research purposes only.