

**PEOPLE'S DEMOCRATIC REPUBLIC OF ALGERIA**  
**MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH**  
**UNIVERSITY OF MOHAMED BOUDIAF-M'SILA**

FACULTY OF LETTERS AND FOREIGN LANGUAGES

DEPARTMENT OF ENGLISH

N°: .....



DOMAIN: FOREIGN LANGUAGES

STREAM: ENGLISH LANGUAGE

OPTION: LITERATURE & CIVILIZATION

**The Impact of Artificial Intelligence on Industry.  
Case Study of U.S Automotive Industry**

**Dissertation Submitted to the Department of English in Partial  
Fulfillment of the Requirements for the Master Degree**

**Submitted By:**

BAALI Asma

**Supervised By:**

Mr. BOUTKHI Guemide

**2017/2018**

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**2017/2018**

**Declaration:**

I hereby declare that this dissertation is my own original work, which I have created myself.

All the literature I used is properly quoted and is listed in the Bibliography.

I declare that I worked on my final master's thesis on my own using only cited literary sources, other information and sources in agreement with the disciplinary regulations for the Faculty of Letters and Languages at the University Mohammed Boudiaf of M'sila and with the regulations and laws of research of the Ministry of Higher Education and Scientific Research in Algeria.

I agree with the storage of this work in the library of the Faculty of Letters and Languages at the University Mohammed Boudiaf of M'sila and making it accessible for study purposes.

Baali Asma

.....

M'sila: .....

## Abstract

In the United States, the adoption of artificial intelligence occurs through a complex system that contributes greatly to industrial performance, especially in the automotive industry, which is considered the largest manufacturer in the states, and the major beneficial of AI machines. This technology also pushed many giant companies to invest in AI-based startups to enhance their services. Thus, AI is the key to economic growth that shapes an agenda for the field. However, today's industries face a challenging mission of the disruptive potential of AI and how to make it more useful than ever. The purpose of this paper is to identify AI potential in industrial growth and car production and analyze the effects of a technological improvement in the U.S industry. Also, in this study, we try to answer questions as what are the advantages of AI in the auto industry? And how far can AI go to achieve its goals in developing the U.S automotive industry? The analysis shows that artificial intelligence gave birth to advanced industries and giant companies in the United States, and it contributed to the industrial growth in the U.S automotive industry. T2he main reason behind the success of the U.S industry and economy is the effectiveness, disruptive potential, and creative innovation of artificial intelligence.

**Keywords:** Artificial intelligence, robotics, innovation, manufacturing, automotive industry (US), advanced industries, economy.

## **Acknowledgement**

All praise and glory be to Allah who has guided me to this destination, and has helped me along the year to fulfill this modest work. Thanks to Allah, the most graceful, the most compassionate and the Almighty, I was able to achieve this success.

I would like to thank my supervisor, Mr. Boutkhil Guemide for all the support, help, and guidance

I would also like to thank the board of examiners for accepting to analyse and refine this work.

# Dedication

First of all, this work is dedicated to the persons who are enlightening my life, to my beloved parents. They give me everything I need just to see me happy and successful in my life.

I am forever indebted for their care, love, grace, and endless support. Whatever to say I cannot thank them for everything they offered for me. Dear father and mother, thank you for being my champions for the past 23 years

## List of Abbreviations

**AI:** Artificial intelligence

**CPU:** Central processing unit

**FCA:** Fiat Chrysler Automobiles

**GDP:** Gross domestic products

**GM:** General Motors

**GOFAI:** Good Old Fashioned AI

**GPS:** Global Positioning System

**IBM:** International business machines

**LISP:** Locator Identifier Separation Protocol

**MIT:** Massachusetts Institute of Technology

**NAICS:** North American Industry Classification System

**PUFF;** data interpret lung tests

**R&D:** Research and development

**RCA:** Root cause analysis

**UNIDO:** United Nations Industrial Development Organization

**VAX:** Virtual Address Extension

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## **General Introduction**

### **1. Background of the study**

Artificial Intelligence is based on computer systems that can sense their environment by taking few steps including thinking, learning and then taking actions as a result, such ability in sensing environment distinct AI from automation in doing work. Artificial intelligence seems to be making a big push into the auto industry over the past years, and It has already made its presence felt across the tech world. Many factories realize the importance of AI in their area of work since artificial intelligence enhances workforce skills and increase work efficiency and productivity.

After recognizing the power of artificial intelligence, the American automotive industry continued to develop until the early 1970s. In the early 1980s, the industrial robot emerged, leading the race to create more productive and efficient robots. Such robots are able to do some jobs more reliably, longer, cheaper than the humans who currently fill the jobs can. Just as the case in the auto industry, as some companies race to dominate the use of AI. Thus, the auto industry is considered to be one of the global power in the industrial sector, and it is one of the most affected by artificial intelligence, as AI presents global coverage for the industrial sector, by 2020 there are expected to be 1 billion cars in the world. Therefore, AI will not just change the way cars are built, it will also change the whole business of how they get built

### **2. Statement of the problem:**

Artificial intelligence technology is making a huge impact on the industrial sector, let alone AI is transforming and changing industries from consumer cloud services to healthcare to factories and cities. The auto industry is undergoing a massive change with the onset of technologies that give other startups and establish car companies alike the chance to

shapethe future of the US automotive industry and incorporate new strategies to push the marketforward. Being this change positive or negative, AI is surely inevitable.

### **3. The literature review:**

The automotive manufacturing is considered one of the most important for the U.S. economy and it is the largest sector in the country. If car industry were a country, it would be the sixth largest economy. The car industry is relative regarding its impacts on the economy and artificial intelligence. Humphrey and Memedovic (2003) conducted in their study that the U.S. automobile industry is described as a capital-intensive industry with vertical integration and economies of scale. This feature has most likely affected the industrial production output, as well as workforce. According to that, artificial intelligence also shapes the auto industry production, and the skill level of workers. Technological progress is the main driver of growth of GDP per capita, allowing output to increase faster than labor and capital. One of the main ways that technology increases productivity is by decreasing the number of labor hours needed to create a unit of output. Labor productivity increases generally translate into increases in average wages, giving workers the opportunity to cut back on work hours and to afford more goods and services. Living standards and leisure hours could both increase, although to the degree that inequality increases—as it has in recent decades—it offsets some of those gains.

Research on artificial intelligence in the last two decades has greatly improved performance of both manufacturing and service systems. It suggests that technological innovation over this period increased the productivity of those engaged in abstract thinking, creative tasks, and problem-solving and was therefore at least partially responsible for the substantial growth in jobs employing such traits. Shifting demand towards more skilled labour raised the relative pay of this group, contributing to rising inequality. At the same time, a

slowdown in the rate of improvement in education, and institutional changes such as the reduction in unionization and the decline in the minimum wage, also contributed to inequality—underscoring that technological changes do not uniquely determine outcomes.

In the world of economy and capital labour, recent research suggests that the effects of AI on the economy in the near term will continue the trend that computerization and communication innovations have driven in recent decades. Researchers' estimates a seven percent on the scale of productivity growth over the next decade or. The economy has repeatedly proven itself capable of handling this scale of change. Although it would depend on how rapidly the changes happen and how concentrated the losses are in specific occupations that are hard to shift from (Furman, Holdren, Muñoz, Megan, and Zients, December 2016).

Studies on robots have been viewed from three dimensions- its navigation, robot's localisation and robot's participation in agent teams. In this context, Shatkay and Kaelbling (2002) described a formal framework for incorporating readily available odometric information and geometrical constraints into both the model and the algorithm that learns them.

In another work, Fox et al. (1999) presented a version of Markov localisation which provided accurate position estimates and which is tailored towards dynamic environments. The key idea to Markov localisation is to maintain a probability density over the space of all locations of a robot in its environment. The work here presents an entirely different environment from what obtains in the literature. Thus, it is a unique contribution to knowledge. Robots were linked to agent teams in an execution monitoring approach used to implement execution assistants (EAs) in two different dynamic, data-rich, real-world domains to assist human in monitoring team behaviour. The credit of the approach lies in that it

customises monitoring behaviour for each specific task, plan and situation, as well as for user preferences.

Moreover, Moraga, Trillas, and Guadarrama (2003) reviewed one particular area of AI, which roots may be traced back to Multiple-valued Logic: the area of fuzzy control. After an introduction based on an experimental scenario, basic cases of fuzzy control is presented and formally analysed. Their capabilities are discussed and their constraints are explained. Finally, it is shown that a parameterisation of either the fuzzy sets or the connectives used to express the rules governing a fuzzy controller allows the use of new optimisation methods to improve the overall performance.

In their study, Stefanuk and Zhzhikashvili (2002) carried out an analysis of the production and rules in the way they are used in AI systems. The proposed new definition for productions refers to a large number of types of production that may be found in the literature on AI systems. This definition emphasises in the most general way those production components that are important both for theory and for practice and which for some reasons remained unnoticed by many researchers. These components are supplemented in a theoretical formalism that concludes the paper.

In the area of manufacturing, Toni, Nassmbeni, and Tonchia (1996) proposed an artificial, intelligence- based production scheduler. The production scheduler utilises a hybrid push/pull approach to scheduling and exploits the expert system technology in order to obtain satisfactory solutions. The scheduler is applied to a multi-stage production and inventory system, managed by make-to-order, with a large variety of incoming orders.

Another interesting research was carried out by Bhuyanb (2003) on tea quality prediction using a tin oxide-based electronic nose with an AI approach. In the research, the authors analysed using a metal oxide sensor (MOS) based electronic nose (EN) five tea samples with different qualities: normally drier month, drier mouth again over fired, well fermented normal

dried in oven, well-fermented over-fired in oven and under-fermented normal fired in oven. Mainly its taste and smell determine the flavour of tea, which are determined by hundreds of volatile organic compounds (VOC) and non-volatile organic compounds present in tea. Tea flavour is traditionally measured through the use of a combination of conventional analytical instrumentation and human organoleptic profiling panels. These methods are expensive in terms of, for example, time and labour.

#### **4. The significance of the study:**

Artificial intelligence has a major driving force to the industrial growth and so the development of technology which has impacted significantly in virtually every sector of the United States economy.

In the U.S. automotive industry, electric engineering use computers in their day to day operations in order to provide the best quality and quantity of service to their customers via the use of modern day technology. Therefore, this study specifically aims to determine the significant role of artificial intelligence in the auto industry and industrial sectors in general.

#### **5. The research questions and hypothesis:**

The present research addresses to the following questions:

- What economic and social factors that gave impetus to the integration of AI in automobile industry?
- Which jobs will AI take over and what jobs will be created instead?
- Will the economy undergo deflation as software becomes a larger share of productivity?
- What companies are winning the race for AI?
- How automation is changing the future of the US automobile industry?

## **6. The aims of the research**

Artificial intelligence set to change the car industry in various ways is and has always offered new ways of innovation, as robotic machines are painting cars, burning welds, and handling materials. These robots are more effective and productive than human workers. Therefore, the automotive industry will no longer need human workers as well as financial advisors. Most products are automated with results. All is done in AI. My objectives from such research are to (1) discuss the industrial growth and economic boosts due to artificial intelligence, and (2) investigate about how innovation and automation shape the future of the U.S automotive industry.

## **7. The research methodology:**

In this research, we will depend on both descriptive and analytical methodologies. Descriptive methodology helps to identify and analyze the elements included in this topic, whereas the analytical one helps to explain the relationship between those elements and how and why they are happening. Those two methodologies are linked to each other. Descriptive methods are used to collect, analyze, and summarize data while the analytical one are used to extend the descriptive approaches through interpreting, comparing, and evaluating the available data.

In this research project, we will investigate the case of artificial intelligence on US industry, in addition to its economic impacts both positive and negative in the USA. The focus will be on the benefits of integrating artificial intelligence, as well as its disruptive potential. In addition to that, we will analyze how automation will help the growth of future innovation in the automotive sector. In this study, we will explain the industrial impact through the provision of the documents that fit the case such as diagrams and charts.

## **8. The structure of the dissertation:**

This modest work will be divided into three chapters. The first chapter will be about the definition of artificial intelligence as a whole and its applications. It will start with defining and explaining the use of artificial intelligence and its features, then it will move to the components of artificial intelligence and its types and applications. Finally, it will end up with the historical background from the mid 1950s we will discuss how artificial intelligence will contribute to economic growth. In the second chapter, we will give a detailed description and analysis of US economic structural change, before the WW1 till the 21st century as a result of the emergence of artificial intelligence as a global changing tool in the economic and industrial sectors. The main points that will be discussed within this chapter are: The impact of artificial intelligence on US economy and how AI is changing the economy due to AI-driven automation. Besides to some negative points, we will speak about the jobless future that AI will cause. In the final chapter, we will discuss the use of artificial intelligence in the US industry, and how the use of industrial automation will lead to more productivity and efficiency with new ways of innovation. we will take the example of the automotive sector, as it is one of the most affected industries by AI.

## **Chapter One: Overview of Artificial Intelligence**

### **Introduction**

The birth of modern Artificial Intelligence (AI) managed to be the centre of attention from the mid-1950's when John McCarty, coined the term of artificial intelligence for the first time in history. This led other researchers to think more openly and seriously about the blooming of this technology, as they started to build new systems and applications by developing new computational systems to assist their needs for technological progress. Many applications and programs have been under development, as researchers tried hard to make machines more intelligent and useful than before.

In the first chapter of this dissertation, we give a general overview and background about the emergence of artificial intelligence, as well as its different applications and use. The first formal emergence of AI all started in The Dartmouth Summer Research Project on Artificial Intelligence at Dartmouth College, USA, when it saw the first glimpse of artificial intelligence as a field, in addition to the "Turning Test", which was developed by Alan Turning in 1950 that later on proved the intelligence level of computers. This progress in artificial intelligence built a bridge to new, and creative inventions such as, AI Watson and Deep Learning that optimized the economic structure and business today.

## **1. The character of Artificial Intelligence:**

Artificial intelligence allows a constellation of mainstream technologies that are having a substantial impact on everyday lives. These innovative technologies are strongly tailored to particular tasks. Each application and type require years of specialized research and deep insights.

### **1.1. Definition of Artificial Intelligence:**

The definition of AI greatly varies according to the field of study and the use of it. John McCarthy, introduced his first academic conference in defining artificial intelligence as “the science and engineering of making intelligent machines.” Which is a simple definition that demonstrates the use of intelligence in machines. Nowadays, the concept of AI encompasses the whole definition that emphasis on both forms: operational and social consequences.

According to Russell & Norvig (2010), AI is defined as: “... the study of human intelligence and actions replicated artificially, such that the resultant bears to its design a reasonable level of rationality” (p. 13). This definition is quite divergent, which comes to discuss the very concept of “thinking machine”. As Russell and Norving is said to have picked the definition of AI from creating rational agents and performance metric to optimize.

In today’s dictionary, the definition of artificial intelligence is defined as being a sub-field of computer science and how machines can think and act like humans (Meriem Webster, 2016). However, Nilsson (2010) defined the term as: “... that activity devoted to making intelligent machines, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment” (p. 13). Nilsson provided his definition with prephirical and the cognitive processes, as well as neurological mechanisms of the human brain. Defining AI in terms of the humanstink rather than humanstask, opens the discussion of its theoretical applications today. Therefore, the meaning of AI evolves

overtime, which gives a fundamental insight of how innovative AI is, whether in terms or theory or practice.

## **1.2. The Goals of Artificial Intelligence:**

Achieving strong artificial intelligence is one ultimate goal for many researchers in the field of artificial intelligence. Recent research started to focus on a more tangible goal that is prone to make it a reality, than “primitive” AI in the early times. The emphasis put on helping humans to build a better society, rather than replacing humans. In general, in order to make this goal a reality; attaining natural processing, is at the core fundamental ground which needs to be applied to be achieved. So that AI will hopefully allow humans to make leaps and bounds in knowledge making humankind better.

### **1.2.1. Creating Expert Systems:**

To build a better and faster AI, expert system is needed in this process as it is built to solve problems in a particular domain. Thanks to this system, many inventions were built through developing computers that are capable to think and behave intelligently. Over time, expert systems dominated AI research, and evolved into a small commercial success, just as many Machine Learning today that are associated with artificial intelligence.

According to a study conducted by Simon (1995), the goal of artificial intelligence is to create expert systems to test intelligent behaviour in machines and develop its functions accordingly. Increasingly, this system brought the attention of the world, when this system developed a chess-playing program; the most influential of these are IBM’s Deep Blue, which defeated the world champion Garry Kasparov in 1997. The chess game has always been regarded as “the model organism”, as it brought the outer attention of many researchers, for its greater complexity that can arise from this game which had challenged human mental

capacity (p. 96). In general, the use of ES helped in building faster and stronger AI machines, in which it is still increasing today.

Yannakakis, Georgios, & Togelius (2018), identified in their book *Artificial Intelligence and Games*, that artificial intelligence game will be more innovative than before, and in the next two decades, it is likely to download public domain software that will perform much better than humans using a regular laptop (p. 21). This example goes to demonstrate that expert systems are the basic form of AI, which reinforces AI systems that are supposed to function much better than humans because they are able to solve complex problems in a short period of time by using more accurate algorithms and heuristics.

### **1.2.2. Modelling Human Intelligence:**

Fathy (2018) claimed that the ultimate objective of AI is to create a better vision than humans, with recent inventions have been applied to make AI more developed than before, where rigorous systems in machine learning and AI have started to build a new and more advancing AI from the most interesting organ in the real world: the human brain.

Cognitive science applies AI to have models based on theories of how the human brain works and its stimulations, then test its credibility to model, and this can be an issue since it is a kind of detaching relationship between research and practice; which means the duality of cognitive science and neurophysiology. As a result, putting those two into practice to implement human intelligence in machines (Turning Test) seems to take two parts: formal symbolic logical systems and sub conceptual neuron-based systems. These two are approaches of AI and known as GOF AI (Nilsson, 2010, p. 42).

Recent research has developed many AI programs that are able to “mimic” humans in almost everything, as AI entered the early stages of implementing human-like intelligence in machines, for instance, emotional AI which is the future AI, and it is considered the major

development so far. Researchers are still in progress in making AI surpasses human abilities (Greene, 2018).

For instance, IBM system is teaching AI how to “mentalize” human brain in machines, in research papers presented at the 2017 International Joint Conference on Artificial Intelligence held in Melbourne, Australia, IBM presented two studies: The first study intends to see how to grant AI an “attention span”, the second one examines how to apply the biological process of neurogenesis; which means the birth and death of neurons to machine learning systems. This system is based on attention algorithm that works most effectively when neural network achieves the highest reward, so if this latter increases more attention the network will push further (Tarantola, 2017).

Therefore, this alludes to how the dual work by using human cognitive models. It has become clear that one goal cannot be achieved without the help of the other part as AI recent research trying to uncover.

## **2. Approaches of Artificial Intelligence**

AI/Machine learning has a set of under-categories, based on how the model learns; it has insignificantly gained more popularity in the past decade. Big Data, is the latest trend in the tech industry that took singularity by storm, allowing machines to create machines and that’s how tech stories evolve.

### **2.1. Supervised Learning**

Russell & Norvig (2010) explained that supervised learning algorithm is applied for making future predictions on the training data, by creating models based on proof in which they defined supervised learning as a system that is directed to any case where the component can be perceived (p. 545).

In this respect, supervised learning ends its mission when the algorithms marked a significant achieving performance. Supervised learning with external inputs/ ways so as to derive the final output, whereas unsupervised set with some kind of preconditions already coded in the machine learning algorithm.

## **2.2. Unsupervised Learning**

Alpaydin (2004) identified unsupervised learning as a kind of machine learning algorithm in which learning has no sense of direction about the correct output where the agent learns patterns in the input. By using supervised methods, unsupervised learning can find connections of hidden patterns. It can also give future predictions without “labelled” data. Its aim is to find the regularities in the input without supervision. One of the most widely used techniques is cluster analysis or grouping of input, which is used for exploratory data analysis to find hidden patterns (p. 11).

## **2.3. Reinforcement Learning**

Russell & Norvig (2010) showed that reinforcement learning enables agents to learn from past experiences through a series of reinforcement –reward or punishments or trail-error (p. 714). For examples lack of points at the end of the video game (FIFA), tells the agent that something went wrong when the wants do not meet, and it needs to cooperate in order to win. But this is still up to the agent to decide whether to take action or not and what needs to be done to perform its task properly. In this case, the agent learns its task through simple reward feedback.

## **3. Types of Artificial Intelligence**

With ongoing advances in computing power in different areas, new artificial intelligence systems had brought significant research attention. In the recent years, there were many fascinating inventions in robots with multiple functions, that they kept the world in check. It increasingly seems that artificial intelligence is likely evolving from “young” AI to self-aware machines.

### **3.1. Limited Memory**

Hintze (2016) estimated that this type of artificial intelligence includes machines that can display previous information through recalling past observations and programmed data to make future decisions. For instance, self-driving cars are equipped with these features they can detect other cars and objects around them, and avoid getting hit in traffics by monitoring their speed and direction. AI machines gradually add such information to the static data (Para. 9). It allows AI with limited memory to adjust to changes and take actions accordingly. These important elements are added to autonomous cars, as they are programmed with ongoing collected data that enables them to carry out the task, such as when the car makes a decision such as changing lane marks.

The Japanese company “Mitsubishi Electric” has been developing a system in autonomous vehicles to improve decision-making functions in cars called “compact AI”, by carrying on important data for certain types of analysis in a short period of time. These types of innovative systems were added in order to see faster and intelligent machines making their own representations. This system also used in chatbots and personal digital assistants (Hintze, 2016).

### **3.2. Reactive Machines**

Hintze (2016) explained that reactive machine is the most basic AI, and it is considered purely reactive, it involves perceiving data directly and make actions depends on the surroundings, but this type of intelligence has no past experiences nor has the ability to recall any memories to affect current decisions. It mainly depends on predicting and analyzing current actions. Examples of reactive AI machines include, Deep Blue, the IBM chess-playing supercomputer, which beat the master of chess Garry Kasparov in the late 1990s, as well as in Google's Alpha Go which defeated human Go champions in the same way. This means that machines success makes AI researchers go deeper into this machine in order to develop the weak areas. However, Deep Blue and Google's Alpha Go are designed to react against predictable moves and possibilities, and they are designed to have limited use, and cannot be used for other features.

Despite having high perceiving system, this type of intelligence cannot assess all future moves and it barely depends on one task. Programs that use neural networks to stimulate game developments, such as *Deeps Blue*, are more powerful compared to *Google's AlphaGo* computer. Researchers in this area still trying to find other methods in order to improve the ability of AI systems to play certain games better and using future moves, but they are still not able to operate the way games participate in the world, which means they cannot function beyond their specific performance (Georgios, Yannakakis, & Togelius, 2018, p. 114).

### **3.3. Theory of Mind**

Hintze (2016) identified that the advancing complexity of artificial intelligence brought very developed cognitive features along the way entered the complex world of technology such as the theory of mind artificial intelligence. This kind of AI has very advanced technological feature, it is based on developmental psychology, basically on Autism Spectrum Disorder (ASD). Hintze also added that the computational theory of mind has the capacity to

attribute human's feelings, thoughts, beliefs, and intentions, as well as the capacity to have social interactions with humans and engage in repetitive behaviours. It is also programmed to predict people's next move and relate to them.

Still, this type of intelligence does not yet exist. But researchers still challenge the ongoing complexity of this technology, to make it more "human-like" and develop emotional AI, so that robots can perform some behaviours that are mirrored with an early stage of child development, such as the ability to detect eye and face movements. In addition to making eye contacts with others, as if they are paying attention (Staff, 2017). These characteristics show the human behaviours that robots need to apply, which would likely be the next class of intelligent machines.

### **3.4. Self-awareness**

Hintze (2016) showed that these types of artificial intelligence are considered the most advanced machines that have consciousness. Super intelligent machines are very different from "young" AI, that would only learn from its past experience and environment, and gradually be able to recognize intentions and patterns. Super intelligent machines are capable to stimulate and recognize their internal states. They can also predict the others' feelings. They are the future generations of machines; sentient, aware, and above all super intelligent (para. 13).

Researchers in this area are fascinated by the idea of self-conscious robots, but this kind of AI is not developed yet. The question whether self-aware machines would co-exist is still an open-ended question, and the proclivity to find the answer is motivating for longer-term research since this current technology isn't even close to being capable of self-awareness, and it is still in the realm of science fiction. Besides, there is not a good understanding and insights of what mechanisms enable the brain to become self-conscious. However, there has

been a study by Shadlen et al. (2017) which dealt with the accumulation of proof that ultimately pierces awareness, it mentioned that the machine would respond with awareness when the accumulated neural response is strong enough.

#### **4. Applications of Artificial Intelligence:**

Artificial intelligence has affected a great deal of today's society as it made its presence in many fields. This growing technology progressed too fast in the last few years and became a game-changing tool, from transportation to healthcare, industry, and finance. AI aims to change the human life and make it easier in the future by providing different applications in every field.

##### **4.1.Gaming**

According to Georgios, Yannakakis & Togelius (2018) gaming has a long history along with artificial intelligence. In the 20<sup>th</sup> century, researchers in the field of computer science tried to apply AI in games as they wanted to test whether game-playing programs can be solved by computers. This was before recognizing the very concept of AI as a field (p. 11).

Elon Musk, the founder of Tesla and SpaceX, has predicted that AI will outperform humans at everything in 2030 (Lant, 2017). However, Georgios et al (2018) explained that this prediction has already been proven true, AI could comprehensibly defeat humans in gaming, games from the interactive card game to *Google's AlphaGo* after defeating Grandmaster Lee Se-dol in go in 2016, and the next victory in 2017 after defeating Ke Jie, the world champion number 1 in a three-game Go match. As well as chess when Deep Blue won

both chess match and chess game against Garry Kasparov, a world champion in 1996 as chess was always regarded as “the drosophila of AI” for decades (p. 31).

This already has proved that AI and deep learning can do things much better than humans, but there are some challenging games that AI still face, games such as FIFA and StarCraft bots, where humans still win as they require more control and strategic quick decisions (Lubin, 2016 ).

StarCraft, released in 1998 and owned and developed by Blizzard Entertainment, is a military real-time strategy game where players use all recourse fields near the military base and attack their opponents’ units. This game has become the centre of attention of many AI researchers and large companies such as *Google*, *Facebook*, and *Microsoft* to better understand the game, by providing techniques and extra data to computers (Lubin, 2016).

However, Julian Togelius, the co-director of the NYU *Game Innovation Lab*, claimed to *Business Insider* (2016) that *StarCraft* bots still have difficulties with algorithms and can easily be beaten by pro-human players, as this game is highly complex and needs more planning.

#### **4.2. Natural Language Processing:**

Nilsson (2010) identified that this system is based on artificial intelligence algorithms in which helps in understanding natural language input, and identifying what is “natural” in language as well as interpreting, reversing, and producing a specific language that is considered natural, as well as distinguishing a given language with the languages that are adopted by computers. For instance, a computer’s main language is English and can translate and distinguish between other foreign languages. Computers that are provided by pattern recognition of individual alphanumeric character can also distinguish other patterns, such as

handwriting. Natural Language Processing involves both written and spoken form in processing information (p. 141).

Natural language processing algorithms (NLP) can be used for different application, for instance, using auto-correct in writing helps to identify misspelled words. In addition to other applications such as spell checker that helps to remove typos.

### **4.3. Machine Vision**

Nilsson (2010) claimed that humans and animals can obtain a wide array of information by vision, this is the same with computers, as this tool helps in providing computers with this data that has been used the perception of early “artificial intelligence network”. Also, it enables computers to use “Stereopsis” by using digital sensors, and it's often used to demonstrate the depth perception which is the same case in 3D vision, by applying two or three-dimensional cameras set in the same direction (p. 173).

Nilsson also mentioned that the 1970s witnessed the first commercial application when a Stanford PhD student called Micheal D. Kelly put this system into an application by writing a computer program that is designed to detect facial features in pictures and use them to identify people’s faces. However, studies in the 1960s and 1970s on face recognition, set many limits and conditions to put this into use, such as the face should be set of standard scale, as well as poses and expressions (pp. 172- 3).

### **4.4. Speech Recognition:**

Nilsson (2010) defined speech recognition as the computer’s ability to decode and convert spoken words and phrases into text form. Artificial intelligence researchers focused on processing a continuous stream of speech because this process is considered difficult to identify all acoustic stream of speech input. Some problems can be involved in this program,

such as the large variety of human pronunciation of words can be quite difficult to identify and classify units of speech, and this problem has still remained unsolved (p. 267).

Nilsson (2010) also added that speech recognition can only work well with clear and small vocabularies, as the human speech while pronouncing words by using a microphone can be too fast for this program to analyze. In the 1930s, at Bell Laboratories saw the first attempt to put speech recognition into action. Researchers at Bell Laboratories set a program for recognizing speech and this was in 1952. However, in the 1950s and 1960s, were other attempts at RCA Laboratories and at MIT in countries such as Japan, England, and the Soviet Union, these works developed in the next decade (pp. 268- 9).

#### **4.5. Expert Systems**

Singh et al. (2015) reported that expert systems are designed to make human knowledge and decision-making ability applicable through a computer system. This program saw a number of different successful applications. The advantages of this program varied from analyzing complex data, including knowledge of previous experts, and reducing time taking in solving complex tasks with high performance and more reliable systems (p. 17). The first expert system to be applied was in the mid 70's, and it is called MYCIN which was developed by T. Sortliffe at Stanford University. This experiment opened the door for other expert systems with a more responsive and developed architecture and extensive devices have been adopted in a wide range of fields such as PUFF concerning medicine. Also, PROSPECTER (analysis of rock formations) concerning geology (Mijwel, 2015, p. 4).

Many new expert systems followed, for instance, the INTERNIST-1, an experimental program used for diagnosis general internal medicine, soon a new system fully assisted this program called QRM (quick medical reference), is based on decision diagnostic program for internists (Nilsson, 2010, p. 301).

However, the applications of expert systems nowadays greatly varied, it is used for camera lens design, car design, as well as medical labs, as a great number of labs engage with ongoing projects, such as S-Group, a tool designed for semantic analysis to papers in order to improve automated coding tools in hospitals and health organizations.

## **5. Artificial Intelligence in Domain:**

Artificial intelligence has affected a great deal of today's society as it made its presence in many fields. This growing technology progressed too fast in the last few years and became a game-changing tool, from transportation to healthcare, industry, and finance. AI will aim to change the human life and make it easier in the future by providing different applications in every field.

### **5.1. Healthcare**

Artificial intelligence plays an important role in clinical practice, after long, challenging obstacles in the acceptance of AI application in the health sector. The use of AI in this field has been always in changing waves, scientists made this progress in every way possible to make it easier by developing new techniques in AI algorithms.

AI algorithms based on Deep Learning brought a significant result in clinical settings, as well as the availability of high-quality medical services. Apply this innovative technology in detecting cancer, not to mention Alzheimer's disease in early stages which resulted in higher accuracy based on speech pattern and voice, which is considered a major improvement in applying artificial intelligence in such field ("AI and Machine Learning for Healthcare," n.d. p. 10).

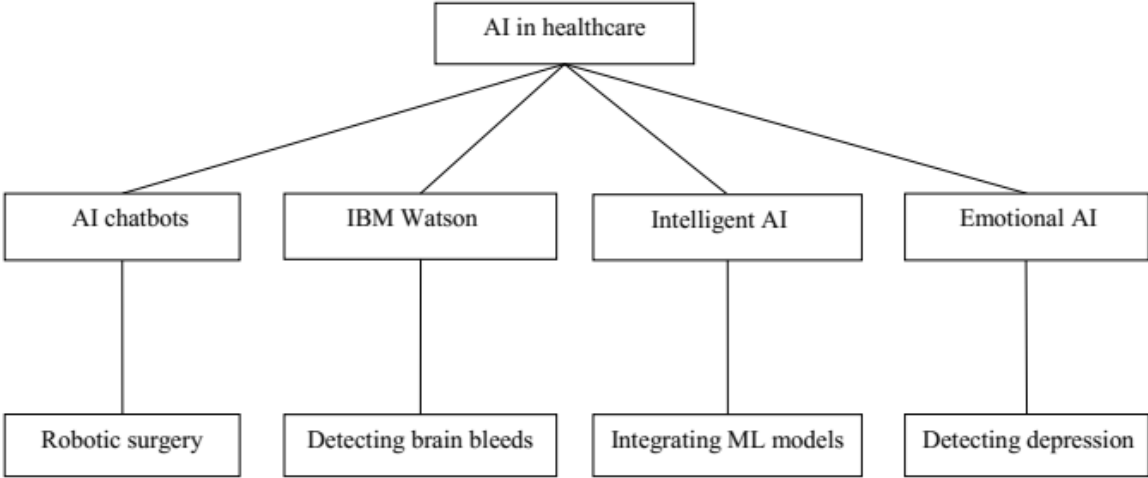
According to a recent survey done in 2017 by *Healthcare IT News* and *HIMSS Analytics* survey showed that half of the U.S. hospitals intend to integrate artificial intelligence within

five years, and about 35 percent plan to use within two years. While 10,6 percent of healthcare organizations intend to integrate AI within a year (Sullivan, 2017 ). Based on this survey, the use of AI is awfully needed and became an efficient tool that can help companies in providing services provision. Nearly all healthcare organizations and companies have already started adopting artificial intelligence into their practice.

Zeman (2018) reported that the integrating artificial intelligence (AI) did not stop at hospitals alone, as many giants companies such as *Google* who worked with the Stanford School of Medicine in launching *Cloud Healthcare API*, an open-source tool formed to cover up the lack of information, and make more medical data available for healthcare providers via cloud, including DICOM (Digital Imaging and Communications in Medicine), FHIR (Fast Healthcare Interoperability Resources), and HL7 v2 (Health Level Seven International). However, API is only available to a certain group of partners who access in earlier stages. *Google* describes this tool as an AI-first data centres (p. 7).

AI is also used for treating veterans with depression and post-traumatic stress disorder (PTSD) by incorporating *Watson* artificial intelligence and analytics, and it has been tested on us soldiers for the first time (Sullivan, 2017 ). By using brain implants that help in triggering mood patterns and then back the brain up into a healthy state. However, this treatment raises ethical issues as the researchers will be able to determine patient's inner feelings, or it may make it even worse.

In addition, the recent application of AI also helped on detecting brain bleeds that's based on *Israeli* healthcare tech company *MedyMatch* and *IBM Watson Health* by using AI systems that include clinical insights and deep learning. This system assists doctors to treat patients with stroke and head trauma.



**Figure1** : Recent AI Applications in Healthcare according to Sigmoidal

**5.2. Banking**

Artificial intelligence is very important in the U.S. banking sector, as AI has been already a “thing” in banking security and the financial industry in general. Digital banking has already started showing signs of interest and adoption that many customers have gained their trust to secure their personal data. For instance, *JPMorgan Chase* has integrated AI to develop a *Contract Intelligence* (COiN) platform created to “analyze legal documents and extract important data points and clauses” (Sennaar, 2018, p. 14).

This company gained successful applications that added into interests by implementing this powerful tool. Bank of America is another powerful example that adopted AI technology with the special appearance of an intelligent virtual assistant named *Erica*, first appeared in Las Vegas’s conference at the 2016 Money 20|20, where her main task is proving financial guidance to company that has over 45 million customers; “predictive analytics and cognitive messaging” (Sennaar, 2018 ). Thus, it is considered the largest payment and financial services innovation event in the world, in which the company marked the second-most

profitable year in history. This shows that AI has started to become a very powerful tool to make a significant change in financial industries and can be advanced to perform better stock analyses and predictions.

### **5.3. Transportation:**

Artificial intelligence in the transportation industry is in a state of flux thanks to the availability of vast data sets and innovative tech, things started to be very efficient that people no longer need human drivers.

According to *One Hundred Year Study on Artificial Intelligence* at Stanford(AI100) that was issued in 2016, mentioned that AI in the U.S. transportation industry will lead to a new urban life with a new AI vehicles design, such as flying vehicles and personal robots in a typical North American city by 2030. With the invention of smarter cars equipped with GPS which was designed in 2001, it became possible to assist drivers with a load of information in routing and keeping fleet drivers safe (p. 18). In addition to self- driving cars that became dominant in 2015, where a car drive itself and be better than a human with no distractions (cell phones, blind spots etc.), but it is still not completely safe, it is still prone to make accidents as its software not fully developed.

## **6. History and Foundations of Artificial Intelligence:**

Researchers started to explore the field of artificial intelligence in the mid-twentieth century by enhancing computer technology and using A.I as a core to support technological innovation. Today's A.I supports other computers' systems including smart phones and autonomous vehicles that are part of AI more favourably as they are increasingly present in our hands and on our minds.

### 6.1. Early Explorations

McGuire (2006) estimated that artificial intelligence based on algorithms and machine learning was the major advance in the past decades. The first move that shook AI history as a field was *Computing Machinery Intelligence*, a published paper, written in 1950 by the English Mathematician Alan Turing, the founder of computer science, opened up the door of artificial intelligence field by a simple question he asked “Can machines think?”, this question eventually led to suggesting a method called “The Turing Test” or “Imitation Game”, this method turned into a test to prove if machines could think. This contributed to the defining the field of A.I as it hits the core issue rather than solving a simple matter (p. 14).

Nilsson (2010) estimated that due to John McCarthy’s interest in *Automata Theory*, neural nets, as well as the study intelligence led to encourage other US researchers to organize a workshop known as *Dartmouth Summer Research Project on Artificial Intelligence* (DSRPAI) with the Founding Fathers of AI including: *Trenchard More* from Princeton, *Arthur Samuel* from IBM, *Oliver Selfridge* from MIT, *Marvin Minsky*, and *Claud Shannon* (p. 77).

According to Nilsson, this conference was a series of collaborative efforts in order to coin the concept of artificial intelligence as a field and it was the largest gathering that helped to open up to the research of artificial intelligence as a vibrant field of interdisciplinary research which was full of intellectual feedbacks to all subsequent of computer science. However, after this workshop the program that is expected to work on a reasoning program, which was recognized through Allen Newell, Cliff Shaw, and Herbert Simon’s “*The Logic Theorist*”, was able to solve most of the theories in Chapter two of Russell and Whitehead’s *Principia Mathematica* as it was recognized through Allen Newell, Cliff Shaw, and Herbert Simon’s, “*Logic Theorist*” (pp. 79-80).

Nilsson (2010) also mentioned that in 1957, an American pioneer *Frank Rosenblit* created perception and started to work on neural networks in his project called PARA (Perceiving and Recognizing Automation), which was built in hardware and still in use today. In 1959, *Bernard Widrow* and *Marcian Hoff* of Stanford created new models called ADALINE and MADALINE, in which MADALINE was the first neural networks to be adopted in real-world tasks, this model was an adaptive filter which blocked echoes on phones lines (p. 92).

## **6.2. Artificial Intelligence from the 1970s to 1990s:**

Russell and Norvig (2010) explained that the enthusiastic wave of AI did not continue in the late 1980s, as U.S and British governments cut signals of the exploratory research in artificial intelligence. Hence, the following years were known as “AI Winter”, the failing recognizing of the obstacles in doing the task, and failing of funding it. After the first AI winter, artificial intelligence stood up again and brought with it “expert systems”, a program designed to solve complex problems. This made a huge impact in AI research and encouraged other ideas to put into action, such as heuristic research, the first application in machine vision followed by face recognition, and natural language processing. There are two types of expert systems: The knowledge engine, which gives facts and rules about a certain topic. The other type is the inference engine, which represents the facts and rules from the knowledge engine to generate new data (p. 24).

Schultebrucks (2017) reported that in the early 1980s, a new expert system emerged named SID (Synthesis of Integral Design), created with 93% of the VAX 9000 CPU logic gates. In the mid-1980's Apple and IBM desktops made a significant improvement and became faster and more powerful than other LISP machines in the market. However, the second AI Winter came back in the late 1980s and early 1990s after a series of financial

relapses that led to the collapse of the AI computer hardware market that worsened with high maintenance costs.

Nilsson (2010) showed that after a lot of ups and downs, Deep Blue entered AI world achievements as an extraordinary milestone of chess-playing computer developed by IBM. This started when a PhD student Feng-Hsiung Hsu developed the chess program “Deep Thought” at Carnegie Mellon University. The first practical attempt was when this chess game playing system beat Kasparov in the first game but lost the match in February 1996. However, in 1997, a more advanced version of Deep Blue than the older one won a six-game match. Deep blue won by using “brute force” techniques, which marked one of AI achievements (pp. 591- 4).

### **6.3. The 21<sup>st</sup> Century A. I.:**

The evolution of AI in the new millennium brought more innovative technologies than the last decade. The emergence of the first robot for the home the “Roomba” vacuum was one of the biggest achievement n the early 21 century despite its simple sensors and minimal proceeding. However in 2005 spotted light on war machines with *Boston Dynamics* inventions such as *BigDog*, it was built to perform as a robotic pack animal. *iRobot* had its own history as well, with its bomb disposal robot with high functioning intelligence including explosive sniffing that has been deployed in Iraq and Afghanistan. In November 2008, *Apple* released a new *iPhone* feature which was a Google app with developed speech recognition. This one was a significant breakthrough in AI system of speech recognition with about 80% accuracy (“AI: Key Moments in the Story of AI” n.d.).

The new technologies are in a state of ongoing change, as new computers emerged with enabled humanoid robots, such as the NAO robot, this latter can do its specific task which is dancing in a perfect harmony for a couple of minutes. New giant technology marked its

presence in 2011, which is IBM's Watson. It can do a greater task than chess game supercomputer itself, as it can answer difficult questions. It was built with neural networks with a wide range of experiments done with several years in order to be familiar with a large number of questions and answers. It was later tested with the best performers and made a great victory for AI. In 2014, another huge breakthrough emerged self-driving cars. *Eugene Goostman*, a chatbot made its entry for the first time after years of development. Google invest in this technology billions of dollars in which made a significant change in people's life ("AI: 15 key moments in the story of AI" n.d.).

## **7. The Impacts of Artificial Intelligence on Economy**

The economy is being set by the new term of robotics, but we cannot be certain of all the possible outcomes. It is very difficult to identify the possible effects associated with robotics so that the benefits can be established and capitalized for the employment and economy as a whole.

### **7.1. Artificial Intelligence and Economic Growth**

Bughin et al. (2017) estimated the innovative wave in AI across industries which brought a new variety of commercial opportunities and the potential to change the economic structure in significant ways. They also identified that artificial intelligence has been used in industries for more than three decades, but the world in the last decade became more automated and adopted faster to this technology as computation became needed and very common that led to decreasing cost. In addition to that, the GPUs (Graphics Procession Charit) such as animation and video displaying for the computer's screen are needed aspects for generating computers in building A.I which helps to perform tasks in a short period of time (p. 9).

Bughin et al. (2017) also explained the wide use of computing power for its availability of data that artificial intelligence offered, many industries are rapidly catching up with this progressing data followed by Big Data in which became a huge share in tech industries. For instance, the biggest investors in this innovative technology are *Facebook, Twiter, Instagram, Google, Apple, Amazon, Yahoo, Baidu, and Microsoft*. Those giant companies set the most skilled researchers in software engineering in order to lead their own research in accessing a wide array of information, which in return decrease the human efforts in analyzing such complex data (p. 11).

The use of artificial intelligence changed rapidly in the recent years, every year there's a new wave of scientific inventions that hit the world, this all thanks to new type of algorithms that set in the core of artificial intelligence in which it is generated from the 1950s technology, called Artificial Neural Networks (ANN) it is designed to solve problems by stimulating human nerve cells in processing information on a computer (Apaydin, 2010, p. 15). This network system set itself completely in 2007 and it was able to solve problems that considered impossible and then became a sub-field of A.I known as Deep Learning.

## **7.2. The Economic Impacts of Artificial Intelligence on Job Markets**

Artificial intelligence is no different from any other technological improvement that enables greater productivity, as it takes less human effort and consequently fewer workers. Over time there will be more technocrats and fewer low-level skills in employment. Overall, this has historically redistricted incomes to the higher income players and has decreased the low-level skill workers, which in return giant investors will be the major benefit of all.

For decades, automation helped in building the modern world, and so the future. It is a vital tool in today's society, as almost everything became automated. This enthusiastic wave of the rise of AI machines hit the economy in the recent years. As AI boom everywhere and

became an inseparable aspect of everyday life, this changing wave also has its economic impacts, whether on the wealth of individuals or broader financial trends. However, machine workforce will cause human workers to lose their jobs, and it may lead to create other jobs to be created instead (Ford, 2015, pp. 153-5).

*Jashua Gans*, holder of the *Jeffery S. Skoll* chair of *Technical Innovation and Entrepreneurship* at the University of Toronto's *Rotman School of Management* said:

At the moment, while some jobs have been replaced by automation, this has also led to job creation as well. So while there may be short-term disruption, the longer-term potential is very strong (Jones, 2017).

According to Joshua the point of automation is to reduce work load, and to create more resources than taking away as it is a change for growth, then he added: I don't think they are going to disrupt the economy but instead make individuals and firms more efficient. In other words, they are productivity enhancing.

This means that some jobs will be lost, others will be gained. However, artificial intelligence and automation will replace many of so-called low skill jobs such as truck drivers, secretaries, and even doctor assistants, and form a new cycle of jobs such as software engineering. Industry, for instance, cost a lot of skilled trade jobs such as blacksmiths and weavers. Those jobs can be less skilled and less fulfilling. Over time, artificial intelligence will create a net increase in economic activity, both in terms of growth and wealth.

### **7.3. The Impact of AI on Employment and Workplace**

It is hard to tell accurately the current impacts of artificial intelligence on employment of workplace in a typical North American city. With ongoing globalization in the past decade, employment has greatly shifted in the US, since the emergence of new AI systems in the late twentieth century. The country saw a change in growing productivity and GDP, with respect

to median income and employment that gradually decreased ('One Hundred Year Study on Artificial Intelligence at Stanford University', 2016, p. 38).

Many industries that adopted digital technologies experienced great changes, whether negative or positive, and it is likely to continue in the near future. These changes are rooted deeply with digital technologies (Ford, 2015, p. 36). One may say according to this study at Stanford University, that AI has affected employment and workplace negatively, but the best work ethic in the world cannot compete with a piece of software that works magnitudes more quickly, with fewer errors that never takes breaks from work, or demand wage and raise. Understanding these changes and effects will automatically lead to deep insights about the future of labour demand.

According to *One Hundred Year Study on Artificial Intelligence* at Stanford (2016), Digital technologies have great impacts mostly on middle- skilled jobs (for instance, carpenters and crane operators), rather than unskilled or highly skilled jobs. In general, everything that can be automated will be, by the very fact that work is menial enough that an automated solution exists. Also, Tasks will be replaced rather than jobs by AI, and the new jobs that will be created instead in the near future are still uncertain (p. 8).

Moreover, the study *One Hundred Year Study on Artificial Intelligence* at Stanford (2016) also mentioned that artificial intelligence may also shift the place and size of the workplace, as many large institutions and organizations set some jobs done by human labours as it is scaled only by them, either "vertically" in organizing the types and levels of management, or "horizontally" concerning geographical regions. With the AI systems dominance over larger areas, fitting in is no longer into larger institutions, since giant companies that are designed for internet services have lesser employees, most tasks are done by A. I. systems.

However, there are two things that tend to happen in using this innovative technology in the labour market, people lose a living but as a whole, they all end up with more. In theory,

having all jobs able to be done by A. I. means that socialism would not need to come at the expense of those that are useful. In other words, it could free people to do what they want to do, so they could spend time learning and experiencing instead of surviving.

## Conclusion

Artificial intelligence made a huge impact in the world with its advancements, that it can improve itself at an exponential rate and codes itself, these advancements “forced” giant companies and industries to adapt to it and hire data scientists. Modern AI began in the mid 1950’s to the 1960’s as a theory. However, it changed from theory to practice practically in the 1970s, when expert system was created and adopted by corporations to develop other AI machines. However, after the stupendous emergence of Apple and IBM that made a powerful presence in AI market, AI industry had ups and downs after the end of the Dartmouth conference, due to industrial setbacks, this “gloom” period known as “AI Seasons”, in which the AI industry collapsed and cut the exploratory research in the field.

Artificial intelligence stood up from the fall and opened the door for greater achievements and inventions, such as Deep Blue that made a chaotic presence in the late 1990s, in which was later developed into a chess-playing game in the most powerful supercomputer. These advancements In AI caught the attention of both the scientific community and the public that became demanding in different fields, as current AI technologies are applied in driving, online advertising, healthcare, industry and personal assistance image recognition.

Giant industries and companies emerged thanks to this technology including, *Google, Facebook, Microsoft, and Tesla*. However, it became frightening that this innovative technology made a significant change in economy, as AI machines started to “invade” many industries and replace human workers in doing tasks with high performance and accuracy that surpass humans, in which make people unemployed, which in return will create new jobs and leads to economic growth.

## **Chapter Two: Overview of US Economy:**

### **Introduction**

The U. S. economy is considered a mixed economy because the government uses both capitalism and socialism systems that allow them to intervene with free markets. The U. S. is also one of the world's largest and most powerful economies with a nominal GDP of 20.4 trillion dollars. California alone is ranked as the sixth largest economy in the world, thanks to its natural resources, human capital, and the integration of innovative technology into its sectors. The rapid development and strong performance of America's economy, notably attributable to its industrial sector.

The present chapter sheds light on the structure of the U. S. economy and its dominant sectors, and how it dominates the world's largest energy producer, and its industrial dominance. Also, it highlights the advantages of adopting artificial intelligence in the industrial sector and its contribution to the economic growth.

## **1. The U.S. Economy: A brief history**

### **1.1. The US Economy before WWI**

The U. S. before world war one was an economic superpower and was the first powerful industrial nation on earth. The period between 1880 to 1920 was a turning point in the US history as it went through a huge increase in economic production and growth due to the dramatic increase of mass immigration of lower-class labourers.

#### **1.1.1. The Industrial Growth**

The economic history of the U. S. had its first formal glimpse long before the late nineteenth and early twentieth century. In this period, the nation experienced a dramatic change of societies due to the industrial revolution. Industrialization and growth of new urban cities went hand in hand, and both working-class housing and factories were built near transportation hubs such as; railroad junction, canals, and ocean ports, and these ports were located in cities (Rodden, 2011, p. 8). These developments in transportation and growing industries contributed to a better life for citizens and made things easier for them. Which produced a new class of self-sufficient middle class and rich industrialists upper-class.

The U. S. in the late 1800's witnessed a new age of industrial boom, especially the Northern industry after abolishing the slave labor system, it grew larger with rapid growth and became the main state to produce half of the nation's corn, and cotton production (Conte. Karr, Clark, Hug, & Manning, 2001, p. 16 ). The availability of manufactory-produced goods made commodities more affordable to the middle-class people.

#### **1.1.2. The Gilded Age: Inventions, Development, and Tycoons**

The second half of the 19<sup>th</sup> century was the era of tycoons. Many Americans admired these risky moneymaking businesses as they were highly competitive and successful in the

business field, even though some of these tycoons used unfair ways to get rich such as using bribery and force. The emergence of innovative technology brought new figures that let the U. S. entrepreneurship and even in the global level; such as, Bill Gates, who built a large fortune through developing and selling computer software. Many other discoveries and inventions led the way to a great nation full of achievements and innovations which resulted in a “second industrial revolution” that significantly altered American life and society in every aspect. One of the most important inventions and discoveries that took place during this period include telephone, light bulb, phonograph, electric power plant, and the discovery of oil in western Pennsylvania (Conte et al., 2001, p. 22).

The parallel of these achievements and the shift from the rapid shift from an agrarian nation to industrial economy led to a wave of immigration. Millions of skilled workers European immigrants were significantly high because they were excited to taste the “American Dream”, but it was not what they expected, job opportunities were limited, and so the housing. However, a number of immigrants also contributed to developing the nation, as they built roads, canals, and railways.

## **1.2. US Economy after WWII**

As the world suffered from a great loss in their economy due to world wars, it was expected to pass this curse to the U. S. as well. However, it was the total opposite. Shortly after the end of the war, the United States broke the world’s expectations and emerged as the richest, most powerful nation in the world since it went through a period of phenomenal economic growth known as the “Golden Age of Capitalism” which brought the economy out of great depression.

### 1.2.1. **The Postwar Economy: 1945-1970**

World War II had a major impact on the U. S. economy, as it brought economic growth and stability. The industrial production increased between 1940 and 1950 with 200-300 thousand -million dollars, and in 1960, it increased to 500 thousand-million dollars, to mark the greatest growth rate of goods and services in history and take the position of the richest and most militarily powerful nation on earth (Wellinget et al., 2012, p. 9). Over time, the American lifestyle changed and became more stabilized than ever.

The period between the 1950s and 1960s is considered as postwar reconstruction. Since the late 1940s, the big corporations extended to the 1950s, where a variety of industries contributed in building the US economy, from the automobile industry, International telephone and telegraph, to Sheraton Hotels and Continental Baking (Wellinget et al., 2012. p.3). As the industrial America changed, and the economy grew, the lives of many citizens also changed for the better and they started to move to big cities to have a better life such as Miami, Florida, and California, and this latter became more populated than New York in 1963 (Wellinget et al., 2012, p. 6).

Many large businesses continued to grow with different franchises and large shopping centers, which increased from eight at the end of world war II to 3,840 in 1960, and became even more larger than before, and equipped with many services including parking and convenient evening hours (Wellinget et al., 2012, p. 8). In addition to the passing of Highway Act of 1956 that helped to build modern interstate system to lead to different destinations in every part of the country, which the federal government spent 26 thousand-million dollars to build the federal roads (Wellinget et al., 2012, p.a. 9). From all these different aspects of improvement in terms of industry, it helped in bringing the white and blue collar workers to work in these industries whether small or big, from sales management jobs to workers who

perform manual labours such as trade occupations. This benefited much of America's economic success to the flexibility and long term commitment of its labour market.

However, the 1970s underwent ups and downs. It was the period of massive credit expansion in household debt, and revolutionary changes happened in terms of money and banking, which resulted in higher price inflation (Roche, 2014).

The losses in stock market grew larger, especially with the declining of gold value, and the abandoning of the gold monetary system (Thornton, 2004). This period is considered a depressing turning point for many Americans, as it was the worst economic downturn after the Great Depression in the U.S. history due to a tremendous deflationary pressure that has thrown both debt and equity markets into turmoil.

### **1.2.2. U. S. Economy in the 1980s**

Since the president Reagan's broad agenda of domestic program with his controversial plan cut taxes, and to control the rate of growth in domestic spending, which increased business investment, and led to economic growth (Wellington et al., 2012, p. 12).

Reaganomics was an ambitious step in the late twentieth century yet it did not last long, as many Americans families with median income lived in poverty and stagnation due to over domestic overconsumption, which ultimately led to a great failure at home (Roberts, 1991, p. 6).

Even farmers were hit badly due to this economic setback as it caused farm revenues to decline drastically, as well as the prices for corn, wheat and other agricultural sources started to drop, which in return the interest rates increased ("American History," 2018 ).

By 1983, the annual inflation decreased less than 5 percent due to the dropping of oil prices and the Federal Reserve's control over prices and credits. But the American economy stood up stronger from the fall to enjoy the stability of economic growth ("American History," 2018).

### **1.2.3. The U.S. Economy from the 1990s and Beyond**

The U.S. during the 1990s lived in economic and social prosperity, with major innovations of the New Deal which made the Great Society. Meanwhile, the economic growth increased around 4 percent per year between the years 1992-1999, and about 1.7 million jobs per year were created which strengthened the American workforce and dropped unemployment rate from 8 percent in 1992 to 4 percent (Anderson, 2015). This employment wave brought many Americans out of the jobless world and created a strong labour force with life full of peace, prosperity, and order.

The American economy boomed even stronger and became increasingly intertwined with the *North American Free Trade Agreement* (NAFTA). This agreement was made to trade with other countries and support international trade. By the end of the 1990s, the acceptance of the new product “technology” grew larger, as many large American industries started to adopt high-technology including heavy machinery in their factories, and this led to a rapid economic and industrial growth (Conte et al., 2001, p. 33 ).

## **2. How does the U. S. Economy Work?**

The U. S. economy is considered a highly developed mixed economy, with government cooperating with private enterprises. It is also the largest in the world and most conspicuous consumption-based global economy. It played an important role on the global stage despite a suffering from many economic setbacks and challenging tasks in the past; from the wars and the global economic crisis in 2008. The U. S. has always gone through a tepid recovery through managing the existing natural sources, labour, and technological advances.

## **2.1. The Basic Ingredients of the U. S. Economy**

The U.S. has the largest and most powerful economy in the world, and it is the most dominant country in terms of technology, economy, industry, and politics. It also has the world's highest GDP, with an estimated GDP of about 59,501 U.S. dollars per capita in 2017. California has the largest share and is ranked the sixth largest economy due to its rich resources and capital-labour.

### **2.1.1. Natural Resources**

It is widely known that the main ingredients of the U. S. economy system are the natural resources, it is the engine that makes the economy work and contributes to the economic growth, so the country depends heavily on this golden instrument. With the U. S. rich on raw materials and large fertile land mass, that its economy has highly competitive benefits in the global marketplace. It also has the world's largest proven reserve of oil, coal, and natural gas that makes the U. S. open to trade in natural sources.

According to *Council on Climate Preparedness and Resilience Climate and Natural Resources Working Group* (2014), the natural resources play an important role in communities, business, and job markets, and should be protected from climate change, as oceans, forests, and wetlands are considered a major advantage to human (p. 33).

*The Council on Climate Preparedness and Resilience Climate and Natural Resources Working Group* also stated in this report:

To Enhance community preparedness and the resilience of natural sources, the Federal government is focused on developing the information and tools necessary to support smart infrastructure investment (whether traditional or natural) and target the highest priority resilience needs, enhancing partnerships with communities to accomplish high priority preparedness needs, and highlighting innovation and sharing best practices among all shareholders. (p. 35)

From the line above, it is obvious that natural resources contributed to the wealth of nation through boosting investment in inclusive, sustainable, and smart infrastructure that can better cope with climate change. But the question that arises is whether the U.S. government can put many efforts working on the innovative new policies that conserve and sustain the land.

### **2.1.2. Labour**

Human capital is another basic ingredient of the United States economy, the number of workers whether agricultural or industrial labour, and their productivity level is very critical for economic vitality and prosperity, especially high skilled labours who are able to perform complex tasks in innovative industries. The U.S has enough skilled workers who contributed to the wealth of the nation and economic growth, many of these workers came from other foreign countries after the world wars as workers and slaves, made a difference in the U.S economy (“American History”, 2012).

Labour quality is also considered a very critical element in the U.S. since it includes three levels of skills including low, medium, and high. Accumulating capital and integrating innovative technologies require labour quality (Karlsson & Liljevreen, 2017).

According to the *Council of Economic Advisers* (2018), modern America has always needed human capital to either manage businesses or hire them as factory workers, the

economy cannot be expended without the workforce. According to the White House article, 2017 was a more fulfilling year than 2016, it was a year of strong workforce market, and the period under Donald Trump Administration, the economy increased employment rate by creating around 2.1 million jobs in critical sectors.

### **3. The Role of the U. S. Government in the Economy:**

The role of the government in the economy is still a controversial topic since much of America's history has put its focus on this debate, and how much limits should the government have to stop intervening with the economy.

According to the U.S constitution, the government's main role in the economy is to sustain market gains, correct market failures, and to set the value of the currency in order to make the economy fair and balanced. Its role is also to regulate trade between the states, and to make enforcement of contracts between individuals, either citizens or corporations because the federal government's role is outlined in the constitution. In other words, the federal government only has the limited responsibilities that the constitution gives to it (U.S. Const. amend. X).

In general, America's view on the government's involvement in the economy is to let small businesses and private economic sectors lead themselves, whether they fail or succeed without any interventions from the government (Conte et al., 2001, pp 32-5). However, Christopher Conte and Albert Karr also claimed, in their article "Outline of the U.S Economy", that the enterprise system in the U.S. is not entirely free, since the government put complex plans that "mess" small enterprises, and private businesses through setting economic regulations. According to Freidman et al (2012), economic and social regulations were made to combat market inequities, recession through cutting income taxes, and to provide safety whether in food, or other commodities, "Economic regulations have tried to combat abuses by

monopolies and, at times, establish “fair prices for specific commodities...Social regulations aim to protect the public from unsafe food or drugs, for example, or to improve the safety of motorists in their cars” (p. 93).

### **3.1. The Major Productive Sectors in the U.S Economy**

The United States has become an increasingly important nation in terms of industrial and service sectors, which presents the main global industrial power. The list below shows the main and most productive sectors in the United States.

#### **3.1.1. The Primary Sector: Natural resources**

The primary sector is the most basic one in the economic structure, as the main objective is to make use of activities that consist in exploiting natural resources that came from food extraction such as farming and fishing, and other raw ones such as mining and forestry.

The U. S. is fortunate enough to have a fertile soil with a modest rainfall and is blessed with good conditions for solar thermal energy. So this made many Americans work in this primary sector that involves the extraction of raw materials. However, the rapid advancements in the economic sector, made more Americans transform into more developed sectors that involve technology and machinery in industry and service sectors.

#### **3.1.2. Agriculture**

Goodwin et al. (2008) pointed out that the early history of the U. S. was heavily depended on the agrarian economy, in which labour force was constructed of approximately 90 % of farm workers, because agriculture was the only source that can help to grow the economy. They also mentioned that in the twentieth century were drastic changes concerning

agriculture, the number of farm workers started to drop, and the agrarian mass lands became larger with high productivity and performance (pp. 6- 8).

The American farmers work under extremely good conditions, and their needs are met. These farmers may be unskilled or skilled workers and able to use machinery, for example; tractors, harvesters and milking machines. In the early twentieth century, the U.S agriculture brought many American labourers to work in farms in an average of half the population, whether in small or large rural lands (Katz & Margo, 2013, p. 37).

However, in later years, the agricultural system took a great shift as technology stepped up and took the leading process of how the industry is done. It replaced workers with machines that can increase the American yield. It also used different types of agricultural chemicals to increase the harvest rate faster. With computer-controlled technology, provide ideal conditions for high-quality crops (Goodwin et al., 2008, p. 33).

### **3.1.3. Mining**

Mining in the U.S has always been one of the most active industries since the nineteenth century. It contains industrial mining mineral extraction such as coal and metals including silver, gold, iron, and zinc. The U.S has the world's largest coal reserve with an average of 17% of world production, it produced approximately one billion tons of coal per year, and it is also ranked the second largest producer of copper and gold ("Office of Energy Efficiency & Renewable Energy". n.d. Advanced Manufacturing).

The leading mining states are California, Nevada, Arizona, and Texas, which made around a quarter of a million American mining workers employed in both aluminium and crushed stone industries in 2003 (Goodwin et al., 2008, p. 16).

However, with the innovative technology that the U.S has, made its mining industries the safest in the world, thanks to autonomous solutions and leveraging fast data.

## **3.2. The Secondary Sector: Manufacturing and Industry**

### **3.2.1. Manufacturing**

This sector is controlled by the manufacture of finished goods or products, such as cars, food, electronics, clothes, etc. It uses heavy materials and machinery to improve service management and attain higher productivity rate.

The U.S. has the world's largest and most competitive industries with an average of 18.2 % of global manufacturing output, which contributes to the power of the U.S economy (Amadeo, n.d).

The power of innovation brought to the U. S. new brand of manufacturing, as it made a huge advantage whether in quality or quantity of products and goods. According to Friedman et al. (2012), "Americans producers have sponsored to rising competition and higher labour and benefits costs by moving operations offshore, purchasing foreign parts and components, and concentrating on higher-value products where innovation offers a competitive advantage" (p.53).

However, in the last few years, the U. S. manufacturing has been in decline in value added, and with ongoing growing demand of nominal GDP, especially in private sectors, but only a few big industries managed to boom, despite of the obstacles, as they have enough experiences that let them handle tough situations (Ramaswamy et al., 2017, p. 14). This ongoing decline is unstoppable according to the U. S. economists, but the rise of new product innovation, made the U. S. manufacturing even worse, because of changes in prices and employment decline with increasing of productivity shares (Ford, 2015, pp. 55-9).

In general, the U. S. manufacturing decline indicates that the cause is the use of automation, as robotics in manufacturing handle tasks that were done previously by human employees. Hence, firms no longer need to hire many employees to make high productivity of its goods and products.

### **3.2.2. Constructing and Housing**

The U. S. constructing and housing industry is one of the biggest drivers in industrial sectors. It is also considered one of the top industries with high employment.

Mutikani (2017) showed that U. S. construction industry thrived, and employees in this sector increased since Obama administration until the current Trump administration, where labor force and manufacturing became stronger. A gauge of new orders and export orders also increased with high demand for raw materials in manufacturing, which led to high prices and inflation. “The solid increase in construction spending promoted the Atlanta Fed to raise its fourth-quarter GDP estimate by four-tenths of a percentage point to a 2.9 % annual rate. The economy grew at a 3.4 percent pace in the third quarter” (p. 15).

### **3.3. The Tertiary Sector: The Production of Services**

The tertiary sector is also called service sector, it is dominated by service activities; such as health care, transportation, tourism, education, finance, entertainment, retail, and wholesale sales. These services are provided for consumers. It can also contain selling products and goods from both primary and secondary sectors.

#### **3.3.1. Wholesale and Retail Trade**

Wholesale and retail trade is the activity for the commercial establishment that involves exchanging and selling goods, it offers new and used goods to retailers and other businesses. This sector is highly competitive, as trade activity management is significantly important for the nation’s success.

Bernard, Jensen, Redding, & Schott (2010) demonstrated that trade chains extended along with wholesale and retail distribution networks that led to better understanding trade and its welfare gains, which meant too change the structure of trade market. Most wholesalers

focused on agriculture-oriented sector, because it is less likely to be affected by market size, in contrast with retailers and other mixed wholesaler retailers' trade because they focus more on goods and products consumer such as accessories, clothes, and cosmetics.

### **3.3.2. Financial and Insurance Services**

Financial services embrace a large range of businesses that manage the process of exchanging funds between investors and lenders; such as, banks, insurance companies, stock brokerages, investments funds, and many other financial service institutions and companies.

The U. S. financial markets are the largest in the world. It scored an average of 7.3 % of U. S. gross domestic products, which facilitates and manage the flow of money and build major forex trading markets. The employment rate in this sector increased in 2016, that it exceeded 6.2 million workers thanks to the emerging markets bankers, "The securities subsector of the industry shows great potential for employment growth, with a 12 % increase expected by 2018. At the end of 2016, 933,700 people were employed in the securities and investment sector" (International Trade Administration, n.d).

### **3.3.3. Healthcare and Social Assistance**

In the U. S., healthcare service is considered one of the most important services, as the U.S government spends a lot of money on healthcare more than any other country in the world in order to improve the quality of its services and to improve patient care. The healthcare services contribute vitally to the economic and social development in the United States by providing new healthcare insurance systems, which gives a huge opportunity for enhancement.

The integration of technology marked a significant era in the healthcare service; it improved its structure and made domestic exports simplify the trading process.

Anupam, Jena, Daniel, & Blumenthal (2018) emphasized that the U. S. invested a lot of money in the recent years for the sake of improving the healthcare sector. For the domestic spending, was about 7-10 %, because the most investments were in services with low-value. The plan to make the less investment with low-value was a failure, because of limited access to data on the relative value in different health organizations that include doctors, patients, and insurers. Thus, to reduce the negative impacts of low value services is to recognize and extend sources of long-term financing for high-value services. They also mentioned, “For both public and private insurers, a long-term view should be feasible” (p. 13).

#### **4. The Integration of Artificial Intelligence in the U.S Economy: The Advantages**

With artificial intelligence set to transform the work into a better place, and change the way people live and work, it increasingly raises questions of how it affects the economy and businesses as a whole. Many industries and companies became automated, as AI offers inevitable innovation in every single field.

##### **4.1. Intelligent Automation and Economy**

In the recent years, many industries became more automated than before, thanks to innovative technology that made the U.S, economy grows with high productivity and efficiency, and AI ability to solve complex tasks for humans.

In 2016, the *Executive Office of the President's* report, *Artificial Intelligence, Automation, and the Economy*, gave an insight of how artificial intelligence will transform the United States economy in the future, whether for better or worse. The report was divided into two parts, the first part pointed out the benefits of innovative technologies including automation, robotics, and artificial intelligence, as they help increasing productivity across all

sectors, which also lead to increase wage inequality and the cost of living, “At the same time, a slowdown in the rate of improvement in education, and institutional changes such as the reduction in unionization and decline in the minimum wage, also contributed to inequality” (p. 2).

The second part of the report suggested strategies and recommended policy advisers according to optimists view. It gave potential reviews on how Americans should act towards this innovative technology, as they need to have prior knowledge on encouraging market competition, and how to invest and create their own entrepreneurship, and how to minimize the risks of automation, “Competition pushes firms to invest in new technologies that help to lower costs, and also to invest in innovation that can lead to improvements in the quality of existing products” (p.30).

However, the adoption of innovative technology and automation reduces economic reliance on low skill jobs and allows people to earn a wage that will depend on, and limits the number of hours to providing healthcare. At the same time, automation also contributes to increase demands and improve workforce productivity.

#### **4.2. Labour and Capital Augmentation**

Many economists warned from inducing human labour in industries, as almost everything became automated and replace human workers with robotic machines. However, artificial intelligence will create new industries, which translates this to arise of skilled labour to support AI.

Purdy and Daughtery (2017) believed that AI will not cause labour induction, but will benefit from existing labor and make them more efficient and productive than before. They also added that using machine learning and big data can assist labour by complementing their tasks and abilities in industries. Purdy and Daughtery also stated:

AI can also improve capital efficiency—a crucial factor in industries where it represents a large sunk cost. For instance, in manufacturing, industrial robotics company *Fanuc* has teamed up with *Cisco* and other firms to create a platform to reduce factory downtime—estimated at one major automotive manufacturer to cost US\$20,000 per minute.<sup>7</sup> The Fanuc intelligent Edge Link and Drive (FIELD) system is an analytics platform powered by advanced machine learning. It captures and analyzes data from disparate parts of the manufacturing process to improve manufacturing production. (p. 13)

This shows that augmentation of workforce is more likely than large-scale automation, as it is a human-centric approach. By augmenting capital labour alongside robotic machines, tasks will be complemented, and skills will be enhanced, because AI functions as an effective factor of production as a human-capital hybrid. So this explains the very idea of how growth is created.

### **4.3. Innovation Diffusion**

Innovation made a great shift in economic growth, as AI and robots can share data in the cloud and eventually free solar power, in addition to other innovative techs, such as autonomous vehicles that extended well and dominated the automotive industry.

Autor & Salomons (2018) elaborated the adoption of innovation in industries, where data grew fast across all sectors, which made automation a “must” in business industry in order to contribute to economic growth and labor productivity, industries such as transport equipment is dominated by the most-intensive industry, and other sectors including plastics and chemicals, metals, and electronics. These industrial sectors have the most active use of intelligent robots.

Automotive Intelligent technologies such as autonomous driving, is directly dependent upon a buildup of bandwidth in the cellular data network. Innovative devices became more intelligent and more connected as inference engines start to be able to deploy advances in deep learning applications. Thus, innovation always came up with innovation. In other words, technology made a push in increasing productivity, and led to more technological developments, because technological businesses thrived with innovation.

## **Conclusion**

The U. S. economy has always been the major economic power in the world, thanks to its use of innovative technology that set its sectors with high productivity and efficiency. It increased its GDP to 2.3 percent in 2018 to score 20.2 trillion dollars and surpassed top global economies. The boom of the U.S industry was all due to its capital and natural wealth. Natural sources played an important role in the economic growth and provided the nation with basic elements of nature from mineral to geological materials through mining industries. In addition to labour force that also contributed to industrial and economic growth, the diversity of human capital drove the economy for a better place.

The U.S. industrial sector built itself from the first industrial revolution, and the aftermath of world wars when it got out from the economic setbacks to become the global dominant superpower. Sectors such as agriculture, in which it became the major industry in the world, as well as the industrial sector which contributed to value added of the country. In the 21<sup>st</sup> century, the country became even more powerful and started to use the most recent technology, to improve its productivity and sharing growth.

The 21<sup>st</sup> century America, transformed from an agrarian into an industrial country, since U.S economy fueled innovation. The U.S became more involved with technology than ever and became hostile to the new business full of innovation. They supported their people to become ready for innovative future by providing the capacity for innovation. Thus, the United States took the leadership of the world through innovation.

## **Chapter Three: Artificial Intelligence and U.S. Industrial Growth**

### **Introduction**

The United States has the largest and most powerful industry in the world, where automotive manufacturing is considered the major industry in the country, contributing to the domestic growth by using robotic machines in factories. This transformed the U.S industrial structure with industry 4.0 and supply chain, made an innovative trend of automation and data exchange in manufacturing technologies.

In this chapter, we shed light on the U.S advanced industry, and its characteristics. In addition, we also identify the different industrial revolutions that led to the birth of the internet of things. Then, we are going to examine and analyze the case study of U.S automotive industry and its major production.

Finally, we conclude with the benefits of using artificial intelligence in the U.S industry, and the major beneficial companies of this innovative technology.

## **1. U.S advanced Industry Profile: Introduction**

The U.S. advanced industries sector covers 50 different industries including 35 manufacturing, 3 energy, and 12 service sectors. The use of technological innovation is high, and the most innovative industries in the U.S. are pharmaceuticals, motor vehicles, aerospace; energy providing industries including oil and gas extraction and electric power generation; as well as critical service activities such as R&D services, software design, and telecommunications (Muro, Rothwell, Andes, Fikri, & Kulakarni, 2015, p12)

Some researchers differentiate between service industries and manufacturing according to the quality of products from “low tech” and “high tech” products, and this is based on the inputs and processes that increase value (Muro et al., 2015, p12).

The U.S. industry faces advances in AI technologies that allow the industry to leverage rapid growth in the volume of fast data to optimize processes in the real time. They have a variety of uses as they can shorten development cycles, and improve engineering efficiency, reduce faults, increase safety by automating risky activities in factories, and increase revenue with better sales (Bughin et al., 2017, p. 53).

This demonstrates that the United States industry is one of the largest manufacturing centers, and this type of advanced industry and innovation leads the global industry. In addition, the U.S. has the largest companies and the most innovative tech in the world. Industry standards: the smartphone, the internet, *Silicon Valley* alone are unparalleled anywhere in the world. These are largely responsible for the modern world where the U.S. leads in innovative industries.

## **2. Characteristics of U. S. Industry:**

The United States industry is highly competitive and is updated with the most updated versions of technological innovation that drives the economy at the top of the world.

## **2.1. Competitiveness:**

The US has been identified that the U.S competitiveness is supported by its large and strong manufacturing core, high exports, high-tech manufacturing, and high manufacturing per capita where the U.S enjoys its sustainable industrial performance. The report claimed that: “Sustainable industrial competitiveness may involve sacrificing current benefits and spending more on the foundations of the industry, providing support and infrastructure of the industry, for the goal of long-term gains in inclusive well-being and prosperity via industrialization” (‘UNIDO’, 2015, p. 210).

This goes to illustrate that the prosperity of industries does not always go without losing anything in return, because successful businesses are built by giving sacrifices that would benefit the industry with long-term goals.

## **2.2. Advancement and Innovation:**

Innovative technology dominated all sectors, especially in developed countries. The U.S has always been thrived with innovation, without innovation, its industries would not achieve such high rate of performance and productivity and rank in the top countries.

Irie, Nagayoshi, & Koyama (2017) explained the use of AI in industries and its benefits. They showed that new industry solutions is recognized through symbolic autonomous decentralization, and has a better version than conventional optimization of production sites for its high-speed data (p. 67).

Accordingly, AI is also used for analyzing site data by using innovative AI tools such as distributed control systems, which are applied for production and quality management. This system allows a large amount of data that has fast access. However, the rapid growth of archive data made it difficult to quantify between this data and key performance indicators (KIPs) (Irie, Nagayoshi, & Koyama, 2017, p. 4).

However, *Ross* mentioned in his book *the Industries of the Future* (2015) that the U.S private sector has a high rate of investments in intelligent robots. For instance, *Google* invested in *the Boston Dynamics* in December 2013, as well as *Deep Mind* (p. 99). *Ross* (2015) also added that giant companies have the most corporate research and development in robotics, such as *Google*, *Toyota*, and *Honda*. The investment rate is increasingly high, and it is more likely to double for the next years, as he stated:

It more than doubled in just three years, from 160 million dollars in 2011 to 341 million in 2014. In its first year investment, *Grishin Robotics*, a 25 million dollars seed investment fund, evaluated more than 600 start-ups the eight now in its portfolio. *Singulariteam*, a new Israeli venture capital fund, quickly raised two funds of 100 million dollars each to invest in early-stage robotics and artificial intelligence. The appeal for investors is obvious: the market for consumer robots could hit 390 billion dollars by 2017, and industrial robots should hit 40 billion dollars in 2020 (pp. 102- 3).

It is clear that the U.S investments in artificial intelligence became a critical juncture as technology continues to develop. The advanced industries became some kind of “hybrids” with the latest AI innovation over 40 years of rapid development and innovation that brought the United States into the new era, However, there are structural deficiencies in the American industry as do happen throughout the world in every country with the misalignment of value and capital efficiency.

### **3. The Fourth Industrial Revolution: Innovation and Digital Revolution:**

Artificial Intelligence has already affected the U.S industry in different ways and will continue to disrupt service models and products in all industries. AI will bring new features and creative innovations that will lead to an efficiency enhancement in the production sectors.

### **3.1. Industry 1.0: Industrialization:**

The first industrial revolutions Industry 1.0 in the nineteenth century was the first to revolutionize industries which marked the formal opening of the industrial age, where manufactories started to use machinery in order to produce good and products (Wisskirchen, 2017, p. 11). It was heavily depended on water and steam power to mechanize production in big and small industries which symbolized the transition from human power in homes to machine power in factories.

### **3.2. Industry 2.0: Electrification:**

The second industrial revolution started from 1870-1914, it contributed to the growth of industries including coal, iron, railroads, and textiles, and it saw the large expansion of electricity, steel, and petroleum. In the first industrial revolution, the steam engine was the assembly line, which was first applied in the automotive industry and contributed to the growth of production processes (Wisskirchen, 2017, p. 11-2). Unlike the first industrial revolution, the second focused on the use of electric power to create mass production

### **3.3. Industry 3.0: Digitalization:**

The third industrial revolution applied electronics and information technology to automate production. It began in the 1970s and brought new ways of innovation, from digitalization, which helped to increase automation levels and mass personalization which offered new services to customers (Wisskirchen, 2017, p. 12).

However, this industrial revolution was different, it was dominated by thinking machines and digital technology that have already lifted by the media and retailing industries, just as cotton mills crushed hand looms and the Model T put farriers out of work. Thinking machines designed to replace humans are far different than anything that people have encountered

before. Apple, Google, and Microsoft have developed code writing AI's that are far more productive and cost effective than human programmers. Therefore, many people enjoyed the advancement that this industrial revolution provided, and contributed to improving the U.S factories full of innovation and shudder.

### **3.4. Industry 4.0: The Industrial Internet**

The fourth industrial revolution is connected with the third industrial revolution as it is its connected chain. It is considered the most influential technology in the 21 century for its fusion of technologies that is connecting the lines between the physical, digital, and biological spheres.

Geissbauer, Veldo, & Schrauf (2014) noted that the fourth industrial revolution featured by the phenomenal increasing rate of digitalization, sustainable production, and agile supply chain (p. 7). Geissbauer et al, (2014) also identified the reason behind the development of *Industrial Internet Solutions* which is in recognizing better techniques for horizontal and vertical value chains. The second reason is digitalization and interconnection of products and services, as it leads to strong competition between advanced industries. The third major reason is digital business models, which is a new feature today's business with high horizontal cooperation across the value chains, and they are better at recognizing customers' requirements.

This explains that it is a worthy groundbreaking movement to transition in the fourth industrial revolution at times the impurities in the world make it what it is. This needed to proactively and thoughtfully reinvent the future of work by simply understanding how industrial automation work which will be a challenging problem for all industries and businesses In the U.S.

#### **4. The Use of Artificial Intelligence on U.S Automotive Industry: Data Analysis:**

##### **Inter-Industry Data:**

The input-output model of annual data provides the inter-industry relationships for more than 70 industries based on the BEA computers Benchmark (2007). The table (1) illustrates the codes of NAICS that identify different results of aggregation, and this relatively goes with economic accounts and industry statistics where the business is conducted. The NAICS refers to the establishments of multiple activities. The data presented is developed by Wassily and Leontief (1966), gives data under constant returns to specific proportions. These proportions are fixed by the current innovative technologies, so it is possible to consider how changes in inter-industry sectors will impact other sectors.

In figure (2), a number of datasets are applied to improve an inventory and model of industrial activities, as well as setting these data sets together means using standard categories of classification. However, it is difficult to use certain datasets in the model NAICS codes or it needs to be changed to fit into these categories of datasets. Some of these datasets apply NAICS and others go with a different classification system to set a data matrix.

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Code	Commodity Description					Total Final Uses	Total Commodity Output
		Automobile manufacturing	Light truck and utility vehicle manufacturing	Heavy duty truck manufacturing	...		
336111	Automobile manufacturing	104	0	0	...	80 339	80 444
336112	Light truck and utility vehicle	0	0	0	...	161 716	161 731
336120	Heavy duty truck manufacturing	0	0	50	...	20 701	24 246
336211	Motor vehicle body manufacturing	1 092	1 263	18	...	3 292	6 834
⋮	⋮				...		
<b>T005</b>	<b>Total Intermediate</b>	<b>66 129</b>	<b>130 438</b>	<b>16 342</b>	<b>...</b>		
V00100	Compensation of employees	13 058	6 191	2 386	...		
V00200	Taxes less subsidies	284	129	35	...		
V00300	Gross operating surplus	8 336	24 146	1 248	...		
<b>T006</b>	<b>Total Value Added</b>	<b>21 677</b>	<b>30 466</b>	<b>3 669</b>	<b>...</b>	<b>14 477 634</b>	
<b>T008</b>	<b>Total Industry Output</b>	<b>87 807</b>	<b>160 904</b>	<b>20 011</b>	<b>...</b>		<b>26 151 297</b>

Table 1: Input- Output Data of the U.S Automotive Industry. Source: (National Institute of Standards and Technology, 2015)

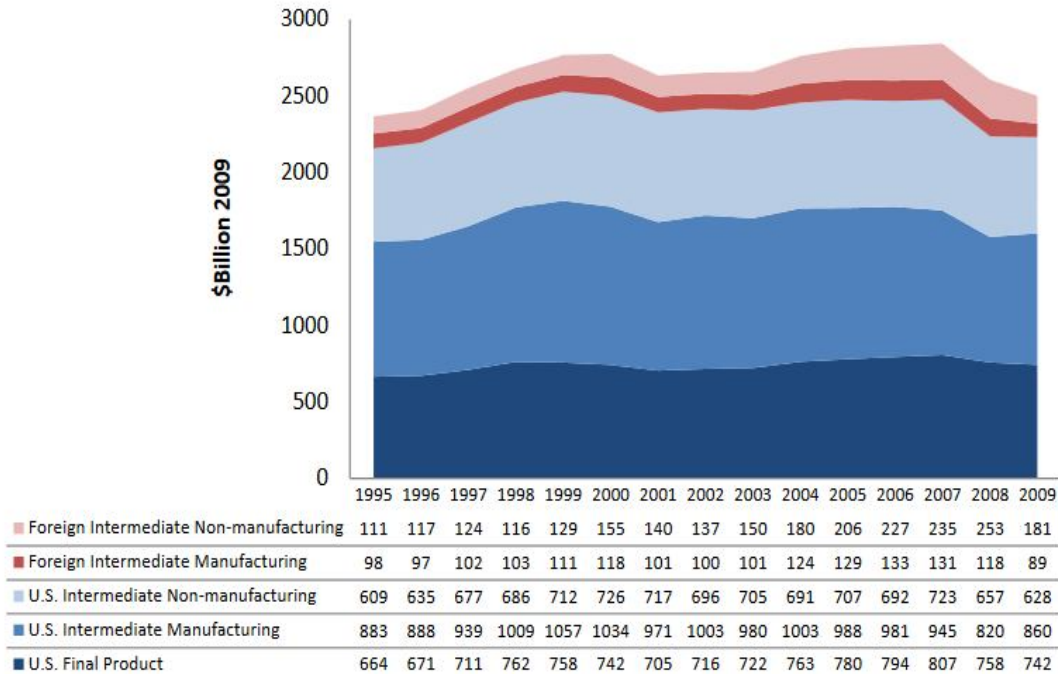


Figure 2: U.S Manufacturing Supply Chain Value Added. Source: (National Institute of Standards and Technology, 2015).

**The Major productive and Innovative companies: Ford, General Motors, and FCA US**

In 2016, the United States major car companies increased its production to 6.6 million vehicles where the most productive companies are as: FCA US, Ford, and General Motors. They presented 84 percent of their production in the same year. Those companies are the major beneficial or robotic machine in their industries. Ford, for example, produced more than 1 million cars in the U. S. in 2015.

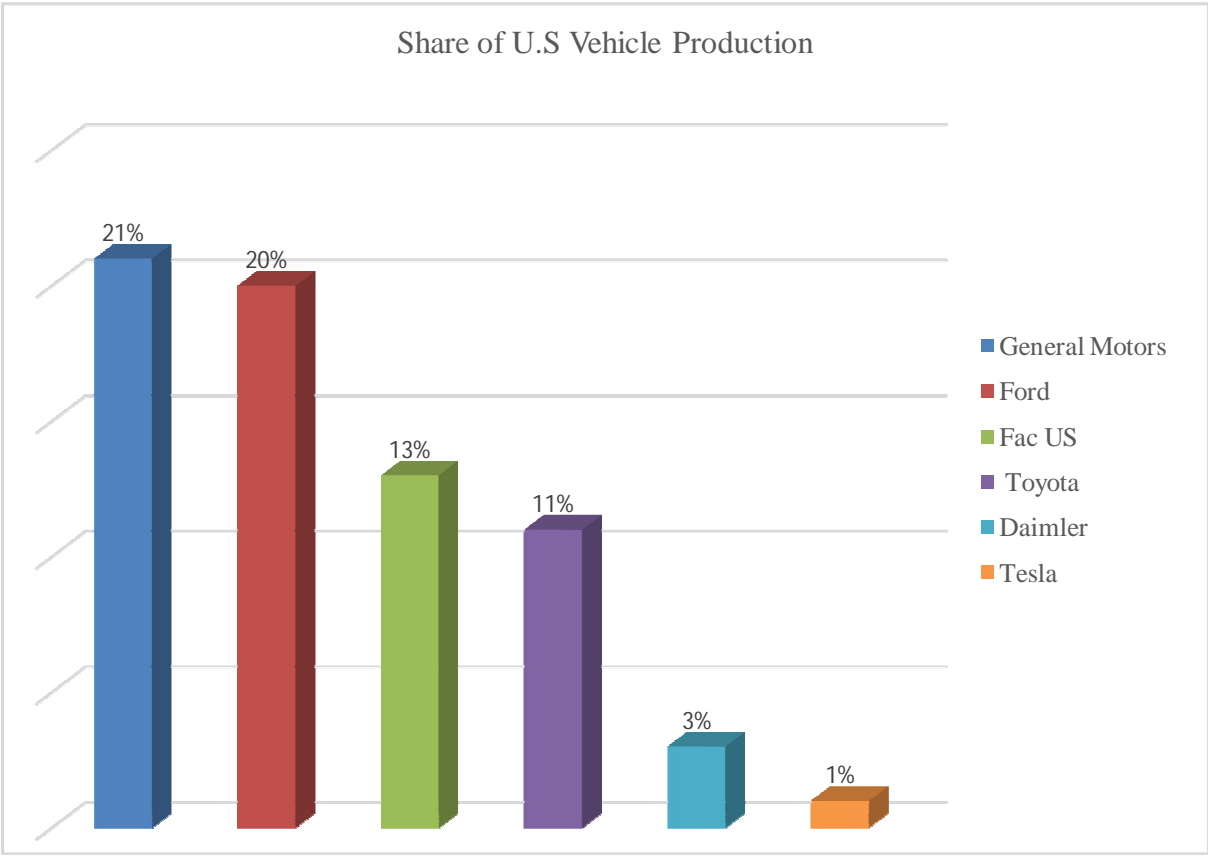


Figure 3: Share of U.S Vehicle Production.

Concerning FCA US, it operates as many plants as Toyota and other car companies which made the U.S car industry highly innovative and competitive than others. Thus, FCA US made its achievement to rank among the eight largest automakers in the world.

**U.S Output Production of Automobile Industry**

The U.S car production suffered a great deal of recession resulted in a decrease in its production before 2010. However, as vehicle industry rebounded thanks to its innovation and high investments in AI, which contributed to the economic growth about 10 percent of its economic growth starting from 2013-2014.

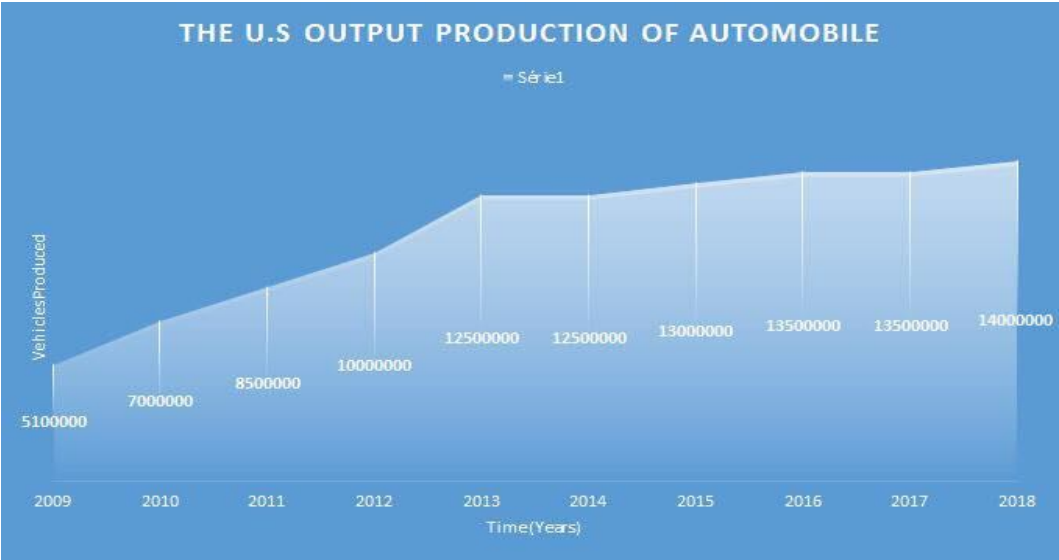


Figure 4: U.S output production of Automobile according to AAC, 2017

In 2013, U.S automotive production doubled from 5.7 million cars to 12 million cars, and it is expected to make a huge difference by 2019. Car production continued to increase in 2018 to make around 6 percent growth rate from 2017. Thus, the world’s largest car manufacturer can be fast and innovative.

Accordingly, RUBENSTEIN and ETTLIE (1981) explain the car manufacturer’s decisions to accept, encourage development of, or integrate artificial intelligence as the major influencing success factor for growing automotive production outputs.

In another study conducted by Berman and Hagan (2006) estimated ten of the most successful and innovative companies that use automation, and identified the motives behind using AI innovation in their industries that push their markets ahead. Their motives were illustrated as follows:

- Increase the basis for competition: Innovative companies recognize themselves from others by having a new vision, which uses an emerging or unarticulated market need.
- Break the rules of scale leveraging innovation to make profits at a lower scale stage or, on the contrary, obtaining scale benefit where none previously existed.
- Create alternative business strategies and models that have the potential to disrupt or undermine the incumbent industry business models.

To be more specific, AI in the U.S automobile industry has to achieve one of the two main competitive dimensions, reducing auto supplies cost, as well as to the availability of resources, markets, and financial strength to be able to adopt A.I technologies into their industries. Therefore, auto companies have to integrate complex and difficult A.I tech systems in order to protect their originality and make it difficult to imitate.

Finally, companies such as GM and Ford with their Hertz Drive-Ur-Self System are good examples of successful automotive supplier innovators. However, their abilities to influence and change the products are often limited, so this is a difficult challenge that many U.S. auto companies face, especially with fierce competition with other auto innovative industries.

The U.S. automotive companies transform themselves into broader mobility providers and the way they operate vehicles in a more innovative way. One of the most innovative car companies in the U.S. is GM. This company has put its focus on disruptive AI technology trends that opened numerous opportunities for growth as it put approximately 7.9 billion dollars for new materials such as anti-lock brakes and automated emergency steering systems. Another innovative company is *Ford* as it has started to rely on smart vehicle technologies and alternative propulsion systems. These automotive companies became the world's forward-looking automakers to be impacted by AI. Thus, U.S car industries are becoming carriers of big data (Fig 5).

The U.S. automakers put high rate AI investments with an average of 20 billion dollars in 2016 contributing to increasing alternative fuels, and developed powertrains, which means for each car was sold in 2016 represents approximately 1,150 dollars of R&D (Fig 6).

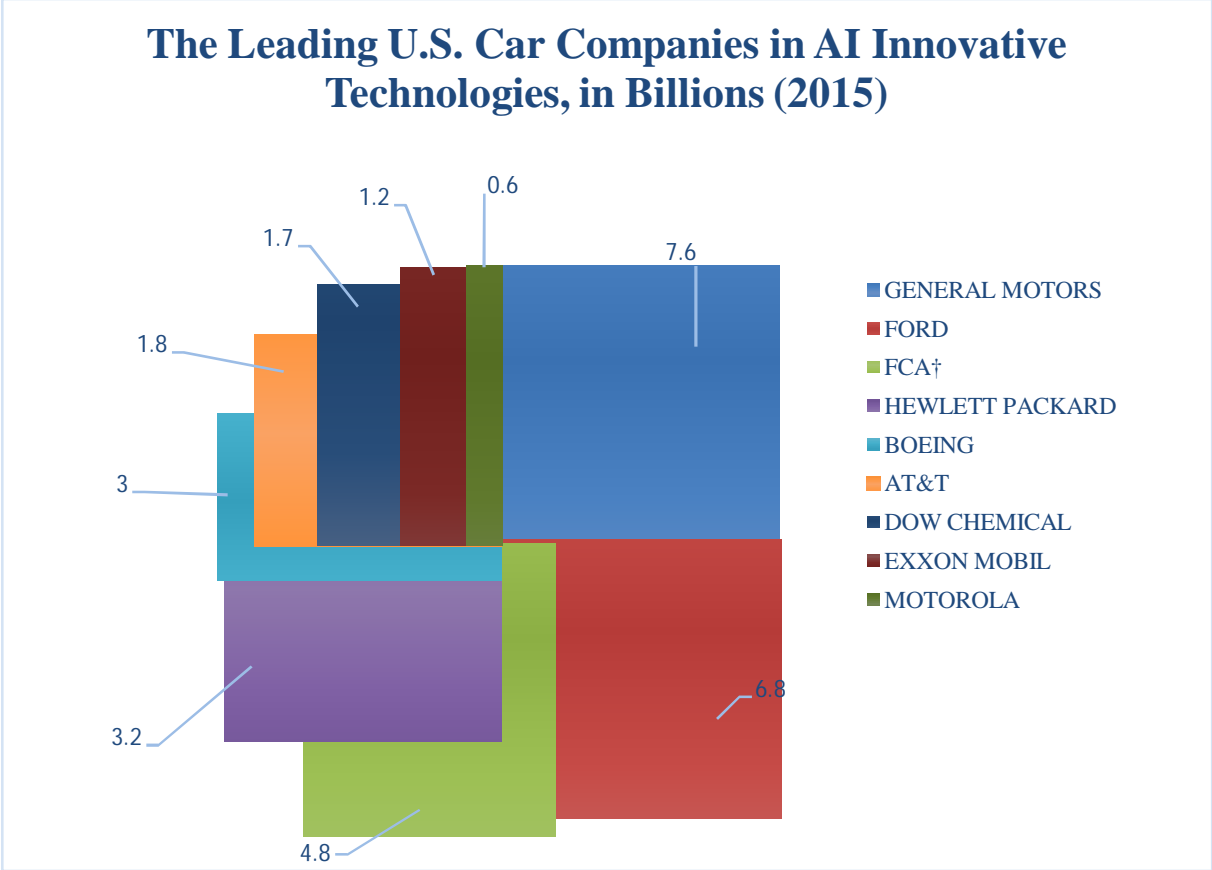


Figure 5: The leading U.S. Car Companies in AI innovative technologies according to American Auto Council, 2017.

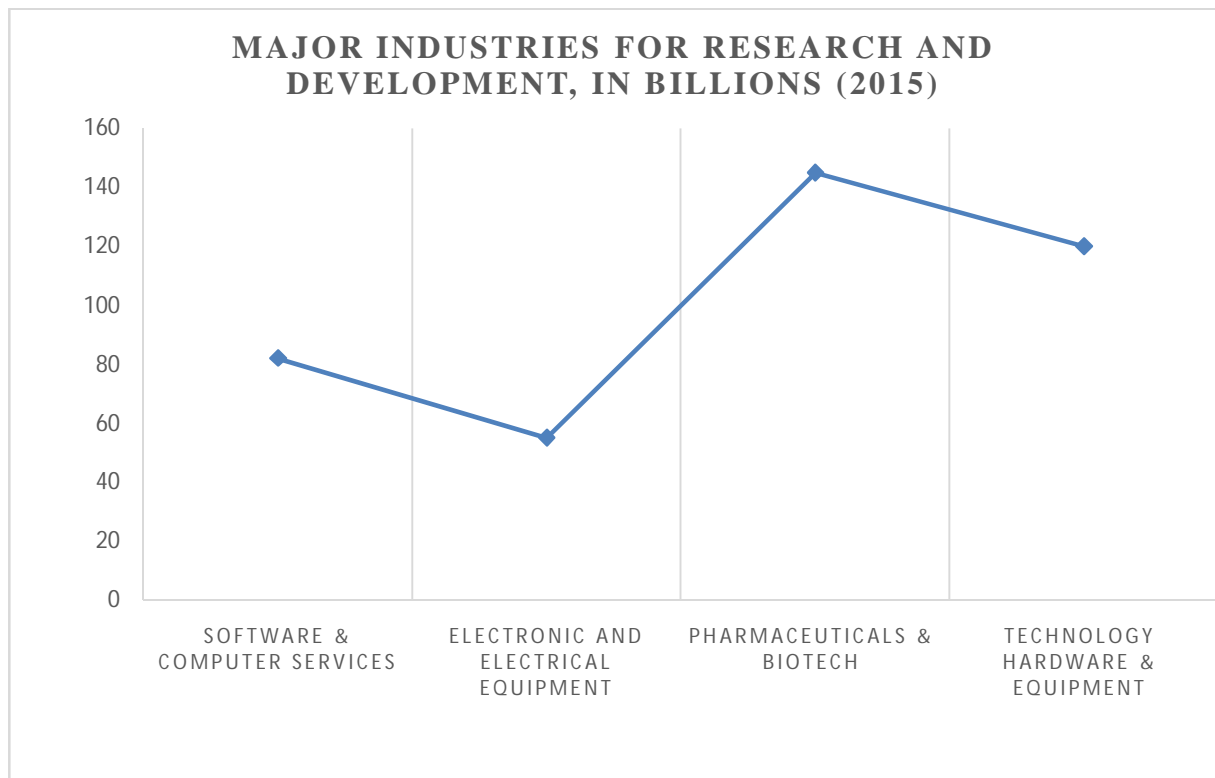


Figure 6: Major U.S industries for Research and Development according to AAC

### **Benefits of Integrating A.I on the United States Industry:**

The adoption of AI technologies remains in its beginning, even though it was known as a significantly advanced tool nowadays. It is a challenging mission to reach its true potential adoption in different firms and sectors. That is to say; many studies have shown that AI can have many useful functions in different sectors, and can also be implemented to transform various business activities and increase commercialisation.

#### **4.1. Boosting Profits**

Bughin et al. (2017) estimated the advantages of artificial intelligence in industries and noted that many digital native companies have made some of the most important investment in AI. For example; *Amazon*, which has reached significant and increased its profits to 775 million dollars from adopting *Kiva* robotics company which optimizes warehouse operations and speed up the picking and packing process. Also, *Netflix* is another company that has

received noticeable results in the sense that it facilitates the process of accessing movies because customers may give up if it takes too much time to find a movie. In addition, the firms that have adopted AI in their business activities have anticipated greater benefits, this means that AI could have essential competitive advantages, but only for the firms that are fully committed to it (p. 20).

Generally speaking, automation is the future, it would take 1 person 2 hours to do what this AI machines do in less than 10 seconds. So many giant companies race to invest in A.I and make their own profits, which means it boosts profits specifically for CEOs and shareholders, but its benefits for consumers/buyers is ambiguous.

#### **4.2. Promoting Offerings in Businesses:**

Bughin et al. (2017) showed five case studies that have been created in different sectors in order to develop a vision of how AI can be used to affect various business domains. These case studies are as follow retail, electric utilities, manufacturing, healthcare, and education. Furthermore, in order to fulfill the expectations that have been raised in four areas, in which AI can create add value, have been categorized: enabling companies to better project and forecast to anticipate demand, increasing companies' ability to produce goods and services at lower cost and higher quality; helping promote offerings at the right price, with the right message, and to the right target customers; and allowing them to provide rich, personal, and convenient user experiences. The four areas of value creations are based on specific cases that are being explored in businesses today (p. 22). This means that adopting artificial intelligence and automation in industries will automatically lead to cost savings, and improve product performance.

Bughin et al. (2017) also identified that the projection and forecasting is the first area in which organizations can apply AI to create added value need to anticipate the future so as to

increase competitive advantages and supply better offerings. Projection and forecasting enable business to anticipate and know what kind of products that they need to stock depending on the AI potential to determine the specific quantities of some trends they will sell. This means AI helps optimize supply in order to anticipate demand depending on electric utilities. Generally speaking, as we have seen in this study, forecasting can help organizations and factories shape future offerings for customers based on the AI.

#### **4.3. Improving Quantity and Quality of Production:**

Wisskirchen et al. (2017) explained the effects of robotic machines in production as it is the second area where AI can create value. AI helps businesses maintain producing in the sense they assemble the high skilled human capital and robots in order to improve quantity and quality of products. New technological advances have helped factories a lot to not waste time and increase productivity. However, the main objective behind AI is to replace humans through automation, but in most situations, AI is complemented by human skills (p. 42).

That is to say, different factories work on improving AI potentials to overcome the traditional ways in doing business, for example; computers vision work in a pre-programmed systematic way in the sense that their abilities were very limited. They react and follow pre-defined steps accordingly. That is why; enhanced computer vision is a notable shift since current robotic systems have more flexibility than traditional systems to react according to the context provided. That means; AI's performance is enhanced significantly, and its qualities introduce new challenges in the industry profit shifts.

## **Conclusion**

From the beginning of the fourth industrial revolution, the United States' industries became advanced thanks to the use of creative innovation that contributed to high competition around the globe. The U.S advanced industries are characterized by high competition between the global markets, as well as innovation and creativity. Along with this period of rapid technological innovation and change have come questions about competitiveness in the industry.

Most importantly, it has been asked if trait providers have contributed to the market profits to constrain workers' ability to perform difficult tasks. However, the adoption of automation goes to represent that automation cannot be done without human workers, and his latter cannot perform properly without the help of robotic machines, as AI robots have the ability to choose a range of industrial products at different price and quality levels.

Moreover, A.I machines contribute greatly to advanced industries as they provide high service with lower costs and make the markets boom. Concerning the U.S automobile industry, A.I made a huge difference in improving its production in the recent years, and it is still in ongoing improvement. Finally, artificial intelligence played an important role in many critical areas, which contributed in booming the U.S. automotive industry.

## **General Conclusion**

The analysis provided by this study clearly illustrates that as regards positive impacts of artificial intelligence on the industry, the answers are clear. We know that changes in the industrial sector will result in more innovation and advancement that will lead to industrial growth, especially in the U.S. auto industry that has a larger share than any other industry. In the inter industry model based on NAICS, we find a significant support that growth in the development of artificial intelligence in which it explains the growth of the U.S. car production, and this might be the results of historical economic stability in the United States, as well as high experience levels of using traditional technologies prior to artificial intelligence.

However, the emergence of artificial intelligence applications in the late twentieth century has dramatically impacted the notions about the effectiveness and efficiency of industrial models. One decade on, and AI innovation in the automotive industry seems to be on fire, with tons of creative applications and services in a wide range of sectors such as healthcare, transportation, banking, agriculture, and industry, helped to drive the U.S economic growth.

Industrial automation has been fought tooth and claw by professional unions for the last one hundred years. All the while projected population growth was supposed to have overtaken food supply and led to widespread famine in the fifties. Was it not for frost resistant wheat strain since then the U.S had more automation and more population than any other nation in the world. By any measure, this growth should have expedited unemployment and suffering. This pushed out a lot of menial jobs, other technical jobs came to replace them. Thus, this trend is likely to continue as long as automation keeps developing.

Many analysts see that entire socioeconomic platform failing before automation sets in as the U.S advanced more scientifically, this will likely meet at a point to where the current

platform is insufficient or to be specific inefficient. Concerning the U.S economy, there are different portions that should be looked over instead of overlooked as software becomes a large share of productivity, some examples being consumer goods, industrial materials, and a waste of both, while other examples referring to inefficient economics spectrum.

Years of research have established that automation and innovation are critical technological dimensions in the development of U.S industry, and investments in AI made giant companies race ahead at even faster speeds. These companies including *Facebook* for its huge investments in AI and machine learning that bring new features and innovative services such as news feed algorithm. Also, another major company is *Google*, which increases the AI potential by investing billions in a transformative technology. Its major acquisition in deep learning and neural network helped the company to make significant upgrades to its image search features, as well as self driving cars. Concerning the U.S. car production, companies such as GM and Ford made the largest share due to their innovative vision of mass production and adoption of artificial intelligence in producing cars. This made the automobile industry an important part of the nation's economy

In the U.S. automotive industry, artificial intelligence contributed greatly to structural change as the world of the car industry is moving fast into the fourth industrial revolution. It changed both the competitive landscape and production output, where AI can deliver significant benefits to the growth of the U.S. auto industry.

The current AI applications in industry, especially in the automotive industry have caused great changes since it was first adopted. But the present study did not tackle many important questions for the fact that AI innovative technologies have just taken place in today's industry, and it is too early to have a clear and deep understanding and analysis of what is going on in terms of A.I challenges that face many auto industries, and the industrial sectors in America in general. After few years from now, such questions will be very attractive areas

for study to many researchers who will have a better opportunity to provide more accurate answers about the impact of artificial intelligence in the automotive industry, and industries in general. The influence of tech industries and their innovations caused a major impact of disruption that pertains to the potential of artificial intelligence in industries.

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## Glossary

**Advanced industries:** Industries that use high-level of R&D and STEM workers, as well as high tech materials such as automation and industrial robotics. Advanced industries also involve advanced technology services, manufacturing, and energy production.

**Big data:** It is mostly used in the field of computer science, specifically in artificial intelligence. It refers to a process that is used when traditional data mining and handling techniques cannot uncover the meaning of the underlying data.

**Capital goods:** Goods used in the production of other goods and services

**Commercialisation:** It is a process or a stage that involves managing and making new products available on the market for financial gain.

**Energy:** The ability to do work. In industry, it often refers to the energy used to power manufacturing processes.

**Forex:** It refers to the foreign exchange market where buyers and sellers conduct foreign currencies. It is considered the largest and most liquid market in the world.

**Innovation:** An innovation is the implementation of new ideas, or the creating of dynamic products that create value in business.

**Supply chain:** A supply chain is a system of business organizations, and logistics management. It is a set of activities that involve the creation and sale of a product, from the supplier to the producer.

**The Federal Reserve:** It is the central bank of the United States. It was created to build a more stable, and flexible monetary and financial system.

**The Great Society:** It was a set of domestic programs established under Lyndon B. Johnson to improve people's lives.

**The New Deal:** It was a group of programs and policies to improve conditions for people suffering during the Great Depression.

**Value added:** A measure of output net of intermediate consumption, which involves the value of materials used in the production process.

**Vertical markets:** It is a market in which vendors offer their goods, products, and services to a variety of industries or group of enterprises.

**Workforce:** The workforce or labour force refers to a group of people involved in or available work.

## الملخص

تتناول هذه الأطروحة بعض تأثيرات الذكاء الاصطناعي الذي يتركه في العلاقات السائدة بين أطراف القطاعات الصناعية عامة، و بين قطاع صناعة السيارات الأمريكية خاصة. حيث ساهمت هذه التكنولوجيا عالية الجودة إلى زيادة هائلة في الإنتاج الصناعي و كذا في التنمية الاقتصادية خصوصا مع بداية الثورة الرقمية و عصر تقنية الذكاء الاصطناعي و الروبوتات. الكثير من الشركات الأمريكية الكبرى بدأت في الاستثمار في هذه التكنولوجيا و ذلك بما تمثله تطبيقات الذكاء الاصطناعي من فرص كبيرة للكثير من القطاعات الاقتصادية من نجاحات في جميع الأصعدة فقد أكدت الكثير من الأبحاث و الدراسات أن تقنيات الذكاء الاصطناعي قادرة على تحفيز الناتج المحلي الإجمالي . والسؤال الذي يطرح نفسه هو ما هي الإمكانيات التي يمكن أن تقدمها هذه الثروة المعلوماتية؟ والى أين يمكن أن تصل هذه التكنولوجيا إلى تحقيق التطور الصناعي ' خاصة في مجال صناعة السيارات؟ بينت الدراسة أن الذكاء الاصطناعي سبب في ظهور العديد من الشركات العملاقة و الصناعات المتطورة نظرا لما تقدمه من تقنيات حديثة التي ساهمت في نجاح و تنمية الصناعة في الولايات المتحدة الأمريكية.