Adoption and inclusion of Artificial Intelligence in digitalization strategies of organizations

Master Thesis

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Abstract:

Current master thesis explores the threats and opportunities that innovations and specifically AI can bring for organizations and how companies need to adjust their business models by including those innovations in their digitalization strategies. In order to do this, the research looks at Artificial Intelligence which is an example of a modern-day technology that has all the potential to cross the chasm of adaptation and start the new, 6th wave of Kondratieff wave. The research presents difficulties and steps that organizations need to undertake in order to adjust their business models to maintain or grow their positions in the market.

Empirical evidences and interviews are presented to analyze the current state of AI adoption.

A new theoretical framework has been developed to assess the potential adoption of AI as a technology.

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Introduction

The 20th century was the era of innovations, which brought us most of the technologies that people use on daily bases today. Since then, however, the world started moving towards higher speeds, global connectivity and higher computational powers. This in its turn created a need for companies and industries to adapt to those fast-changing technologies and automatize as many operational processes as possible. The process of implementation of those technologies for the purposes of automatization, transformation of operations, functions, business models or activities is called digitalization (Clerck, 2016). One of the most prominent new technologies that we are currently witnessing fast growing role of, is Artificial Intelligence. This technology has the potential to start a new wave of innovation, by analyzing the massive amount of data that humanity is generating every day.

Indeed, the expectations from AI are big - from making better R&D and more accurate financial predictions to intelligent automation in manufacturing. And while there are number of companies which claim that they already use AI technologies in their daily tasks, there is still a larger number of companies which don't even know what AI can do for them.

In this research, the author would like to elaborate on the topic of AI, what it is, what are the potential benefits of adopting it and possible risks of failing to do so. Most importantly, the research will try to answer the question what exactly should the companies do to remain competitive in the market, is there a need to integrate AI solutions in their digitalization strategies and how AI can be adopted by them. By answering this question, the research will aim to answer a broader question about how organizations adopt innovations, why is it needed and how it affects their business models.

Background and problem

2010s marked the new wave of developments in the field of Artificial Intelligence. Like a lot of other modern technologies, AI has its roots in 1950s when its theoretical idea was just being discussed. The first successful algorithms of so-called Machine Learning were introduced in 1980s, yet due to lack of data and computational power the algorithms couldn't do much. The second life to AI was given when Deep Learning algorithms started appearing. This allowed analyze and learn from vast amounts of information created by internet users (Big Data), and come very close to what half a century ago would be considered a science fiction. Some AI solutions are now quite advanced, easy-to-use and capable of helping users solve daily tasks, such as financial analyses, making better marketing predictions, helping diagnose illnesses etc.

On the other hand, we see companies transforming and digitalizing their businesses. In fact, there are just a few industries where companies are not planning to digitalize their businesses and replace traditional processes. In order to tackle the challenges that imposed on the modern business, organizations need to adapt and be ready to adopt new technologies. AI is becoming more and more developed and one can see examples of companies who are profiting while using it. In order to remain competitive, it is crucial for businesses to understand what kind of threats and opportunities can AI bring and if needed, adjust their business models accordingly by including AI in their digitalization strategies.

On a larger scale of this research, AI will be viewed as an example or case study, and will help understand how the innovations are adopted by organizations and why is it important.

Research Questions

As stated before, current research is not interested in AI as a standalone technology, but is rather looking at adoption of innovations through the prism of AI. In order to answer the main question, the research will raise sub-questions.

Main Research Question:

What are the potential benefits of adopting and integrating AI into digitalization strategies of organizations and potential risks of not doing so?

Research Sub-Questions:

1. What is the current state of AI?
2. What are the potential threats and opportunities that AI brings?
3. What can be an effective framework to assess the potential adoption of AI?
4. What is the current level of AI adoption in organizations?
5. What benefits does AI provide to organizations which are already using it?

Research Objectives and Scope

Objective 1: In the “State of the Art” chapter, current paper will define what digitalization is and separate it from terms that are close in meaning. Further the research will focus on Artificial Intelligence by defining it and discussing the current state of development.

Objective 2: In the innovation adoption and theoretical framework chapters, the research will present existing theories and frameworks on adoption of new technologies, address their limitations and propose a new theoretical framework.

Objective 3: Analyze and assess the potential adoption of AI using the proposed theoretical framework and gathered empirical data. Learn whether organizations need to adjust their business models and include AI in their digitalization strategies.

State of the Art

Digitization, Digitalization and Digital Transformation

The current subchapter will define the terms digitization, digitalization and digital transformation and discuss their differences. The need for this is dictated by the confusion that people often have between those terms. It is worthy to mention that out of those the terms “digitization” and “digitalization” are the ones that are quite close in meanings. In fact, different literature sources often use those interchangeably. Yet this is a confusion that needs to be clarified. In fact as Brennen and Kreiss state “there is analytical value in explicitly making a clear distinction between these two terms” (Brennen & Kreiss, 2014).

Digitization

The term “digitization” is defined as “the action or process of digitizing; the conversion of analogue data (esp. in later use images, video, and text) into digital form” (*Oxford Dictionary of English*, 2010). In other words, digitization is the process of making digital copies of things that have previously existing only in non-digital format. List of examples includes, but is not limited to paper documents, photographs and sounds. Yet, digitization doesn’t mean replacement of the original documents, images, sound and other things, altogether.
Digitizing data can allow it to be stored and transferred in new ways, while providing users opportunities of “easy manipulation and display of these data” (Verhulst, 2002, p. 433). This provide users with additional control over the digitized data (Beniger, 1997; Owen, 2006).
Another big benefit of digitized data is that it allows “data compression” (Negroponte, 1995, p. 15), which leads to “controlled storage in large volume” (Verhulst, 2002, p. 433).
Across different disciplines, scholars talk about “radical uniqueness of digitization and digitized information” (Brennen & Kreiss, 2014). Digitizing information also enhances it with new qualities. For instance, in most business cases digitized information enables organizations to make their workflow, business processes and systems more efficient. Sometimes this affects the whole business model.
An example of this is media. Digitization led to radical changes in the landscape for this industry, and, as a result, most of the media technologies we use are digital.
As a result of this all, digitization brings macro-level changes in social structures, groups, practices and interactions, which leads us to the term “digitalization”.

Digitalization

The term “digitalization” first time appeared in a 1971 when Robert Wachal discussed potential use of computer in helping make researches and how it can lead to “digitalization of society”. Manuel Castells (2010) in his book “The Rise of the Network Society” identifies digitalization as one of the main characteristics of the 21st century.

Often being confused with digitization and digital transformation, digitalization is the use of digital technologies and of data for creating revenue, improving business, replacing and/or transforming business processes, functions and operations. Rather than just digitizing the data, digitalization is concerned with creating an environment for digital business and a “broader use of digitized data, turned into actionable knowledge, with a specific benefit in mind” (Clerck, 2016). So, digitalization is all about merging the digitized data and processes. For organizations it means that the employees work differently, using digital tools and technologies that make them more mobile including unified communication platforms. The list of what you can digitalize is long. This creates new opportunities for employees to work differently.

Different scholars have talked about how digitalization shapes our life. An example of this is globalization, which facilitated, and is still facilitated by, the expansion of the economy to a new, worldwide level (Sassen, 1998). Other theories note that digitalization’s effects on social life resulted in unification of disparate sectors. Finally, there are scholars who believe, that due to the ability of digitalization to consolidate all other media, mimic or simulate their work, “digital” must be views as a “generalized medium” that combines “diverse forms of information” (Beniger, 1997, p. 26), or that is ultimately “mediumless” (Negroponte, 1996, p. 71).

In general, digitalization is seen as a road to digital transformation, while creating new digital revenue streams. Digital transformation essentially consists of different digitalization processes.

Digital transformation

Digital transformation was well defined by Haluk Demirkan and James Spohrer in their article “Emerging service orientations and transformations (SOT)”. They say that “digital transformation is the profound and accelerating transformation of business activities, processes, competencies and models to fully leverage the changes and opportunities of

digital technologies and their impact across society in a strategic and prioritized way" (Demirkan & Spohrer, 2016, p. 16).

The speed at which technologies are getting adopted nowadays change the market and introduce a new economy. Digital transformation is a key element in all of this. Yet, it is crucial to clearly understand that successful digital transformation has more aspects to it than just digital business or technologies. It is just as much about leadership, connections between IT and the business, employee engagement and bad operation. In fact, according to Capgemini Digital Transformation Institute and MIT Sloan School of Management, it is often because of not having those in place, that the companies fail to successfully undergo digital transformation (Understanding digital mastery today, 2018).

Difference between digitalization and digital transformation

At this point of the current research, it is crucial to identify the difference between digitalization and digital transformation. Digital transformation, is an enterprise-wide phenomenon, meaning it is much bigger than digitalization. It needs more connections across different field of operation, to build a successful digital transformation strategy.

To look at the picture from a larger scale we must say that the road to digital transformation happens in following steps: transforming information from analog to digital (digitization), changing processes of workflow by digitalizing them, and finally digitally transforming company's entire strategy and the business itself. It is crucial to keep in mind that the third step – digital transformation is not as much about technology as the previous steps, it is much more about transforming the way that business is done.

Artificial Intelligence

In 1956 John McCarthy, a math professor at Dartmouth College, assigned his students to conduct a research. That was considered to be the birthday of Artificial Intelligence as the research was aiming to give answer if "every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it" (McCarthy, Minsky, Rochester, & Shannon, 1955, p. 1).

As of the moment of writing this work, it is hard to closely define the term "Artificial Intelligence" due to the reason that when we say AI, we typically mean more than one type of technology that conducts more than one type of operation. There are other issues with

the term as well. The definition of what “intelligence” is being one of them. And while it can be viewed rather as a philosophical or scientific, it is important to define what is the “intelligence” that people are trying to build. Some authors would argue that intelligence consists of linguistic, logical-mathematical, musical, bodily-kinesthetic, spatial, interpersonal, intrapersonal, naturalist and existential parts (Gardner, 1999). At the same time psychologist would argue that numbers such as IQ cannot measure intelligence in full. In fact, the truth is, it is almost impossible to identify the elements from which “intelligence” consists of. Throughout the last decades, if not centuries, different people tried to find answers to this, Robert Sternberg’s “Three aspects of intelligence” being one of the notable works (Sternberg & Detterman, 1986). Winkless and Browning also tried to answer this question in their 1978 book by writing that “intelligence is the ability to behave appropriately under unpredictable conditions” (Winkless & Browning, 1978). This in its turn was later elaborated by Ben Gotzel who wrote “intelligence is the ability to achieve complex goals in complex environments” (Goertzel, 1993). And while the question of what is intelligence is still being argued, there is one thing that everyone agrees on - “Intelligence... can only be achieved by a system that is capable of learning, especially autonomous and incremental learning. The system should be able to interact with its environment and other entities in the environment and learn from these interactions. It should also be able to build upon its previous experiences, and the skills they have taught it, to learn more complex actions and therefore achieve more complex goals “ (Pennachin & Goertzel, 2007, p. 8).

With all this being said, the author of the current work would like to point out that are already some AI projects already exist and will be discussed below.

General AI

AGI or “Artificial General Intelligence”, also often called “Strong AI” is typically what a lot of people think when they hear the phrase “Artificial Intelligence”. This happens to due numerous movies, science fiction book, comics etc. that were shot on the topic of Artificial Intelligence. The term applies to a program which can do different actions and solve problems in different fields of operation. AGI is often described as a program that “controls itself autonomously, with its own thoughts, worries, feelings, strengths, weaknesses and predispositions” (Pennachin & Goertzel, 2007, p. 1). Or as Bughin and his colleagues put it, AGI “seeks to be able to perform any intellectual task that a human can do” (Bughin et

al., 2017, p. 8). So, if this is just a piece of science fiction, why did it appear in the first place? The reason is that AGI was the first and original focus of development and researches in the field of AI. Yet, when the idea of it just appeared and handful of people where working on building such a program, information technologies were not developed and after several attempts, researches were paused. With the rapid growth of technology, scientists got access to stronger computational powers and the topic of AGI was raised again. Today, some researchers try applying abstract mathematics to build AGI, others believe that the solution is to build "smaller" AIs that will do a single task and then putting them all together. And while AGI remains a science fiction, those "smaller" AI solutions already exists and are commonly known under name of Narrow AI (see Figure 1).

Narrow AI

As mentioned above AGI seemed to be a hard task to accomplish at one take and that is why the researchers try different ways to achieve it. Most of the scientists believe that Artificial Narrow Intelligence (ANI), also known as Weak AI is a key to eventually reaching AGI.

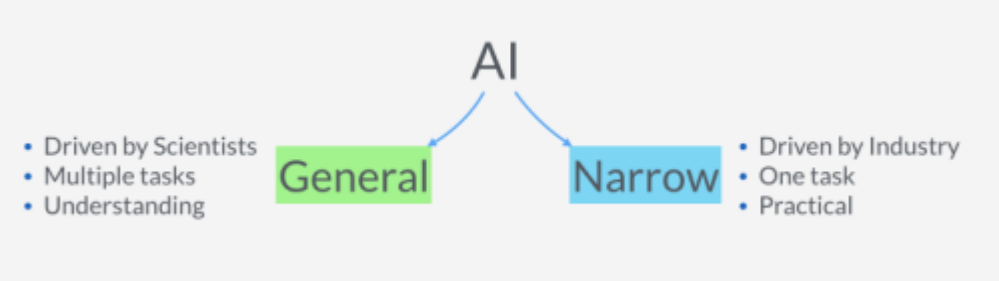

Figure 1: Types of AI (Argility, 2018)

This resulted in rapid development in this branch of AI and allowed "creating programs that demonstrate intelligence in one or another specialized area, such as chess-playing, medical diagnosis, automobile driving, algebraic calculation or mathematical theorem-proving" (Pennachin & Goertzel, 2007, p. 1). Businesses quickly saw potential in adopting this type of Artificial Intelligence to fit their products and soon the ANI development was primarily led by industry, as opposed to AGI which is primarily developed by scientists. Due to this, ANI has a big business potential (Vorhies, 2016). In fact, Purdy and Daugherty

(2016) mentioned that ANI can not only double annual economic growth rates by 2035 but also increase labor productivity by up to 40% (Purdy & Daugherty, 2017).
However, although ANI systems that we have in our phones today as personal assistants or even the more “professional” ones that play Go with world champions, appear intelligent it is important to understand that they can only simulate intelligence (Bringsjord, 1998). ANIs are called narrow, because of their ability to perform one narrow task within a given “specialization”.

Existing ANI initiatives and products

A number of ANI initiatives already exists today, examples which are presented below:

Self-driving cars

- Google cars
- Tesla
- Volvo
- Mercedes-Benz
- BMW

Personal assistants

- Siri
- Alexa
- Alisa
- Cortana
- Google Assistant

Game playing ANIs

- AlphaGo Distributed
- AlphaGo
- Zen
- Pachi
- Hui

Content

- Image identification
- Music suggestions
- Text (hate speech) identification

Digital photo cameras

- Image processing
- Image recognition

Figure 2: Examples of what a ANI can do today (Argility, 2018)

Figure 2 shows the list of things that AI can do, yet it is not complete as there are hundreds of examples. The categorization of those examples is also non-complete and differs in different sources. There is no doubt that over time, with continues developments in the field, the number of industries which use ANI will increase.

Machine and Deep Learning

The backbone of any Artificial Intelligence technology are Machine and Deep Learning. To understand better what they are and how they affect the work of AI and development in the field, it is important to look into the history of AI.

As mentioned before, Artificial Intelligence appeared in 1956. Yet, when it just appeared it was rather an idea or science fiction which sparked an interest in few scientists. The so called Darmouth Conferences gave a chance for those enthusiasts to gather and discuss the future implications and possibilities of AI. Those people, yet, understood that with the technologies that existed back then AI was impossible to create, and that turned to be the main reason why the developments in the field didn't happen until 1980s. 1980s signified the appearance of first computers with rather strong computational power. Machine Learning (ML) algorithms allowed "feeding" the generated information to programs in attempts to create AI. Even with this, however, the developments went slow.

2012 was the year when AI was given a true second birth. Deep Learning (DL) algorithms revolutionized the way machines process information and the field started developing rapidly.

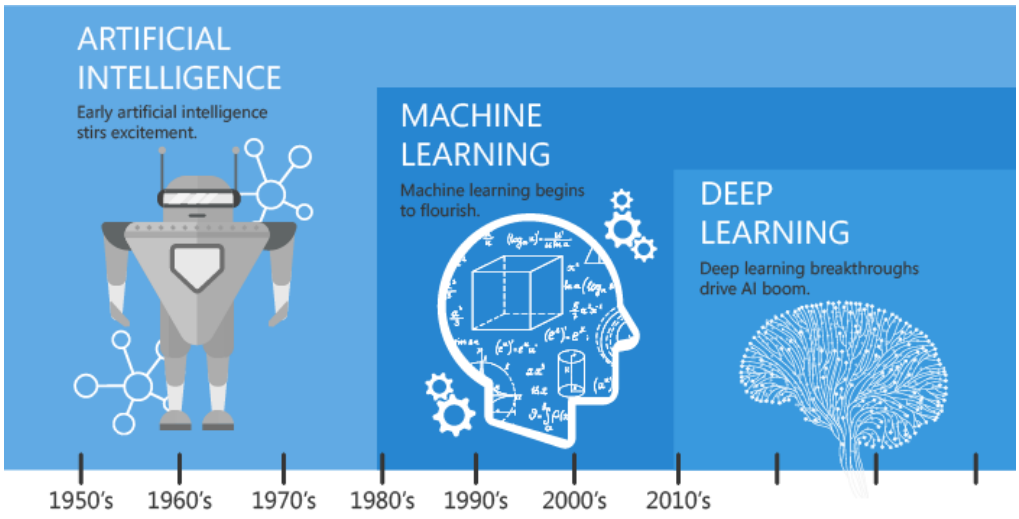

Figure 3: Chronology of AI and ML development (Argility, 2018)

The reason for this development was the "availability of GPUs that make parallel processing ever faster, cheaper, and more powerful. It also has to do with the simultaneous one-two punch of practically infinite storage and a flood of data of every stripe – images, text,

transactions, mapping data, you name it" (Copeland, 2016). These in their turn allowed using ANN (Artificial Neural Network) which is essentially a new type of structure for algorithms.

ANN was developed by Frank Rosenblatt in 1958 for understanding how the human brain works (Kay, 2001). Simple Neural Networks evolved into Deep Learning Neural Networks, which are the building blocks of Deep Learning algorithms (see Figure 4).

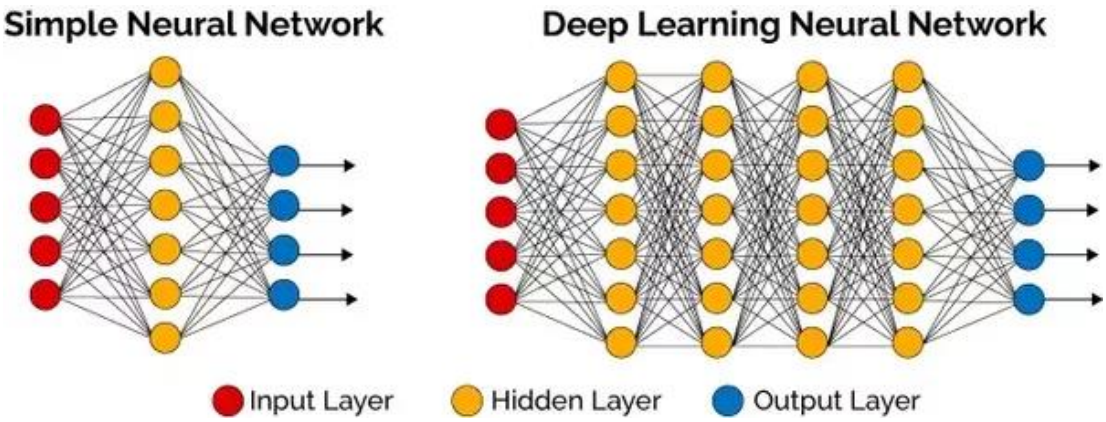

Figure 4: Simple Neural networks vs Deep Learning Neural Networks (Argility, 2018)

To further understand what Machine Learning and Deep Learning we need to properly define them:

- During Machine Learning "algorithms that parse data, learn from that data, and then apply what they've learned to make informed decisions" (Grossfeld, 2017). To say in other words, ML performs certain functions with data while slowly getting better at it.
- Deep Learning is the more complicated version of the above-mentioned process. Besides doing what Machine Learning does (parsing and learning), Deep Learning also allows the program to analyze and understand if results are correct or not. Besides allowing it analyze larger variety of data, Deep Learning algorithms can make decisions without human-computer interaction. This allowed enhancing the Machine Learning in a new way.

Figure 4 shows the difference between Simple and Deep Learning neural networks in a graphical way. To clarify, we can look at the example that was presented by Brett Grossfeld

(2017). Let's assume there is a bulb in a room, which is attached to a speech-identifying smart system. If programmed, the system will react to the phrase "it's dark" by turning on the light. Machine Learning algorithms can also identity other phrases containing the word "dark" as well, and react to those. In case the system makes a mistake, the programmer would need to update the ML by "teaching" it new things. Also, the system will not be able to guess anything that matches the phrase "it's dark" in meaning but is not programmed. Deep Learning on the other hand can check itself to see whether the light was turned on correctly, which significantly reduces the rate of mistakes. Also, DL will allow the system to understand phrases that are equivalent in meaning to the programmed phrase, like "I cannot see anything" or "the light is off".

As we can see in this example, Deep Learning is called so, due to its ability to learn on deeper levels. It creates an Artificial Neural Network, modifies itself accordingly and makes intelligent decisions.

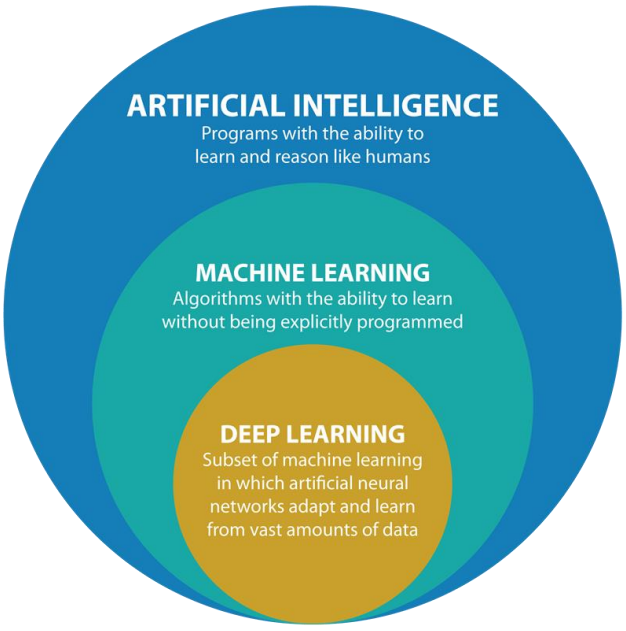

Figure 5: Basic construction of AI system (Argility, 2018)

To summarize: Artificial Narrow Intelligence which exists today is a technology powered by Machine Learning algorithms, which in their turn have a subfield of Deep Learning that operates based on Artificial Neural Networks.

Big data

The above-mentioned breakthroughs in building more sophisticated versions of AI “would not be possible without developments in hardware computational powers, popularization of personal computers and notebooks. The availability of internet to large masses allowed humanity to start collecting, storing and sharing enormously huge amounts of data, both personal and public” (Gevorgyan & Kessir, 2019). Some calculations state, that as of 2018, humanity is creating approximately 2.5 exabytes of data daily (Marr, 2018). And while storing and managing of this huge amount of data raises its own issues, it also leads to further advancements in various fields. Kenneth Cukier (2014) writes in his book “the ability of society to harness information in novel ways” will allow people to “produce useful insights or goods and services” and do things “at a large scale that cannot be done at a smaller one, to extract new insights or create new forms of value” (Cukier, 2014, p. 85).

The Convergence of Big Data and AI

One of the fields where big data is without a doubt had a major affect is Artificial Intelligence. Big chunks of data have proven to be the perfect “food” for Deep Learning programs. Together with rise in computational power, Big Data enabled capabilities that were impossible throughout the previous decades. Those include data availability, practically unlimited data sample sizes and ability to analyze big chunks of information in a matter of seconds. “For the first time, large corporations report that they have direct access to meaningful volumes and sources of data that can feed AI algorithms to detect patterns and understand behaviors” (Bean, 2018).

AI and Business

As a result of the above mentioned, business have to become more robust by discovering things that were hard to analyze before. They experiment more, and faster learn on their mistakes, thus allowing potential innovative disruptions in different industries and delivering business value at much larger scale. And although the perspective of this is promising, the real picture is different. A research conducted by McKensey among over 3.000 businesses reveals, that most of the business leaders that were surveyed, are not sure on what benefits can AI do for them, how to integrate them into their companies, and how to assess their

return on investment (Bughin et al., 2017). So how exactly can AI help organizations in their path to digitalization. Below are presented two of the most prominent fields where AI can help organizations, that is intelligent automation and labor and capital augmentation.

Intelligent automation

AI offers huge advantages for companies who are trying to automate their processes. In fact, the possibilities that AI allows are much bigger when we start comparing them with traditional automation methods. One example of this would be supply chain management. Nader (2016) says that a process that can free even just a day in supply chain, can bring big corporations millions in clear cash-flow (Nader, 2016). An example of a similar product would be Elementum. This startup has become popular with some big companies including, but not limited to Tesla and Johnson & Johnson. Through analysis of manufacturing outputs Elementum provides real-time supply chain visibility, moreover it has the ability to track the transportation and reports on incidents (John, 2015; Kim, 2015). “By analyzing more than 10 million incidents per day and US$25 trillion worth of products in real time, Elementum can provide early warning of potential problems and propose alternative solutions” (Elementum website, product brochure, 2018). Now, this is a bold statement coming from the company and clearly done for advertising purposes. And while keeping in mind that companies are often biased and make numbers bigger for ad purposes, we have to realize that even if what they claim is partially true, this means that the market were AI can be integrated is huge.

The above mentioned is just one example of intelligent automation. AI can be also integrated in other automation processes. “Applications range from the routine to the revolutionary: from collecting, analyzing, and making decisions about textual information to guiding autonomous vehicles and advanced robots” (Schatsky & Mahidhar, 2014).

Generally saying Intelligent Automation can be divided into three main categories: deciders, doers and movers.

Deciders

These are the systems that allow automation of decision making. Examples of such decider systems can be found in different fields. Below are presented some of the fields with corresponding examples.

Financial: Credit Suisse bank uses a tool called Quill developed by Narrative Science to analyze data from over 20,000 companies, make over 15,000 calculations per company and write reports on their expectations and risks. In their turn, those reports help make better, more accurate investment decisions. Credit Suisse's Managing Director Tim Bixler says that "the technology is helping to triple the volume of reports it produces while improving their quality and consistency compared with analyst-written reports" (Bixler & Hammond, 2013).

Healthcare: Wellpoint, one of US's largest healthcare companies, is connected to IBM's Watson cognitive computing technology. It helps not only to save clinician time and costs, but also make better decisions about patients' care (IBM News, 2013). Generally saying, Watson, is one of the most interesting AI initiatives today in the market. Developed since 2004, the system constantly evolved. It learned to identify natural language and to answer questions in it. One part of the AI system, called Watson Healthcare helps analyze vast information on cancer, and provide accurate cancer treatment plans.

Public Sector: With China being the world leader on implementing camera systems around its cities, the rest of the world is also starting to use AI-enabled cameras for security purposes. Latest Japanese development's in the field, showed that AI-enabled cameras are the future of surveillance. A system called "AI Guardman" helps to automatically identify shoplifters in stores by matching a person's behavior to pre-defined "suspicious behavior" patterns (Vincent, 2018).

Doers

This Intelligent Automation systems automate physical tasks. Intelligent robots can be viewed as such system. Traditionally, robots were doing one task over and over, yet with the help of AI, they can now do more versatile tasks while collaborating and learning from humans. An example of this can be primarily seen in two fields.

Retail and distribution: Back in 2013 Amazon acquired a company called Kiva Systems for $775 million (Rusli, 2013). The reason of such interest was the product developed by Kiva Systems, which empowered robots to move around its distribution center, transporting products while not hitting people and other robots. This system helped increase the labor productivity in big retail companies. In fact Crate and Barrel claimed that in 2010, before Kiva Systems was purchased by Amazon, the robots helped increase labor productivity by nearly two times (Rosenberg, 2010).

Car industry: In 2019 it seems that a lot of people know that robots help making car parts for most of the car brands. Yet, the first steps in including AI-powered systems in the car production were done by Volkswagen as early as in 2013. Universal Robots, a company working primarily with Volkswagen, embedded AI-powered systems into robots so they can take on physically demanding and "ergonomically unfavorable" tasks during the engine assembly. Ever since the solution has evolved to do less mistakes during its operation and other car manufacturers, seeing the benefits, introduced their AI powered robotic systems.

Movers

This category of Intelligent Automation services uses AI and various sensors (movement, proximity, speed etc.) to create autonomous transportation. There are three main directions that this type of services major in: Aerospace and Defense, Cars, Mining and other resources.

Aerospace and Defense: Robots that are being used for national security purposes have long been a science fiction. Nowadays we are seeing several countries adopting this idea and making big progress in the direction of building intelligent, automated troops. An example of this would be a world-famous company called Boston Dynamics. It is not a secret that the organization is funded by Defense Advanced Research Projects Agency (DARPA) which is a part of US Department of Defense. Within last years, Boston Dynamics developed a wide variety of robots that can run, jump, climb, open doors and carry heavy loads. Videos of those robots can be found all over Internet, including their own YouTube channel(Boston Dynamics, 2019; "BostonDynamics - YouTube," n.d.). And while those robots are far from being called autonomous and even farther from doing serious tasks, one can clearly see that the field has a big implication and is moving forward, developing very fast.

Cars: Tesla is the first name that comes to a lot of peoples' minds when talking of self-driving cars. Yet, Tesla is not the only one in the field. Nearly all of the big car producing companies (Audi, BMW, Mercedes-Benz, Nissan and Volvo) are developing their own versions of self-driving cars. Artificial Intelligence is a big part of this and that is the reason why we see large tech companies like Google also getting into the car industry (Korosec, 2019).

Mining and other resources: Rio Tinto, one of the world's leading mining corporations has built an autonomous train to transports the iron ore, uses autonomous drilling machines and, together with Komatsu, fleet of autonomous haul tracks (Jamasmie, 2018; Rio Tinto, 2018; Turner, 2018). This forced other companies to get into automation too. Just in the beginning of 2019, BHP announced that they are starting to use autonomous trucks and drills (Hilton, 2019). A side observer can clearly witness how the mining industry is transforming from being all-humans to being all-robots.

“Advances in artificial intelligence, robotics, and automation, supported by substantial capital investments, are fueling a new era of intelligent automation, which is likely to become an important driver of organizational performance in the years to come. It is important for companies in all sectors to understand and adopt intelligent automation, or risk falling behind”(Schatsky & Mahidhar, 2014).

Labor and capital augmentation

Although this can be argued upon, one of potentials for labor augmentation is passing low value-added tasks to AI, while allowing the humans to focus on the main tasks. Yet those main tasks, depending on the job, are also likely to be somewhat augmented by AI (Acemoglu & Autor, 2010, pp. 1043–1171). In fact Morgan Frank and his colleagues from MIT mention that AI “will likely transform almost all occupations at least to some degree” (Frank et al., 2019, p. 6531). An example of a complicated task where AI augments human labor can be making a market research. With all the data being gathered through different games, social media and other platforms, marketers have the opportunity to make more accurate marketing campaigns. Yet, the amount of information is so big that one or even a group of specialists cannot analyze it. Here, AI takes over to analyze all the information and provide raw numbers to the humans who will finalize the research and come up with a corresponding strategy. Examples of such augmentations are numerous – from Human Resources to Financial services and Healthcare. Examples of low-value added tasks being taken by AI can be seen in almost every industry. Any tasks that is repeatable in its nature, can be automated and the AI can conduct it.

What needs to be done

After all the discussed above, it is reasonable to ask what exactly do the companies need to do in order to integrate AI into their company and their business model. An answer to this can be seen on example of IBM, which integrated an AI of their own development into their company. Janine Sneed (2019), Chief Digital Officer of IBM Hybrid Cloud points out that the companies need to adopt the Idea of Information Architecture first. As the figure below shows (see Figure 6), there are 4 big steps that need to be taken (Sneed, 2019).

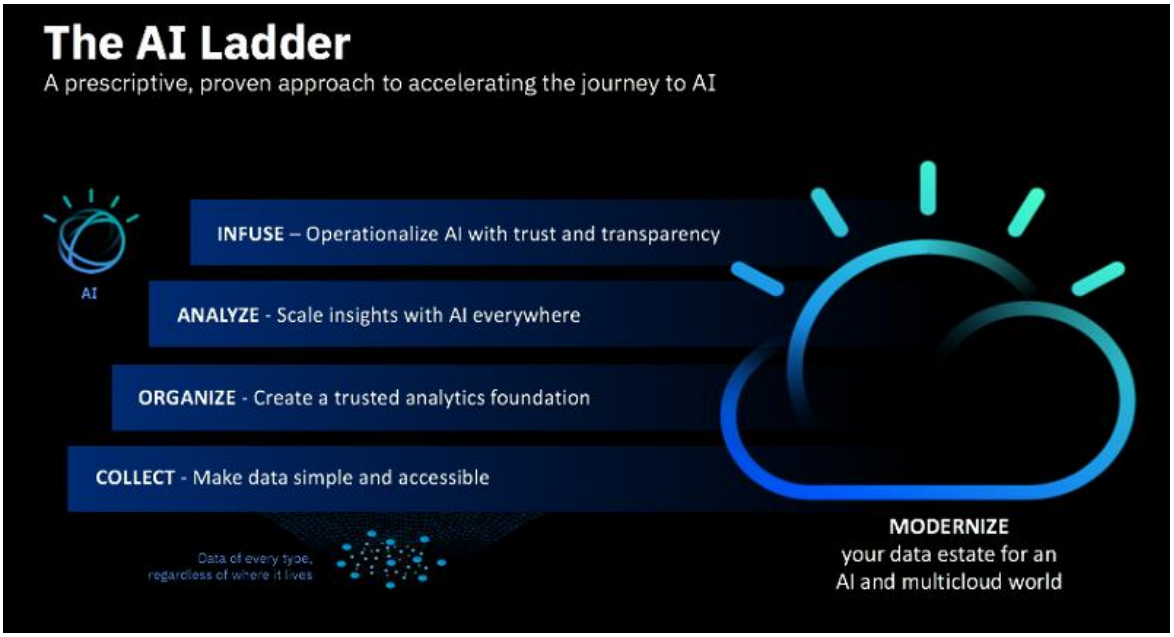

Figure 6: The AI Ladder (Sneed, 2019)

Collect

This step focuses on getting the data, whether it is structured or unstructured, whether it is proprietary or open source. Gathering data from your own products or other trustworthy sources. The company needs to make a pool of all of the data it can collect.

Organize

The next step is all about organizing the collected data to lay good foundations for trusted analytics. This requires governing your data assets in a way that it is easy to find, catalog and categorize them.

Analyze

Probably one of the hardest for organizations. These steps require the company to become insight driven, and describe the further plan. During each taken step company need to know what and why happened and to compare it against plan? This will allow understating what is going to happen next and thus what needs to be done to adjust the trajectory. Once this is in place, decisions need to be automated and optimized.

Infuse

The final step is to assign tasks to the AI and fully integrate it into the business. This include building or purchasing machine learning models, deploying and managing them with trust and transparency.

Examples of above mentioned AI integration model can be clearly seen on several initiatives of IBM company including Real time dashboards for insight, chat bots, affinity models etc. (Sneed, 2019).

Criticism

The following paper is not trying to present AI as a panacea for the problems existing in organizational management today. Neither is AI an absolute solution to all economic problems. With all the optimism towards this rising technology, it is necessary to mention that there is a number of critical points that need to be addressed.

Intelligence

In order to understand what is Artificial Intelligence, one first needs to define what intelligence is.

Howard Gardner's theory states that human intelligence mostly consists of specific parts - linguistic, logical-mathematical, musical, bodily-kinesthetic, spatial, interpersonal, intrapersonal, naturalist and existential (Gardner, 1999). Yet, any psychologist would argue that the intelligence cannot only measured by numbers such as IQ, it is virtually impossible to break down what it consists of. Partially this comes due to our physiology as we as humans are able to process vision, control motions and even interact socially. There have

been numerous takes to pin down the term, some of the notable ones being by Winkless and Browning “intelligence is the ability to behave appropriately under unpredictable conditions” and Ben Gotzel’s “intelligence is the ability to achieve complex goals in complex environments” (Goertzel, 1993; Winkless & Browning, 1978). While the question, what intelligence is, might seem to be more philosophical than scientific, in order to understand what AI should become and which direction is it going in, there is a strong need for defining the term and understanding how is it achieved. The best attempt of doing so was conducted by Pennachin and Goertzel in their article “Contemporary Approaches to Artificial General Intelligence”. They write that “intelligence... can only be achieved by a system that is capable of learning, especially autonomous and incremental learning. The system should be able to interact with its environment and other entities in the environment and learn from these interactions. It should also be able to build upon its previous experiences, and the skills they have taught it, to learn more complex actions and therefore achieve more complex goals“ (Pennachin & Goertzel, 2007). However, it is important to approach the matter critically and realize that although Artificial Intelligence is claimed to be intelligent, often it doesn’t meet none of the above mention definitions.

AI is not AI

We live in times when ads are surrounding us on daily basis. Large corporations often use marketing tricks to grasp the attention of the audience and sell products that sometimes are not what they seem to be. AI is one of those examples. With too much hype about AI, companies sell products which are claimed to be powered by AI. Voice assistants, smart home devices, cars and many more things are being advertised with the promise of providing people with power to harness the Artificial Intelligence. Yet not all of the systems that are presented as AI solutions, are such. Often those are systems powered by simple machine learning algorithm, which are far from being called Artificial Intelligence. In the current research, the author tried to differentiate between academic researches on AI and industry ads and claims about their products.

What is AI

The above mentioned brings us to the second problem. A lot of people don't understand or know what Artificial Intelligence is. For most of the people Artificial Intelligence is associated with machines taking over the world – a scenario presented in countless Hollywood movies. So, AI is often thought of as robots with integrated Artificial General Intelligence, while it is essentially intangible code. Unawareness of those basic information leads to general lack of knowledge about what AI can do for people and for business specifically.

Digitization, Digitalization and Digital transformation

In previous chapters the author tried to break down each of those terms and give descriptions to each, allowing to differentiate those. Yet, it is important to understand the different approaches to those term from the academic and industry point of view. While academic viewpoint differentiates those and identifies the first two as a way towards digital transformation, the industry often times presents each of those as a separate phenomenon and create a lot of buzz around each term. Another common mistake is that often organizations who want to advertise their advancements do not go deeper into the semantics or the actual meaning of the above-mentioned terms. As a result, we often see companies announce that they are undergoing digitalization when in reality they are simply digitizing their data, or announce digital transformation when in reality they are digitalizing. For the sake of clean academic research, in current work we will use the cases that are truly undergoing digitalization and digital transformation, differentiating those from the marketing buzz surrounding other companies.

Big Data

The world is generating massive amounts of information every day. Yet, very often this data is not useful at all. Large chunks of data generated from different applications, websites, researches etc. often contain information that is irrelevant for Machine and Deep learning algorithms. If not differentiated from useful information, those irrelevant pieces can cause malfunctioning of AI algorithms. Therefore, there rises a challenge to properly "clean" the generated information and understand which parts of it need to be used. This issue is mentioned here to indicate that the generation of data and input of it into algorithms is not

the panacea and there needs to be strong fundament of Big data management prior to developments in AI initiatives.

Academy vs Industry

Although in its beginning, studies on AI were conducted by academics, nowadays AI is mostly the prerogative of industries. This can be viewed as a potential issue by itself, because due to this, most of the AI initiatives started are aiming towards creating income rather than striving to create a public welfare. Being so deeply tied to industry, AI can potentially become a tool for advertising, selling and promoting products.

Rise of unemployment rate

In previous chapters, the research presented potential implications of AI and how it can positively reflect on economies in micro and macro scales by augmenting main tasks and taking over the low value-added tasks. Yet, although the potentials are truly big, the advancements in AI need to be proceeded with caution, as it is a "double-edged sword" that can cause unemployment rates to go up. Different studies are brining different number, from alarming 47% of all US job (Frey & Osborne, 2017) to more optimistic 9% for OECD countries (Arntz, Gregory, & Zierahn, 2016). Different governments today are worried how that AI powered automation can affect the unemployment in their countries. Researches conducted in EU showed that up to 35% of employment in Finland and Norway (Pajarinen, Rouvinen, & Ekeland, 2015) and 59% of German employment (Brzeski & Burk, 2015) can be affected by AI. And although those studies yet lack practical validation, they are a "flag" that tells researchers that AI needs to be addressed with caution and that maybe optimistic views are not so correct.

Difficulties for companies

A 2016 research conducted by Gartner, reveals that although Big Data and AI investments are interesting for companies, only 15% who actually try to integrate AI into their business make it past the pilot stage (Van der Meulen, 2016). The main reason for this is, as mentioned above, is the uncertainty that C-level executives often have on what can AI do for them. The next difficulty is understanding how to do the integration, and calculate correct

return on investment (Bughin et al., 2017). With those who overcome the difficulties on initial stage the reason of failure often is the lack of information architecture. "There is no AI without IA—information architecture," says Rob Thomas, general manager of IBM on Data & AI, "if companies don't have the right infrastructure, it's hard to do AI right. To get meaningful results, data needs to be in an organized state, and the right technology has to be put into action" (Thomas, 2019).

AI, control, robots and weapons

With rapid developments in the field of Artificial Intelligence more and more countries start to look at it from the military perspective. This is especially true when we talk about AI powered robots. There have been numerous talks about weaponized autonomous systems, and a lot of specialists in the field agree that humanity needs to do everything in order to avoid this. This in its turn raises the issue of control of AI systems. Although coming from science fiction, Isaac Asimovs "Three laws of robotics" are a widely recognized ideas which state:

1. "A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws" (Asimov, 1950).

In here, robots are discussed as having their own Artificial Intelligence, therefore the laws described above may just as well apply to AI as such. Yet, with all those precautions, it is important to understand that AI can give a lot of power to the ones who developed it. As president of Russia Vladimir Putin once said "Artificial Intelligence... brings huge opportunities and threats that are hard to predict. The one who becomes a leader in this field, will rule the world ("Pan-Russian open class 'Looking into Future'" 2017). AI is a business for industries and national interest to for countries, and the history shows that those two often don't display a necessary amount of interest in fundamental safeties — especially philosophic ones. So, it is important to say that Artificial Intelligence can have a "dark side" to it, in case countries or companies decide to promote their interest using it and if there are not enough regulations behind it.

Theoretical Framework

Although there has been a number publication on adoption of Artificial Intelligence conducted by industry and academia (e.g. Allianz Global Corporate, 2017; Chen, Christensen, Gallagher, Mate, & Rafert, 2016; Ransbotham, Kiron, Gerbert, & Reeves, 2017), current research is not interested in AI as a standalone technology, but is rather looking at adoption of innovations through the prism of AI. Before describing the theoretical framework used for the current research, there is an academic need to describe other existing, recognized theories in the field together with corresponding critics of each.

Together with Diffusion of innovation theory which will be presented in next chapters, there have been other theories proposed regarding innovational adoption. Some of those are the Theory of Reasoned Action (Fishbein & Ajzen, 1975), the Technology Acceptance Model (Davis, Bagozzi, & Warshaw, 1989), the Theory of Planned Behavior (Ajzen, 1985; Taylor & Todd, 1995) and Social-Cognitive Theory (Compeau & Higgins, 1995). Theory of Reasoned Action (TRA) argues behavior of individuals are followed intention, which in its turn is a composed of personal intention and social influence. Unlike TRA, Technology Acceptance Model states that technological innovation will be adopted only in the case if potential adopters find the technology: 1. Useful, 2. Easy to use. Perhaps more complicated among those theories is Theory of planned behavior. It states behavior to adopt an innovation is a result of 3 main factors: Attitude toward adoption, subjective norm and perceived behavioral control.

While all of those theories received a recognition, they are not considered an absolute truth and have their shortcomings. One of the shortcomings is that those theories “take individual autonomy as a key element, while often times the customer autonomy can be limited” (Gevorgyan & Kessir, 2019). When it comes to individual criticism it is worthy to mention that in Theory of Reasoned Action "some behaviors are more likely to present problems of controls than others, but we can never be absolutely certain that we will be in a position to carry out our intentions. Viewed in this light it becomes clear that strictly speaking every intention is a goal whose attainment is subject to some degree of uncertainty" (Ajzen, 1985, p. 24). Technology Acceptance Model has been criticized by many authors such as Bagozzi (2007), Hu (1999), Wu and Wang (2005) and Pikkarainen (2004). Chuttur (2009) summarized those criticism by saying that TAM has “lack of falsifiability, questionable heuristic value, limited explanatory and predictive power, triviality, and lack of any practical

value" (Chuttur, 2009). Theory of planned behavior is criticized because of two main things: 1. it is based on cognitive processing, 2. it ignores completely ignores the needs of potential adopters before they engaged in a certain action. Adopters' emotions during interviewing or decision-making processes are also ignored. Finally, Social-Cognitive theory poorly organized, assumes environmental changes will lead to personal changes and doesn't take into account the emotions and motivations of adopters.
With all this being said, for the current thesis researcher decided to base the theoretical framework upon the following theories

- Diffusion of Innovation theory
- Waves of Innovation theory
- Technological Trajectories theory

Innovation adoption

At this point, it is necessary to mention that AI in the current thesis is not being viewed as a standalone technology, but rather as an innovation. The potential adoption of AI should be viewed from the perspective of adoption of innovations. Therefor there is a strong necessity to define what innovation is, who are the potential adopters of innovation, who can be adopters of AI specifically and finally outline the respective theories on innovation adoption.

Innovation

The first step to understanding how the innovation adoption is taking place is to understand what innovation is. Same as in the case of AI, the word "innovation became a "buzzword" and as Eric Shaver write "One should always be afraid when a concept becomes a business "buzzword" (Shaver, 2016). Different authors defined innovation in different ways and the lack of agreed definition has caused unclarity in the field. For the current research, the author would like to point those by McKinley, Latham and Braun (2014), O'Sullivan and Dooley (2009). McKinley et al. state that innovation is "…any novel product, service, or production process that departs significantly from prior product, service, or production process architectures" (McKinley, Latham, & Braun, 2014, p. 91). O'Sullivan and Doodley

define innovation as “the process of making changes, large and small, radical and incremental, to products, processes, and services that results in the introduction of something new for the organization that adds value to customers and contributes to the knowledge store of the organization” (O’Sullivan & Dooley, 2009, p. 5). Perhaps the shortest description is given by the Merriam-Webster dictionary, where it says that innovation is “the act or process of introducing new ideas, devices, or methods” (Merriam-Webster). Yet with all those definitions talking about the process of making change, the introduction of new ideas, it is important to identify how exactly this happens, what are the stages of innovation adoption.

Diffusion of Innovation

To understand how technology was being adopted in 1942 Joseph Schumpeter “broke” the term “innovation” into 3 distinct stages: Invention, Innovation and Diffusion. Those, now, classic terms later became known as Schumpeterian trilogy and got wide acceptance among academia. Arguably, one of the best definitions of trilogy was given by Paul Stoneman (1995):

“The first stage is the invention process, encompassing the generation of new ideas. The second stage is the innovation process encompassing the development of new ideas into marketable products and processes. The third stage is the diffusion stage, in which the new products and processes spread across the potential market. The impact of new technology occurs at the diffusion stage and thus the measurement of impact is very much a measurement of how the economy changes as new technologies are introduced and used” (Stoneman, 1995, p. 27).

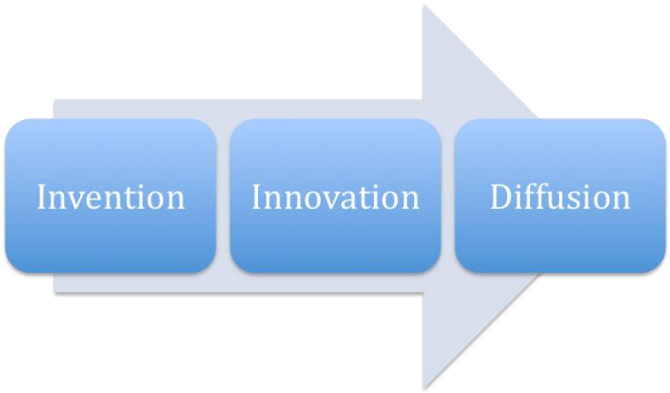

Figure 7: Schumpeterian Trilogy

Throughout decades after the trilogy was introduced various authors elaborated on it, one of the most notables being Everett Rogers with his Diffusion of Innovation theory. He stated that the adoption is the decision of an individual to use an innovation, while diffusion is the "process by which an innovation is communicated through certain channels over time among members of a social system" thus leading to increased amount of users in a market (Rogers, 2003, p. 5).

Rate of Adoption

Throughout the last decades we have seen lots of examples of innovation being adopted. Some of those were adopted quicker while others are not. We have also witnessed technologies that didn't get adopted at all. In the attempt to identify how the innovation gets adopted, in 1962, Everett Rogers formulated the idea of Rate of Adoption, within its Diffusion of Innovations theory. Rate of adoption states that after the innovation is introduced, the adoption starts growing, however the rate is slow in the beginning. After some time, the adoption becomes more rapid and stable, eventually reaching its peak and then declining (Rogers, 1962). The figure below (see Figure 8) shows the S-curve of the Diffusion Process.

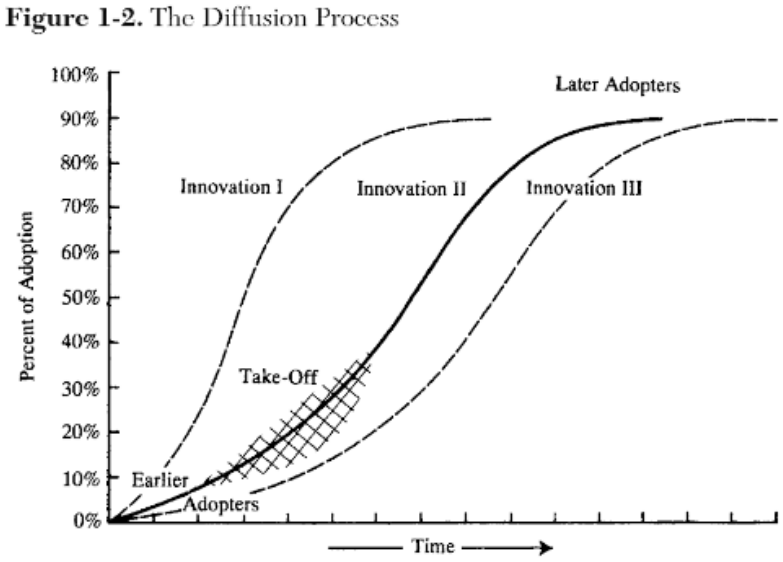

Figure 8: Diffusion S-curve by Rogers (Rogers, 1962)

In order to understand why do certain innovations fail and other manage to succeed, Rogers (1962) identified three core groups of variables:

1. Attributes of the innovation
2. Characteristics of adopters
3. Features of the setting or environmental context

Attributes of innovation

Essentially, there are 5 attributes of innovation that affect the speed and scale of adoption:

1. **Relative advantage**

In the 5th edition of Diffusion of Innovation book, Rogers states that the first and one of the most important attribute of innovation has to be its relative advantage (Rogers, 2003). So, to say, innovation has potential to be adopted only if users think of it being better than the previous idea or product. This applies to different aspects, including economic, social, technical and others.

2. **Compatibility**

Innovations that fit users' values, norms and beliefs are more easily adopted. In case the innovation doesn't fit, there is a high chance that users will not adopt it at all.

3. **Complexity**

Innovations that are easy to use are more likely to be adopted. If the innovation is complex in using, users might decide to proceed with alternative solutions, or stay with the previous technology.

4. **Trialability**

Innovations that can be tried out before making a decision to adopt are adopted more easily.

5. **Observability**

If the benefits of an innovation are visible and easily measurable, it will be adopted more easily.

Characteristics of adopters

The second variable in adoption of innovation is the characteristics of adopters. Rogers (2003) divided adopters into 5 categories and later applied that to the S-curve to build a "bell-shaped" distribution. This helps understand who are the adopters and how their decision making is affecting the adoption. The categories of adopters are the following:

1. innovators
2. early adopters
3. early majority adopters
4. late majority adopters
5. laggards

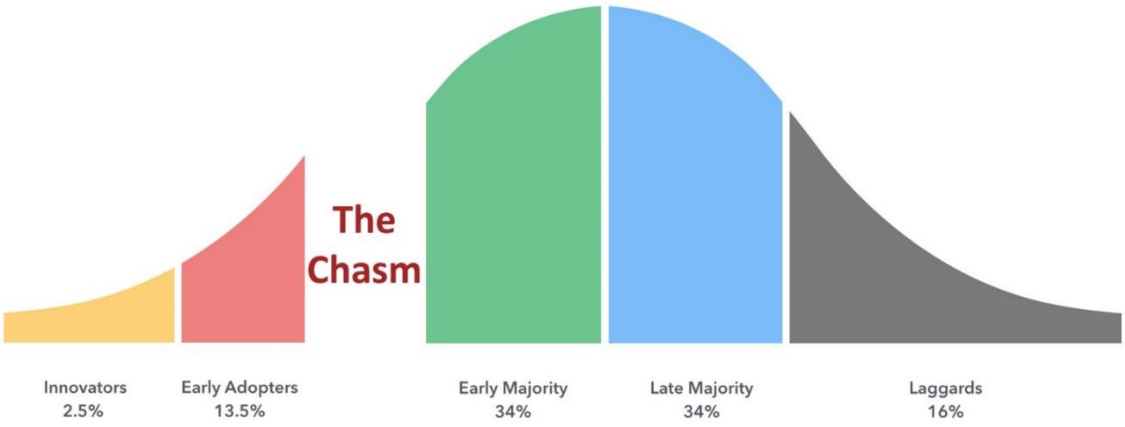

Figure 9: The bell-shaped distribution of technology adopters (Rogers, 1962)

- Innovators: This group is the first one to adopt an innovation. Statistically, innovators are the youngest age group yet they typically have higher social class and a high income. People in this group are excited about innovations and are constantly looking for something new. Although there is a certain amount of risk, high income allows them to absorbs potential failures, in case the innovation doesn't get adopted. Innovators make up 2.5% of total adopters making them the smallest category (Rogers, 1962).

- Early adopters are the so-called opinion leaders. This group too, is young of age, has higher social status and financial income. Representatives of this group want

to have a central communication position while being ahead of the curve on new ideas. They make up about 13.5% of all adopters (Rogers, 1962).

- Early majority and late majority together make about 68% of all adopters. Early majority adopts innovation much later than the two previous groups. Those are people who have an above average social status and income. Early majority people are usually in touch with early adopters to keep up with the latest trends. Unlike early adopters, early majority usually does not hold opinion leadership (Rogers, 1962).

- Late Majority – Those are the skeptics, people that wait even longer than average, hear out opinions, make research, listen to feedbacks before actually adopting the innovation. Social status level is below average, financial lucidity and opinion leadership are on low level (Pearce, 2013).

- Laggards – Being second smallest group (16%), those are on average the oldest of all adopters. Those individuals do not like changes and resist them until forced to adopt. Laggards have the lowest social status, lowest financial lucidity and no opinion leadership.

It is important to realize that adoption is a process. This process starts from simple awareness about the innovation and develops into attitude toward it. At the end of the day, it is this attitude that affects the decision whether to adopt or reject the innovation. This decision making is best described as a 5-step process and is presented below, in Figure 10.

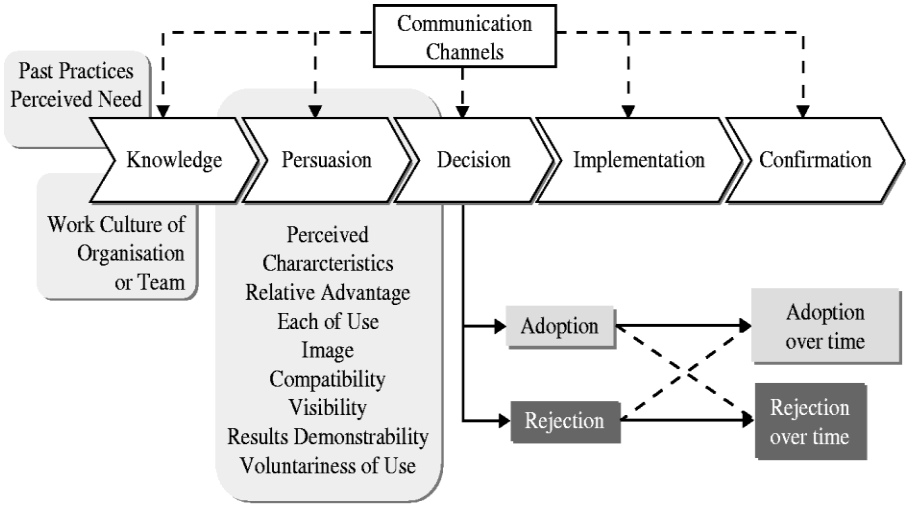

Figure 10: Process of decision making when adopting innovation

1. "knowledge—when the individual learns of the innovation's existence and gains some understanding of how it functions;
2. persuasion—when an individual form an attitude toward the innovation;
3. decision—when an individual engages in activities that lead to a choice to adopt or reject the innovation;
4. implementation—when an individual puts an innovation to use; and
5. confirmation—when an individual seeks reinforcement of an innovation decision that has already been made" (Rogers, 1995, p. 20).

Features of setting or environmental context

In some settings and environments innovation get adopted much faster in comparison to others (Greenberg, 2006). Features of settings that can have affect the adoption and diffusion of innovation can be categorized into 4 group:

1. geographical settings
2. societal culture
3. political conditions
4. globalization and uniformity (Wejnert, 2002)

It is worthy to mention, that out of those variables only the ones related to geographical location have consequences on individual adopters, others affect both individuals and organizations.

The chasm

As can be seen by the bell-shaped distribution of adopters, there is a big biggest gap between Early Adopters and Early Majority. This gap is known as the chasm. This is exactly what determines if the innovation will succeed or be adopted by the majority. The chasm appears because of difference in adopter expectations.

“Early Adopters are looking for a change agent. By adapting early to the change, they hope to beat their competitors. They know that being first with new technology likely means that there will be glitches and problems, but they are comfortable with that. The Early Majority, on the other hand, is looking for productivity improvement. They favor evolution over revolution; they want things to work smoothly” (Stringfellow, 2018). Early Adopters typically are not role models for Early Majority, which in its turn need a reference and need to see how product works for them.

Another two key concepts are the network externalities and critical mass. The idea of network externalities is that the bigger the network the more value it has, or as Katz and Shapiro (1986) put it ‘the more subscribers there are on a given communications network, the greater are the services provided by that network’ (Katz & Shapiro, 1986, p. 825). Critical mass, is the point when so many people adopted the innovation that adoption is gaining a momentum and the innovation succeeds. This can be viewed as the last stage of the chasm(Allen, 1983; Alwin & Rogers, 1999; Markus, 1987; Rogers, 1995).

Yet, not all of the companies manage to breach the chasm, in fact most of the startups and initiatives die out on this stage. The examples can be seen for innovations introduced by big companies as well as individuals. The borderline is – if innovation wants to be adopted, it needs to cross the chasm.

Diffusion of Innovation criticism

As a summary, Diffusion of Innovation theory has its roots in theories that mainly deal with social influence and persuasion. The theory describes how new ideas are presented in a social system, and how later they get adopted. DOI makes a strong emphasize on

communication relations and how the information is spread, thus reflecting on the adoption of innovation (Rogers, 1995). In fact Rogers and Kincaid (1981) write that networks of relationships between adopters are one of the key factors leading to adopt of technology (Rogers & Kincaid, 1981). Although DOI gained widespread acceptance in technology and social change studies, it has also received a significant amount of criticism (e.g. Lundblad, 2003; Lyytinen & Damsgaard, 2001; Macvaugh & Schiavone, 2010).

Critics often say that DOI is very technologically deterministic, due to the fact that it takes innovations as something given and pays a closer attention on the effects that innovation has on a social system (Lievrouw & Livingstone, 2010). In the 4th edition of his book, Rogers (1995) says that Diffusion of Innovations theory has a "pro-innovation bias" (Rogers, 1995). This bias made researchers and technology proponents question the academic neutrality of the theory.

Another criticism of DOI is that it describes innovations as something happening only once and being stable throughout the entire diffusion process. Yet, Freeman (1991) and Perez & Soete (1998) argue that technological innovations mostly happen in 'groups' or, as they call them, 'clusters' of connected innovations that complement each other, rather than standalone inventions as such (Freeman, 1991; Perez & Soete, 1988).

Some critics write that in DOI, adopters sometimes do not fall in only one category. The laggards for one innovation can be innovators another, opinion leadership can also change. Another weak side of the theory is that it doesn't take into account that innovation can change during the period of adoption.

Despite the critics written above, the reason for adopting DOI theory for current research is that it brings together ideas from rational theories of economics, sociology and communication theory. This is exactly the reason that made Rogers' theory one of the monumental works in the field.

Waves of Innovation

Adopting or resisting to changes has always been part of the human nature. "Change leads to consternation for some, indignation for others, shock for still others, and hope for a few. Because of this inherent potential for trauma, defining concepts and developing measurement procedures for assessing what is actually accomplished by change is difficult and challenging work" (Hall, Loucks, Rutherford, & Newlove, 1975, p. 52).

Waves of Innovation theory also known as “Kondratieff Waves” theory was developed to give answer to the question of what exactly has been pushing economy forward over the last decades of human history. Nikolai Kondratieff, a Russian economist was first to discover cycles of invention, expansion and depression by putting quantitative economic theories together with historical facts.

In their 2001 book “As Time Goes By: From the Industrial Revolutions to the Information Revolution” Chris Freeman and Francisco Loucca (2001) identified five “carrier-branch technologies” (Freeman & Loucca, 2001). “Carrier-branch technologies” are the breakthroughs which allowed humanity to do certain things “so much more efficiently than the old ways that it reshaped every aspect of the economy” (Burnam-Fink, 2011). Those are:

1. Steam power, textile industry
2. Railway, Steel
3. Electrification, chemicals
4. The internal combustion engine, automobiles, petrochemicals
5. Computerization and ICT

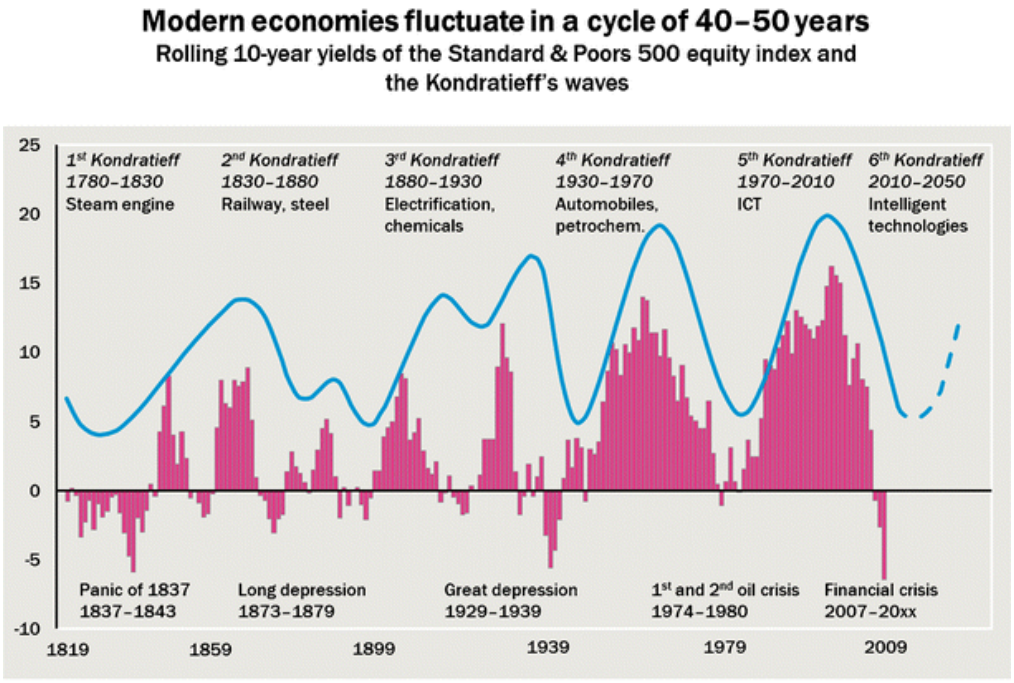

Figure 11: Rolling 10-years of the Standard and Poors 500 since 1814 to 2009

As can be seen in the Figure 11, economic patterns of Kondratieff wave are quite similar and judging by Standard & Poors 500 equity, modern economies fluctuate in cycles. After its introduction, the invention causes an economic boom leading to material wealth. When the invention reaches its peak and has no more place to grow the economy starts going down. This is periods of economic downswings are often called “crisis of structural readjustment”. In total, a lifecycle of such inventions was summing to 50 years each. Yet previous wave, becomes the backbone of the new one, and the thus the technological progress goes forward.

If we take the very first wave as an example, we can clearly see how steam engines led to new waves. Steam engine was invented in 1712 by Thomas Newcomen, but was used only for mining purposes. This gradually led to advancement metallurgy and early 1800s saw the rise of efficient, high-pressure steam engines. In 1829, George Stephenson introduced the first steam locomotive leading to the “railroad-building boom”. With more widespread transportation system, the price for iron and coal went down, while creating big revenues for the railroad owners. Developed transportation gave rise to general tourism (including hotel and restaurant businesses). The demands of financing and administering railroads led to the formation of national markets and joint stock markets. Yet, as with any of the similar inventions, railroads also reached their peak and died out together with the inflation of the long depression. The world economy remained shaken till the 1890s and was given a new birth with better energy sources - electrical power and chemicals. Chemicals, including petroleum started the waves of innovation that are familiar known to us – automobiles and ICTs.

Now, what we see is that the world economies seem to stumble in place. There is a recent financial crisis of 2008 on one hand and computers developing quickly soon to reach saturation point in different markets on the other hand. This all leads us to thinking what exactly will the 6th wave of innovation be.

6th wave of innovation

Predicting future is always a hard thing. This is especially true when talking about Kondratieff waves. The truth is no one knows what the 6th wave of innovation is going to be, and this is also one of the critiques of it. Yet, several researchers hypothesized on the topic. To understand what the 6th wave can bring to humanity, there is a need to understand what issues exist today and how they can be solved. There are undoubtedly problems in a

number of fields, such as traditional healthcare systems, depleting natural resources and climate change. And we see the attempts to make fundamental breakthrough in science which can definitely become a solution to those problems. Yet, there is also another field that has a high potential to trigger the next wave of innovation and that is the field of ICT. Indeed, we are seeing all of the signs of Kondratieff wave when talking about technology. Throughout the last decades technology has come a long way. With growing amount of data and developments in Information technologies, the possibility that Artificial Intelligence will lunch the next wave of economic prosperity is becoming higher. Beside the potential of AI to solve the problems with big data, it can help solve the above-mentioned problems too.

Criticism of Waves of Innovation theory

Economists have mixed opinions over the theory, with many of them not accepting it. The reason is the uncertainty about the causes of waves. It is quite unclear if the waves are results of innovations themselves or something else. Another of the big critique, as mentioned in the previous chapter is that it is hard to impossible to predict the upcoming wave. Although exaggerated, Jacob van Duijn (1977) writes, "if you want empirical evidence, you'll have to be patient for another hundred years" (Duijn, 1977). When exactly the wave will occur, what technologies will it be based on and what new innovations is it going to bring, can only be seen when looking back on the timeline, therefor the theory lacks predictive power.

Technological Trajectories theory

In attempt to understand why are the Kondratieff waves happening Joseph Schumpeter developed on top of Kondratieff's theory, and came up with what is known as the theory of technological trajectories. The basic idea of the theory states that Kondratieff waves appear due to bunching of basic innovations, creating a technological paradigm. So, the technological paradigms themselves are seen as reasons of technological revolutions that create economic sectors by becoming modeling solutions for selected technological problems.

Giovanni Dosi (1982) has conducted a large study on the topic of technological trajectories which became monumental for this theory. He wrote that "the technology trajectory is a way of expressing the innovation process, seen as a path resulting from the development of a

new technological paradigm, which is itself determined by the autonomous progress of science" (Dosi, 1982, p. 152). Otherwise Dosi (1982) puts it that "technological trajectory is the direction of advance within a technological paradigm… It is a cluster of possible technological directions whose outer boundaries are defined by the nature of the paradigm itself" (Dosi, 1982, pp. 148, 152).

One must understand that the trajectory occurs within the technological paradigm, therefore to certain extent it has an inertial character. This means that innovation is "forced" to go in a certain path. Yet it is this inertness that allows, trajectories gain more stability and ability to absorb minor variations, changes and even breaks in processes without changing the general direction of the trajectory (Sewell, 1996).

Criticism of Technological Trajectories theory

Dosi (1982) writes himself that in literature there have been large number of attempts to identify the main moving power of innovations. Rather than following a certain trajectory there have been two different basic approaches, to as how does the innovation happen. First approach says that the market is the main force that determines technological change. Those fall under general category of "demand-pull" theories. The basic argument is that the market creates a demand and productive units recognize the need and fulfil it. So, these theories assume that there generally exists a possibility of knowing a priori the direction in which the innovations will go in. The second group of theories are defining technology as an autonomous or quasi-autonomous factor, which bring innovations to the market itself ("technology push'" theories). Both of those groups of theories contradict to the core idea of technological trajectories.

Proposed theoretical framework

In order to answer the research question, author of the current work has decided to develop a new theoretical framework. The framework is based on the works of above-mentioned Technological Trajectories, Wave of Innovation and Diffusion of Innovation theories and is presented graphically below. The reason for developing a separate framework came rather than using one of them separately, came from the notion that each of those theories have their share of criticism. Yet, the author believes that the theories can complement each

other in order to answer the research question. The proposed theoretical framework is presented graphically below (see Figure 12).

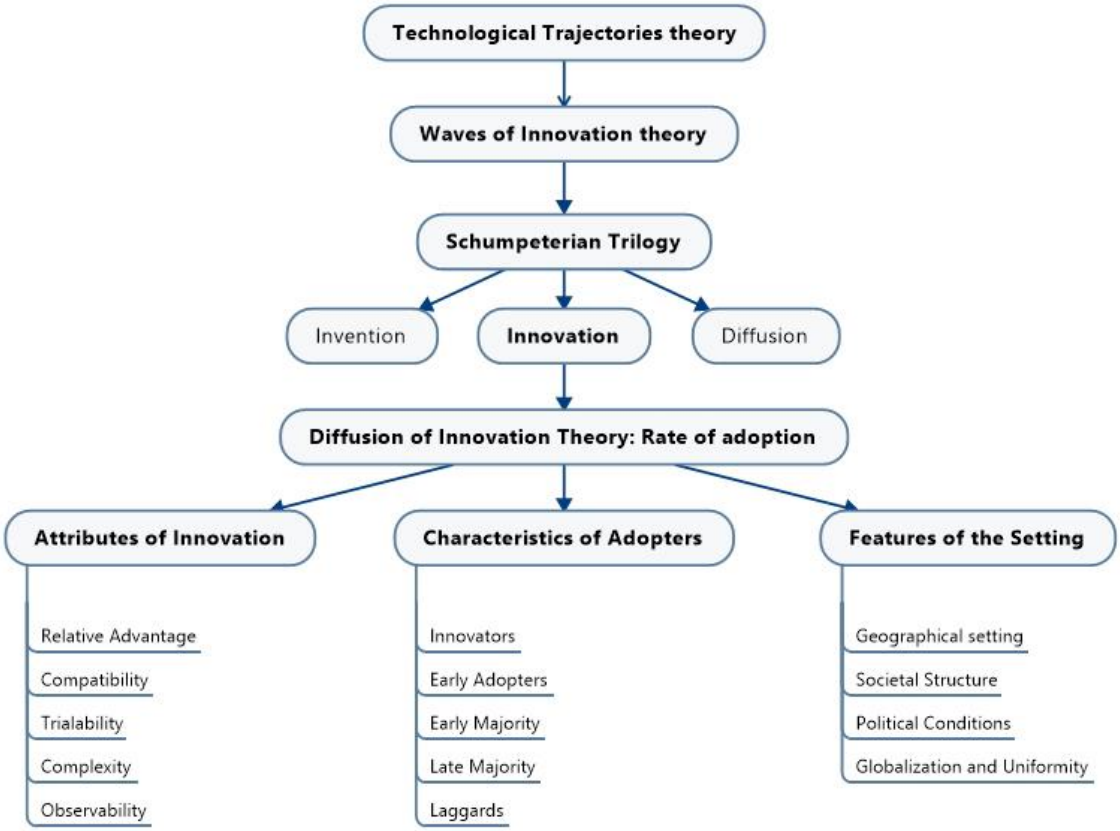

Figure 12: Proposed Theoretical framework

According to the framework, innovation - Artificial Intelligence in current case, is discussed as a technological paradigm which derives from bunching of other technologies and formation of technological trajectories. Technological trajectories here is not viewed as a standalone theory and does not have predictive power. Rather author proposes that on a larger scale, those new paradigms and trajectories, result in formation of a new, 6th Kondratieff wave. Yet, to understand how this wave will be accepted there is a need to analyze the potential adoption of the innovation. For this purpose, the framework looks at the Schumpeterian trilogy and discusses the potential Rate of Adoption of an innovation. The potential Rate of Adoption is assessed by using Rogers' (1982) Diffusion of Innovation theory.

Methods

Data gathering

Due to the fact that the current research focuses on a developing technology, the author decided to use a mixed methodological approach. Literature review, empirical study and expert interviews are the main data collection techniques used.

Literature review here is “used for the exploration and use of relevant scientific and practical information and insights on areas of the research and formation of the theoretical framework” (Gevorgyan & Kessir, 2019).

The other technique used is semi-structured expert interviews. The researcher had a list of themes and questions to be covered, yet some questions were omitted given a specific organizational context, while other questions were added along the interview. This allowed keeping the natural flow of the conversation and further exploring the questions related to the research question and objective. For the same reason, the order of pre-determined questions also varied. The interview questions were primarily open-ended which gave a room for discussion.

Literature review

Literature review was the first step conduct for the current research. The review revealed that there is an interest in both the academic and business worlds in seeing how the AI can affect job places of the future. Further literature review was done to write the “State of the Art” chapter. This chapter gives an extensive and comprehensive information on Artificial Intelligence and digitalization. Keywords used for the literature review include but not limited to: artificial intelligence, intelligence, digitalization, digital transformation, big data, machine learning, intelligent automation.

The literature was also used for building the above-mentioned theoretical framework. The author reviewed several theoretical and conceptual frameworks related to innovation adoption and technological change. Limitations of those framework were reviewed and the theories that best fit the research objectives best were selected. Keywords used for this part of literature review included but were not limited to: adoption of innovations, rate of adoption, waves of Innovation theory, technological trajectories, model of innovation, technological change.

Interview Procedures

The expert interviews were conducted with two executives from two companies - TicketMaster and XYPro. The companies and conducted interviews will be presented in more detail in the next subchapter. The author declares that data gathered during the interviews – notes, e-mails, recordings is securely stored and codified. Both of the interviews, were recorded and the transcriptions of those are attached in the Appendix of the current work. The purpose of the interviews together with brief description of the research was shared with the interviewees prior to the interviews. Consents for interviews were received in a written form prior to interviews and in the beginning of the interview, as can be seen in the transcriptions. Both of the interviewees declared that there is no need for the anonymity, which can also be seen in the transcription of interviews.

Interview details

The following table (see Table 1) shows the list of individuals interviewed and organizations they present:

Number	Interviewee	Role	Organization
1	Steve Tcherchian	Chief Product Officer	XYPRO
2	Mark Roden	Head of fraud detection and amelioration department	TicketMaster

Table 1: List of interviewed individuals

Interview number 1 was conducted in XYPRO's office which is located in Simi Valley, California, USA. The conversation was held in Mr. Steve Tcherchian's office and was not interrupted for the entire duration. The recorded duration of the interview is 26 minutes 26 seconds. Although in the beginning the interview felt like a formal one, soon it turned into a relaxed conversation.

Interview number 2 was conducted via Zoom. Mr. Mark Roden was at his home and the interview felt like a friendly conversation during the entire length.

Interviewee details

Steve Tcherchian

48 years of age, Mr. Tcherchian is on the NonStop Under 40 executive board and part of the ANSI X9 Security Standards Committee. He is on the CISO Advisory Council board member and has been the chair of the ISSA Forum in Q2 2015 and Q1 2016. With over 20 years of experience in cybersecurity, Mr. Tcherchian has spent the last 15 years working for XYPRO. He is responsible strategy, direction and innovation of XYPRO's security product line as well as overseeing risk, compliance, infrastructure and product security (XYPRO website, 2019).

Mark Roden

Mr. Roden is 42 years age. Graduate of UCLA, he worked in the medical field as an engineer for a nearly 13 years. He later worked 6 years as a data scientist in various companies. Mark employed in Live Nation Entertainment group since 2016, first as an engineer, then as a Data Scientist. Currently he is the head of fraud detection and amelioration department.

Company details

XYPRO

Being 35 years in the market, XYPRO is listed among best workplaces of 2017 by Inc magazine (Inc Magazine, 2017). The headquarter of the office is located in Simi Valley, California. The company also has offices in Canada and UK. Total amount of employees is close to 100, with 65 of them working in the headquarter. IPO status of XYPRO is private. The revenue of company as reported by Owler.com and Inc magazine, are close to $10M - $25M (Inc Magazine, 2017; Owler.com, 2019).

XYPRO is the market leader in HPE NonStop Security, risk Management, compliance and database management solutions and services. As Mr. Steve Tcherchian mentioned in the interview, it is basically impossible to name a bank in US that is not XYPRO's client. The

reason for this is that Hewlett Packard Enterprise NonStop servers are number one choice for most of the financial and governmental organization in USA. XYPRO is filling the niche by providing security solutions for those. Their primary product, called XYGATE allows to perform keystroke auditing and limiting the use of shared resources to only the functions required by each user's job. This also allows identify security threats by tracking and reviewing all activity on the HPE NonStop. XYGATE returns an audited log, with identified potential security risks, which need to be looked closer by the administrator. As a result, time of detection of potential breach is reduced to a day rather than 197 days, which is the average (Columbus, 2018).

TicketMaster

Ticketmaster is a ticket selling website based in Beverley Hills, California, USA. It was established in 1973 in Phoenix, Arizona. It currently employs 6,678 people and operates in 27 countries ("Ticketmaster International Sites," 2019). TicketMaster is listed on NASDAQ stock market with "TKTM" symbol.

In 2010 TicketMaster and Live Nation merged to establish Live Nation Entertainment group. The reported revenue of 2018 by Live Nation Entertainment was $10.8B, with ticket master accounting for most of the income (Mims, 2019). In fact gross transaction value of Ticketmaster equaled $33B for 2018 (Aswad, 2019). Billboard (2019) reports that "overall last year, Ticketmaster managed more than 400,000 events, delivering almost 500 million tickets to fans in 28 countries with 10 million new tickets added in 2019" (Mims, 2019).

The company has 2 security departments, one dealing with fraud transactions and varying individual from ticket buying bots.

Collected data

Literature review

The literature review done by the author has identified that due to the fact that developments in AI are primarily conducted by the industry, majority of researches and report were conducted by the industry. Particularly two companies conducted extensive researches on AI and its impact: Accenture and Deloitte. Therefore, for the empirical data presented in the next sub-chapter will be mainly from those. The author would like to mention particular helpfulness of Deloitte report. Yet, realizing that AI is a buzzword for most of the industry representatives, not only those companies, the author will separate “marketing” claims and keep the critical view on numbers.

Empirical data from Literature Review

Various companies conducted researches on the topic of AI affecting businesses and workplaces of the future. Accenture (2017), together with Frontier Economics, published a report where AI was assessed on having impact on 16 different industry sectors (Purdy & Daugherty, 2017). Their research showed that AI can potentially increase company incomes and economic growth rates by average 38% and 1.7% accordingly by 2035 (Purdy & Daugherty, 2017). The chart of real annual GVA growth is presented below in percentages (see Figure 13):

Figure 13: Teal annual GVA growth (Purdy & Daugherty, 2017)

With this being said, it is important to mention that although Mark Purdy and Paul Daugherty are renowned authors and researchers in the field, the author of current work has a critical view on their papers. The research, alongside other works by those authors seem to be overoptimistic and the numbers presented do not have strong data support. However, their vision of how AI can drive economic growth seem to be well justified. They write that “AI can drive growth in at least three important ways. First, it can create a new virtual workforce—what we call intelligent automation. Second, AI can complement and enhance the skills and ability of existing workforces and physical capital. Third, like other previous technologies, AI can drive innovations in the economy. Over time, this becomes a catalyst for broad structural transformation as economies using AI not only do things differently,

they will also do different things" (Purdy & Daugherty, 2017). The list of all AI benefits can be seen below, together with change in perception from 2017 to 2018 (see Figure 14).

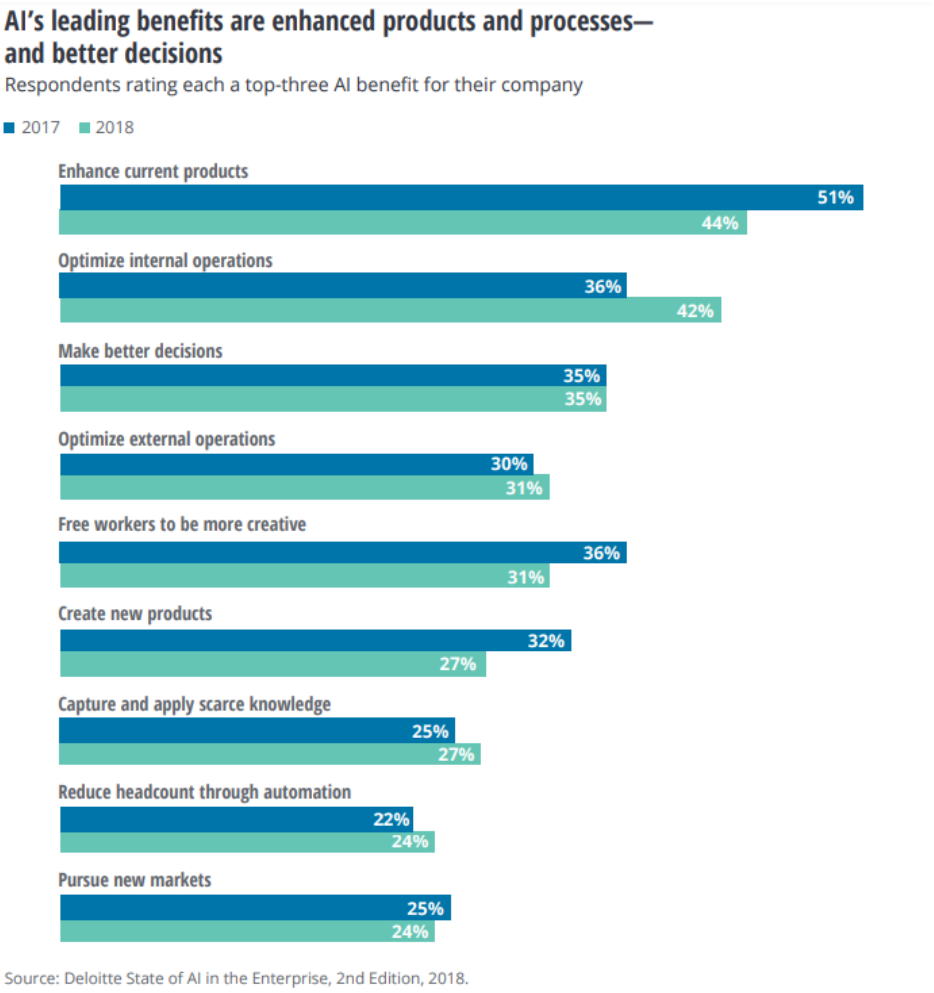

Figure 14: Benefits that AI can offer (Budman, Hurley, & Bhat, 2019)

To understand how exactly organization are adopting and benefiting from AI, Deloitte conducted a survey of 1900 early AI adopter IT and business executives from Australia, Canada, China, Germany, France, UK and US. Roughly 81% of respondents say that AI is "very" or of "critical" importance to their business success today (Loucks, Jarvis, Hupfer, & Murphy, 2019). Surprisingly, another survey conducted among executives from companies that are considered early adopters, shows that more complex AI technologies have higher adoption rates - machine learning - 63%, natural language processing - 62%, computer

vision - 57% (Rudini & Loucks, 2018). However, investments in those technologies are different as can be seen in Figure 15.

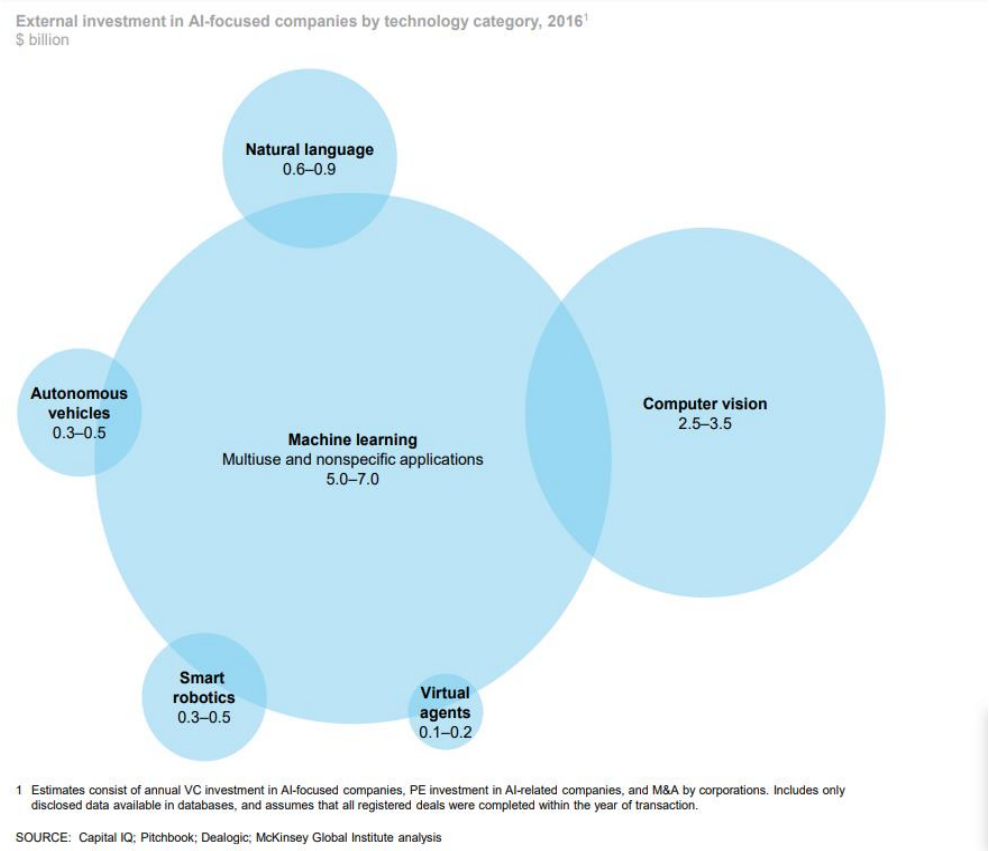

Figure 15: External investments in AI-focused companies (Bughin et al., 2017)

With those numbers, one must understand that the investments in AI solutions will be growing and this is especially the case for organizations that have financial assets. 2017 report by McKinsey shows that in 2016 the companies invested $26B - $39B in Artificial Intelligence (see Figure 16).

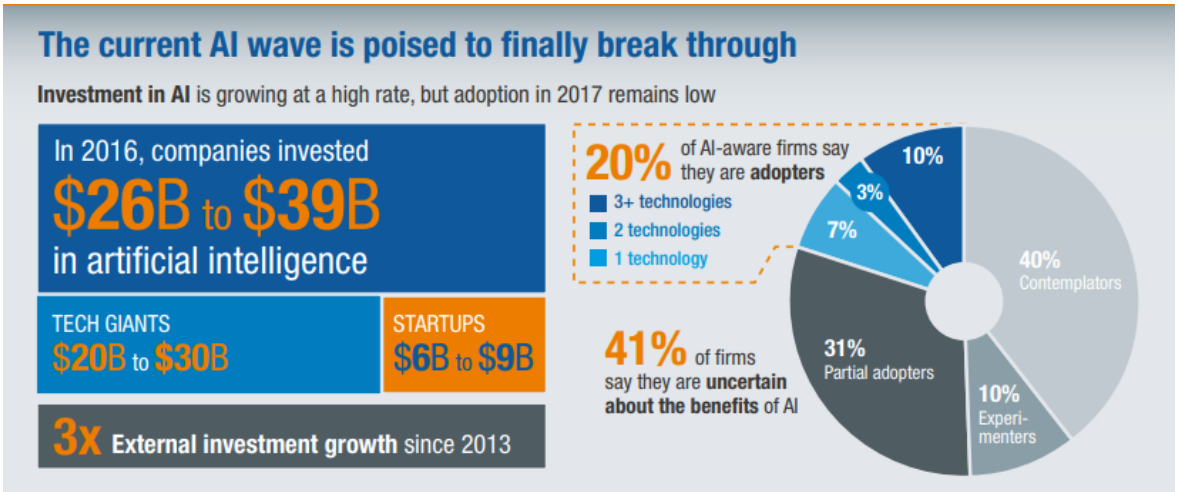

Figure 16: Growth in AI investments (Bughin et al., 2017)

Undoubtedly, this number will be rising throughout time. A survey by DBR Research, for instance, finds that 48% of banks, which have more than US$50 billion in assets, use some sort of AI solution (Marous, 2017). The reason for this growth in investment is that organization see return on investment (see Figure 17). 82% of people surveyed for Deloitte by Budman, Hurley and Bhat (2019), said that had a return on investment for AI (Budman et al., 2019).

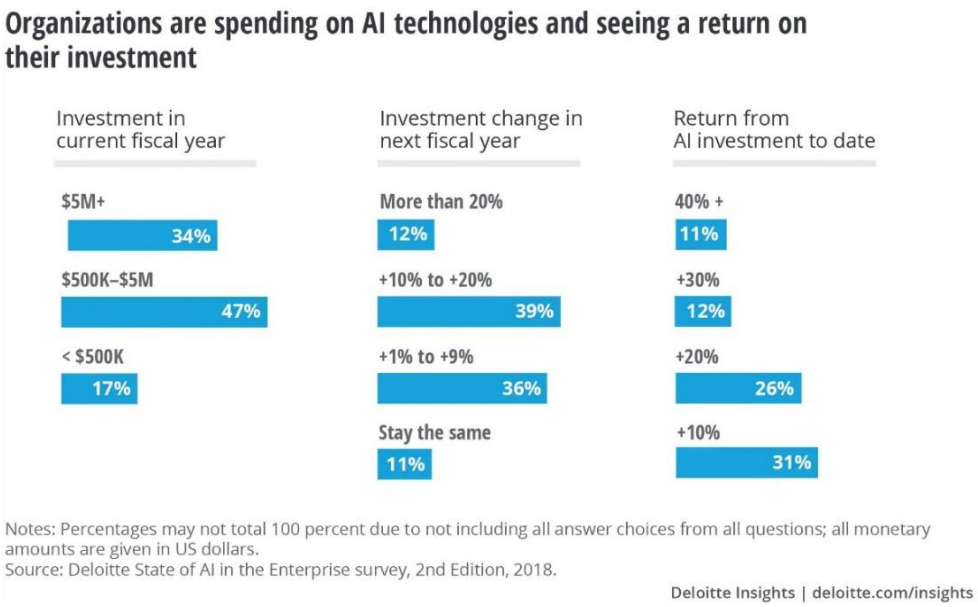

Figure 17: Return on investment from AI (Budman et al., 2019)

The same applies when one looks on the mention of AI in earning calls, both in IT companies and in other industries (see Figure 18 and Figure 19).

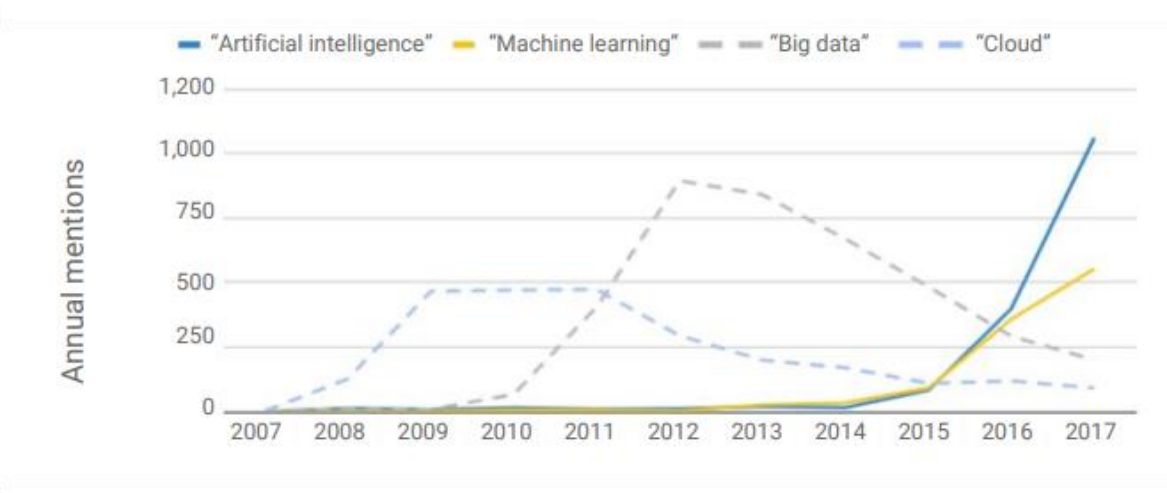

Figure 18: Company earnings calls mentions - IT companies (Shoham et al., 2018)

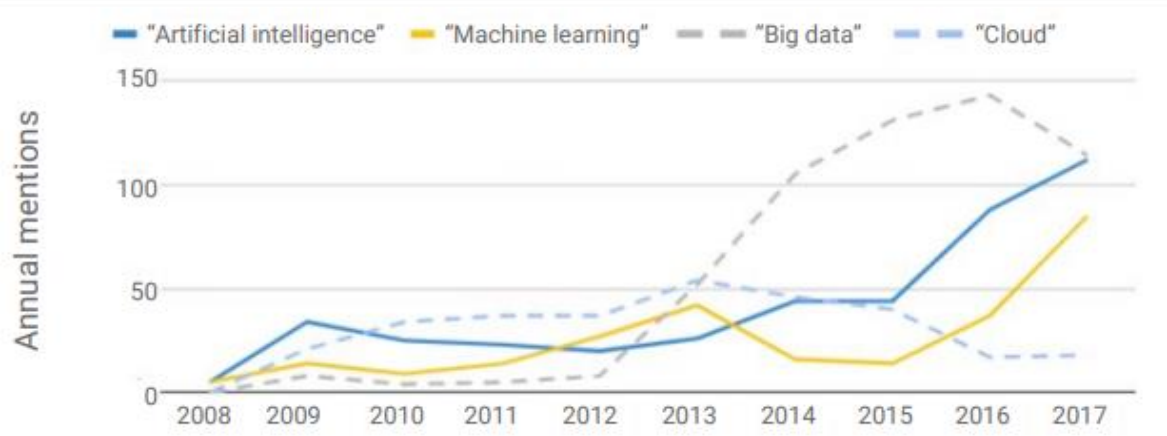

Figure 19: Company earnings calls mentions - Sum of other industries (Shoham et al., 2018)

Moreover, the research from Deloitte (2018), reveals that there is a belief among the industry specialists that AI will transform their company. As can be seen in Figure 20, over 54% of respondents believe that this transformation will happen within the next 2-5 years (Loucks et al., 2019).

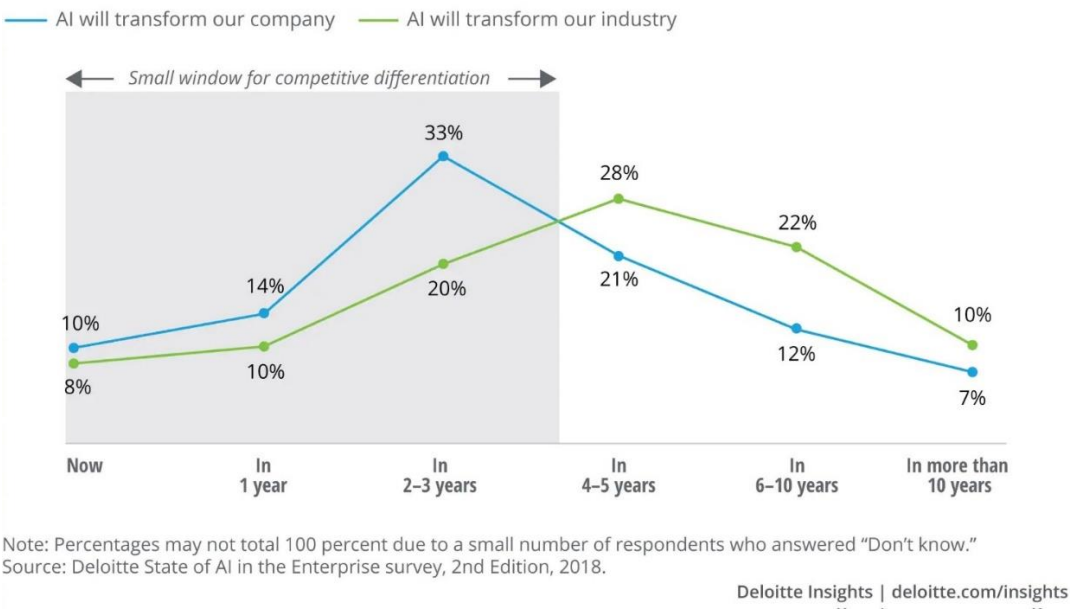

Figure 20: Transformation as foreseen by industry specialists (Budman et al., 2019)

78% percent of executives agreed that AI-based augmentation will fuel new ways of working (Rudini & Loucks, 2018).

So, the question to ask at this point would be: if industry representatives believe that AI has big benefits and think that the change will happen relatively soon, why not everyone is investing in AI? The answer is that it is not that easy. 41% of surveyed executives report that their companies lack or have inadequate AI strategy (Loucks et al., 2019). The challenges that companies face include data issues, cost of implementing, measuring the value, understanding how to integrate AI into specific organizational functions. 69% of respondents say that have a "moderate, major or extreme" skills gap (Rudini & Loucks, 2018). The lack in knowledge is explained by the fact that implementing AI in daily tasks need far more than just a single AI specialist. The range of skills needed is rather large, starting from AI researchers and software developers to subject-matter experts (see Figure 21).

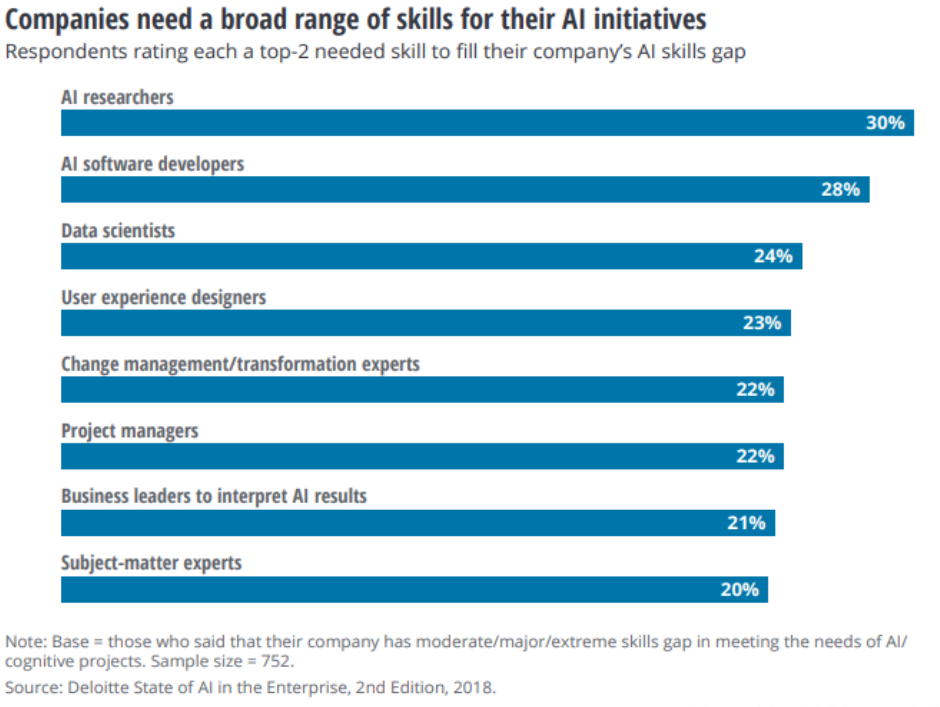

Figure 21: Skills needed to implement AI strategy (Budman et al., 2019)

And this situation is not locked to a certain geographic location only, it can be seen in all the countries presented in the "State of the AI in the Enterprise, 2nd Edition" (2018). The figure below (see Figure 22), shows maturity, urgency and challenges, in countries.

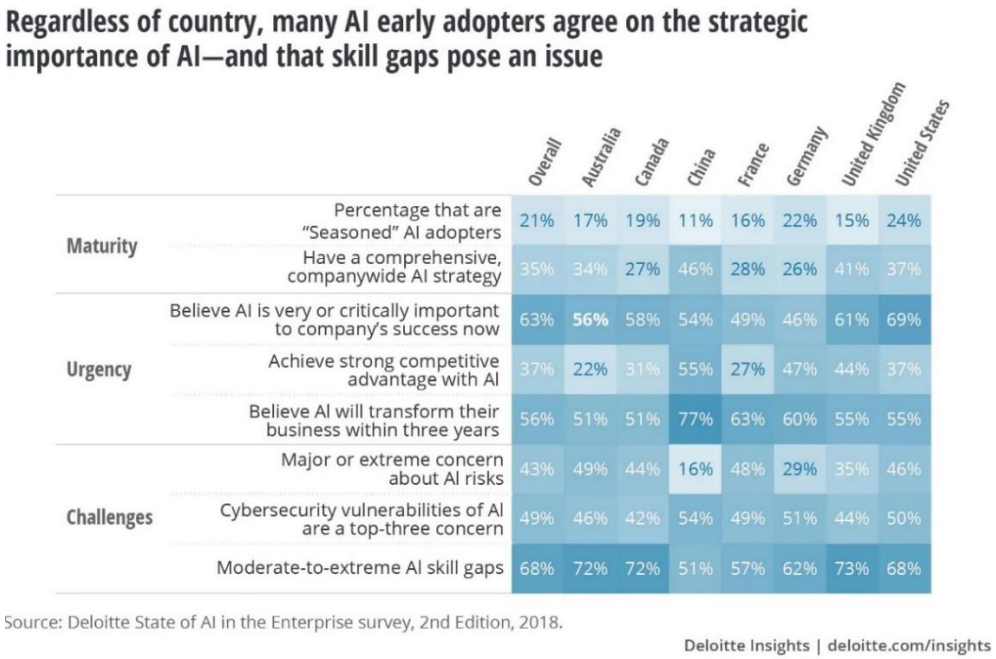

Figure 22: Maturity, Urgency and Challenges of AI by countries (Budman et al., 2019)

Nevertheless, research show that even with risks and uncertainty, above mentioned countries continue to invest money and train professionals (see Figure 23). Germany is the leader country when it comes to AI training (see Figure 24).

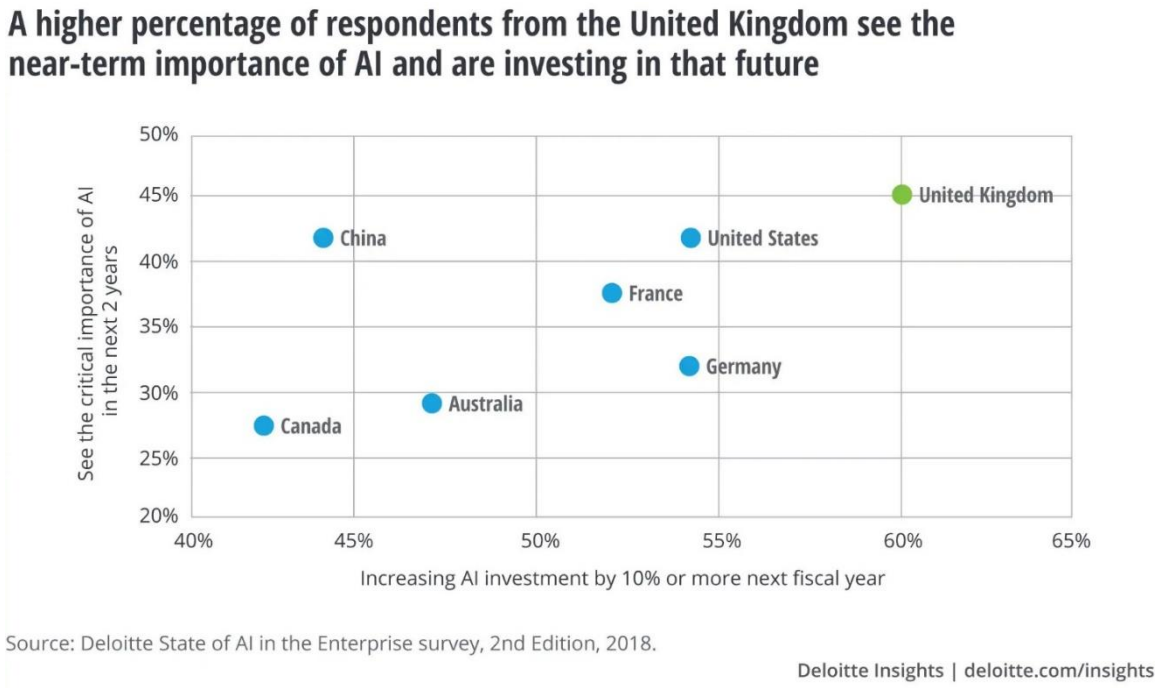

Figure 23: Near-term importance of AI by countries (Budman et al., 2019)

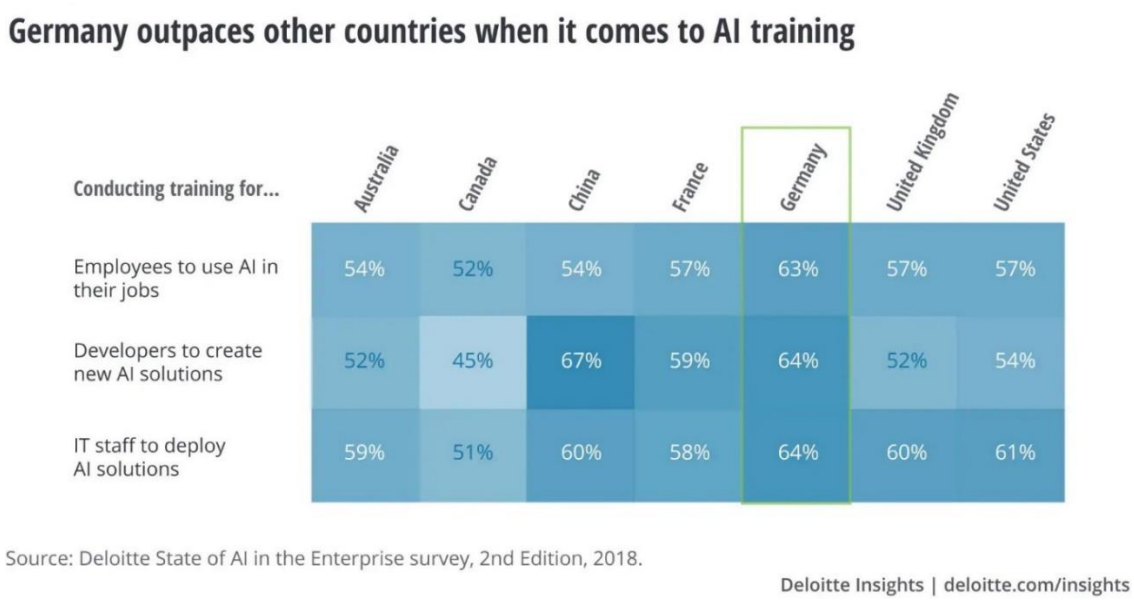

Figure 24: Trainings in AI by countries (Budman et al., 2019)

Another interesting geographical fact was mentioned in Accenture (2016) report. It shows that Managers in emerging countries are more open to accepting AI than in developed countries (see Figure 25).

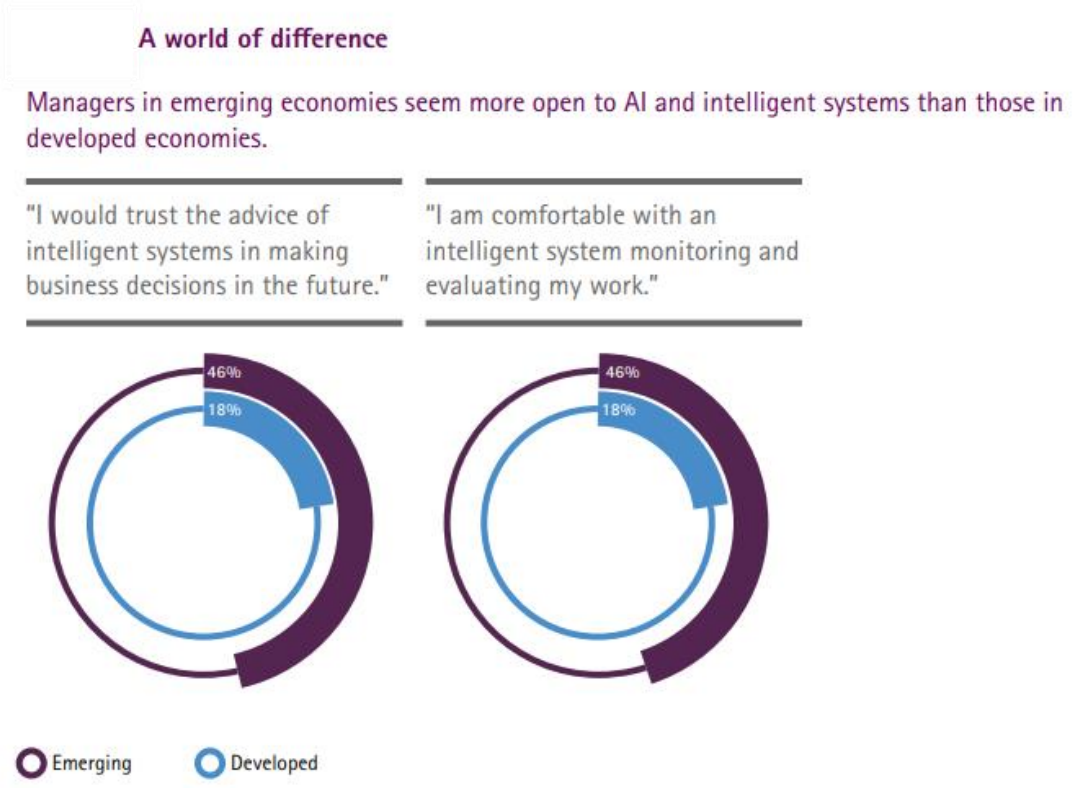

Figure 25: Difference openness towards AI in different countries (Kolbjørnsrud, Amico, & Thomas, 2016)

Lastly, it is worthy to mention, the possible negative effect of AI implementation and smart automation. There have been a number of researches conducted to understand what impact will AI have on the future rate of loss. While some authors such as Acemoglu & Restrepo (2017) find negative effects and increase in job loss, others like Graetz and Michaels (2018), Mann and Puttmann (2017) and Dauth et al. (2017) find that AI can lead to increase in mean hourly wages and in local employment. Another big study on this was conducted by Frontier for the Royal Society and the British Academy (2018) which held a rather neutral position on the topic. They also claim that in future “impact of AI is likely to be influenced not only by technology but also by cultural, economic, social factors” (Frontier, 2018, p. 55). This debate around the topic clearly shows the unclarity and uncertainty about the future. And while current research would like to skip assumption regarding the future, it is important to mention that a study conducted by Deloitte shows

that 36% survey of respondents “feel that job cuts from AI-driven automation rise to the level of an ethical risk” (Budman et al., 2019, p. 15).

Criticism of empirical data

The biggest criticism of the above-presented empirical data is that it has been taken from researches conducted by industry representatives rather than from academic works. The reason for this is that the developments in AI are primarily conducted by the industry rather than academia. Papers, especially the ones containing empirical evidences on AI and adoption of AI, are therefore mainly published by companies. An example of this is a wonderful research published by Stanford university called “One Hundred Year Study on Artificial Intelligence (AI100)” (2016). The report analysis past, current and future development of AI, yet lacks empirical evidences.

The author has kept a critical approach while reading through research conducted by the industry and would like to acknowledge the over-optimistic views on adoption of AI in some of them (eg. Plastino & Purdy, 2018; Purdy & Daugherty, 2016, 2017, 2018). Critical approach here is extremely important as the number of neutral articles decreased and the number of positive articles, on the contrary, increased. This can be seen in the data from TrendKite was analyzed by researchers in Stanford university in their AI Index (2018) report (See Figure 26). They concluded that “articles have become less neutral and more positive, particularly since early 2016, when articles went from 12% positive in January 2016 to 30% positive in July 2016. The percentage of positive articles has hovered near 30% since then” (Shoham et al., 2018).

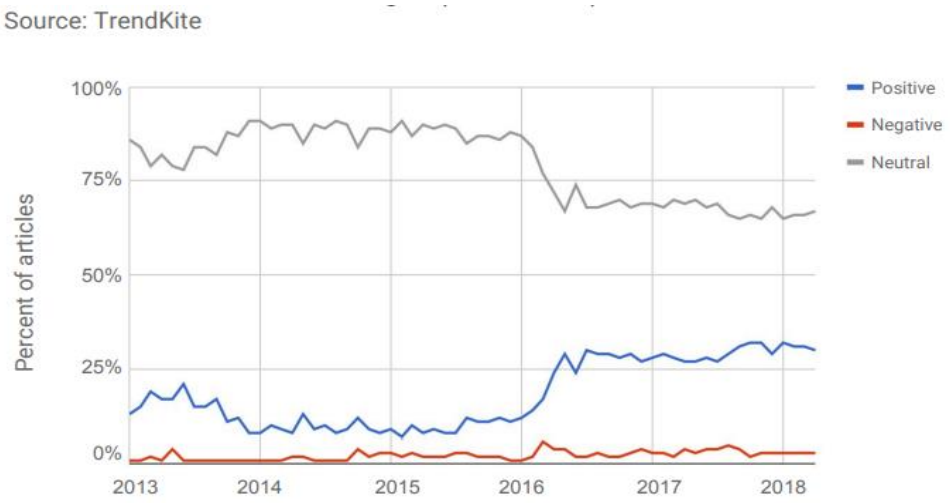

Figure 26: Sentiment of articles referencing AI ((Shoham et al., 2018)

The author would also like to single out Deloitte's "State of AI State of AI in the Enterprise" (Budman et al., 2019) report as being especially helpful. Although published by an industry representative company, the research kept an academic approach to the topic while providing helpful insights on adoption of AI.

Expert Interviews

Expert interviews in the current work serve the purpose of complementing the empirical studies. At this point, it is important to mention that both interviews held were of great importance. They allowed the author to personally view two different case. One (Xypro) – a small, private company the products of which mainly focus on local (US) market, the other (TicketMaster) – a very big, public company which sells their products worldwide. Xypro is still in early stages of investigating AI opportunities for their company, while TicketMaster claims that they have Machine Learning algorithms up and running in their company.

Xypro interview

The interview with Xypro revealed that the technologies that they built generate all of the data necessary to run Machine Learning algorithms and more complicated versions of AI. Mr. Tcherchian said that their company doesn't have a ready AI-strategy yet, however the company might use a mixed approach of buying some technologies and extended on top of it. Another alternative for Xypro would be to partner with another company, leverage what Xypro built and what the potential partner has built to come up with something new.
Mr. Tcherchian said that narrow AI can be of help in the company's daily task, as it is able to identify anomalies and malicious activity. He mentioned that in their business it is close to impossible for human to pull a needle out of haystack. AI can "profile the system, profile the users, profile the network, profile everything and get an understanding of what normal is".
However, Mr. Tcherchian expressed skepticism as he thinks that people still do not fully understand the potential of AI. He mentioned that it's a buzzword. An interesting comparison was drawn with Internet, in its early days. There were companies that didn't realize that Internet was the next big thing and as a result they lost their market positions.

As of for the future the vision that Mr. Tcherchian shared during the interview, is that in near future AI will be augmenting human activity, however in longer term “somebody’s always going to be pushing the envelope”. Yet, people need to embrace the change, because eventually it is going to become the new normal and anything that is repeatable will be gone. The amount of impact that AI will have is going to vary from industry to industry and the maturity level of organizations in that industry.

The interviewee said that as he foresees that there will be resistance companies yet they need to stay current and be flexible. He suggested that companies need to put up exploratory teams together to identify what the current state of technology, what are the current inventory of the business units, where technology can be leveraged. This shall allow the companies understand how to integrate AI in their work processes or at least be prepared when the need for it arises.

TicketMaster

During the interview with TicketMaster, Mr. Mark Roden shared that their company uses Machine Learning and other AI-related technologies in their everyday work. Mr. Roden works in the fraud detection department. The aim of their model there is to sort security threat cases in a way that most fraudulent ones appear near the top and then humans go through and evaluate them. This allows their company to have a labeled dataset. In Mr. Roden’s words “a labeled dataset is gold in any form of Machine Learning”, because it a verified information. Mr. Roden said that the narrow AI that they use is of critical importance for their company and if it goes down, they cannot operate as a business.

He identified several problems that companies will be facing when adopting AI. The base problem is knowing what the company wants. As he said “if you don’t have clarity on what is it you need to do and what you want to do, there’s no amount of AI that is going to help you”. A lot of people, as he said, try doing AI just because others are doing it, but if the company doesn’t know why they are doing it, they are just going to spend money. The second problem is the data cleanliness.

If the companies decide to have an AI solution, they will need to form a strategy for it, rather than adopt just fire-and-forget approach. With this being said, Mr. Roden doesn’t believe there is a resistance towards adoption of AI. On the contrary, he thinks that there are a lot

of companies that decide to adopt AI strategy just because others are doing it and without much understanding if that will be a solution to their problems.

He sees fintech and driving being among the industries that will be most affected by intelligent automation. All of the repeatable tasks will be automated and the human endeavors are going to shift towards creativity. The reason is that AI can mimic creativity, but it is not creative, it stays within the boundaries of what it was told to do. This shift will cause job loss in future and is causing uncertainty today.

Humanity has gone through similar technological changes in the past, and has survived. Yet there is a matter of people who understand and control AI being less than the 10^{th} of a percent of population, everyone else has a vague understanding of AI. We as a society will have to address this income inequality.

Mr. Roden doesn't see AI completely replacing human workforce, because in that case people will be left jobless thus without the money to afford certain goods. The companies producing those goods will start bearing financial losses, which is not in their interest.

Lastly, Mr. Roden mentions that using more natural language processing is not enough for having a true AI and at the end of the day it is not even important. It doesn't have to have a whizzbang interface. That is the Hollywood vison of what AI will look like. The interface that we are currently used to is more than enough for displaying AI information.

Note from interviews

The fact that surprised the interviewer was that both of the interviewees said the same phrase that no humans will be able to "find a needle in the haystack", meaning that it is practically impossible for a person to find necessary information in the vast amount of generated data. Both interviewees saw AI being the solution for this.

Analysis and Discussion

In order to analyze the data gathered from the literature review, the data will be put on the proposed theoretical framework. The analysis will start from the last part of the proposed theoretical framework: Diffusion of innovation and rate of adoption theory. In the later part, the analysis will look at the gathered data through technological trajectories and waves of innovation theories. Finally, the theoretical framework will be looked at as a whole, to see if it can or cannot be used to analyze the adoption of AI.

Diffusion of innovations: Rate of adoption

Characteristics of adopters

The literature review has clearly demonstrated that the adopters of narrow AI are currently organizations. The reason for this, is the near-business term potential of AI and return on investment that companies are seeing. Biggest time and financial investments in AI are also done by big companies. Individuals do not develop AI solutions but rather adopt what has been presented to them by the companies, which often are just voice assistants. Yet, due to the fact that AI today can do very specific task which are mostly business related like skimming through big data to find patterns, the users do not find the need to adopt such corporate innovation.

With this being said it is important to understand that the technology is still in its early stages of development, therefor we are currently seeing Innovators and Early adopters of it. Yet, with technology becoming better quickly, more and more people are looking to adopt it in this or that scope. This mean that it will soon approach the chasm and as with any other technology further diffusion will depend on whether it manages to cross that chasm.

Attributes of innovation

Relative advantage:

As presented in the empirical findings section of the current work, the potential advantages that AI offers are numerous starting from enhancing current products to optimizing internal operations. The biggest advantage that AI can give the company, as seen both by empirical

findings and interviews, is the ability to analyze big amounts of data, which humans cannot do.

Compatibility

Narrow AI can be potentially compatible with most of the existing hardware. Yet, the higher computational power is required from the AI solution, the more hardware power it will need. For corporate and individual users who are not using AI solution of their own development, most of the computing will be conducted on the servers, rather than users' computers. Only the results are shown on users' display. In that case it is fair to say that most of the computers with good internet connection are and will be compatible with AI solutions.

Complexity

Due to the fact that AI encompasses different branches in it, it is hard to say how complex it is to use. Solutions that have voice assistance and natural language processing (NLP) are of course easier to use. However, if the AI solution doesn't have NLP still it can return the results of its work in an easy to understand manner – text, Excel spreadsheet etc.

Trialability

There are some companies that sell their AI solutions to other companies. In this way the solution purchasing companies can get a trial version and see if it is working for them or no. When talking about developing their own product, obviously there cannot be a "trial" version as such. Yet, while developing, companies can try understanding if the solution is good for them based on beta versions.

Observability

As presented above, in the empirical findings the impact of narrow AI on businesses can be measured and is observable. The biggest indicator here is the return on investment.

Features of the setting or environmental

As shown in empirical findings, the countries where the AI technologies are developing and getting adopted matter strongly. However, the findings show an interesting picture. The biggest investors today are countries with more developed economies and IT sectors.

Germany, Australia, UK and US are among the countries, where companies are developing companywide strategies and believe that AI is of critical importance to their success. Among those countries, Germany is the leader when it comes to AI training. Surprisingly, in developing countries the managers seem more open towards AI and intelligent automation, this can be explained by optimistic view point that AI will help strongly strengthen companies and economies of those countries.

When talking of feature of the setting or environment for AI as a technology, it is only geographically limited by the availability of internet. Autonomous AI solutions developed by the companies themselves and running solely on their servers, do not have limitations as such.

Technological trajectories

When looking at AI as a technological paradigm, one can clearly see how it appeared as a result of bunching of other technologies. Starting from introduction of electricity and later computers and internet, technologies were following a certain trajectory. The rise in amount of generated information brought up the problem of managing it. As discussed in the literature review, Machine Learning became a modeling solution for this technological problem and with rise in computational power it started developing further, leading to more complicated versions of AI.

Waves of innovation

While it is impossible to predict the future, the author would like to argue, that AI has all of the potential give a start to new, 6^{th} wave of innovation. The first reason for this is the economic pattern. As discussed in the previous chapters, after its introduction the invention causes an economic boom, followed by crisis of structural readjustment. Most of the authors agree that the previous crisis of structural readjustment was during the financial crises of 2007 – 2009, which means that the next wave should have started in 2010s. As indicated in the “State of the Art” chapter, AI was given second birth in 2012 and we see that the technology is currently in the early adoption stage. It is true that it is not the only technology introduced throughout the last years. Yet, based on the data gathered through

empirical study and expert interviews, the author would like to argue that it is the only one, that offers solution to structural problems.

Theoretical framework

The proposed theoretical framework was looking at AI as a technological paradigm that was formed by technological trajectories. It claimed that AI can lead to the next wave of innovations and in order to assess its potential adoption, the framework evaluated it using Diffusion of Innovation theory.

Analysis using the DoI theory showed that AI can potentially take off and gain massive adoption in case it manages to cross the Chasm. It is safe to say the empirical data and potential larger adoption show that AI can become, or at least has a high potential of becoming the main reason of next Kondratieff wave.

Answering the main research question

AI is not the only technology that follows this adoption patter. Other large innovations are similar when it comes to adoption. Throughout history we have seen how organizations failed to adopt to a certain innovation and stopped being competitive. In order for companies to grow or keep their positions in the market they need to learn to quickly react to changes in their environment. The case of adoption and integration of AI in digitalization strategies of companies, which was discussed in the current thesis, is a good and ongoing example of this. In case companies do not adopt they start baring the risks of failing in the market. Technological companies tend to have “high levels of lock-in effects” (Antonelli, 1991, p. 12). Because of this lock-in organizations often continue defending their practices and do not properly respond to changes (Utterback, 1996). Even when the companies do innovate, they tend to innovate only within the scope of their activities and follow previous innovation trajectory (Archibugi, Filippetti, & Frenz, 2013; O’Reilly & Tushman, 2004; Utterback, 1996). This inflexibility in accepting changes can potentially destroy the company. Realizing this, companies need to seek innovations that can make them more competitive (O’Reilly & Tushman, 2004) and gain understanding of what technologies can impact their field of operations (Utterback, 1996).

On the other hand, as shown by the empirical data and interviews – the companies that do adopt AI have a chance to be on improve or remain their market positions, if AI crosses the adaptation chasm as a technology.

Conclusion

Current research was conducted on the adoption of Artificial Intelligence in organizations and the need to include AI strategy during organization's digitalization. Using the proposed theoretical framework, the author evaluated current progress of AI and potential future opportunities. Using the empirical studies and the theoretical framework, research found the potential benefits of adopting AI and the risks of not adopting it, thus answering the main research question.

The research revealed that in case of successful crossing of the chasm, AI has high potential of being adopted by the majority and thus launching the new wave of innovation. Some big companies already started building their own AI solutions. Others are developing their digitalization strategy with considerations about AI. And while third ones are researching on the topic, there are still a lot of companies who are not doing anything regarding AI. While the technology is still in its early stages, companies need to keep an eye on it and be ready to change if the time chasm is crossed. Paul Daugherty, Accenture chief technology and innovation officer says:

"To realize the opportunity of AI, it's critical that businesses act now to develop strategies around AI that put people at the center, and commit to develop responsible AI systems that are aligned to moral and ethical values that will drive positive outcomes and empower people to do what they do best—imagine, create and innovate" (Purdy & Daugherty, 2017, p. 23).

While the author of current work believes that Mr. Daugherty's statement is exaggerated and there is no urgency to dive head-first into the AI, still current research and presented empirical evidences show that AI has a potential to become next important digital frontier. In order to remain competitive, organizations need to stay current and be ready to adjust their business model if the need arises. This can be done by forming research groups that will identify current state of AI and monitor its impact on their field of operation. In case the research group identifies potential threats and/or opportunities that AI can offer, the organization needs to adjust their business models and include AI in their digitalization strategy.

Conflict of interest

The authors declare no conflicts of interest.

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Appendices

Appendix A

Interviewer:	00:03	How are you doing today?
Steve Tcherchian:	00:04	Good. How're you?
Interviewer:	00:04	Yeah, good. Just for the purposes of the paperwork, do you mind if I record our conversation?
Steve Tcherchian:	00:12	No, that's perfectly fine, yeah, I give my consent.
Interviewer:	00:12	Okay. Of course, you can choose not to answer to certain questions and we can stop this conversation at any time.
Steve Tcherchian:	00:22	Sure. Do you want to give me a little bit of a summary of what...
Interviewer:	00:24	Yes, of course. Of course. Of course. Just a couple of more things. Do you mind if I indicate your name on the thesis?
Steve Tcherchian:	00:34	That's perfectly fine.
Interviewer:	00:34	Yeah. Okay. yeah, so basically what am I doing? My full name's Tigran Gevorgyan. I'm doing an Erasmus Mundus studies in Europe. It's a joint master's degree, it's a collaboration between the Salzburg University in Austria and the Aalborg University of Copenhagen in Denmark. My final semester is here in UCLA as a visiting graduate researcher. The program is called digital technology management. So, the major is in the management of technologists as such. Currently I'm working on my master's thesis, which will be

presented to all of those universities, so those three universities. The topic, the working title, is the role of AI, the adoption of AI in organizations specifically in digital transformation of organizations. So yeah, that's, I'm currently writing my master's thesis, again, I'm done with my “State of the art chapter”. I'm developing my theoretical framework, which is, discussing, artificial intelligence through the prism of innovations, of adoption of innovation, of the so-called technological trajectories. To see where it came from, where is it going to and how are they organizations going to if adopt AI. So, yeah. Although I've read and watched quite a lot of videos about Xypro, can you just briefly describe what your company does?

Steve Tcherchian: 02:25 Sure. So, Xypro is a cybersecurity provider, we've been providing security solutions for HPE nonstop servers, formerly known as Tandem computers for the last 35 years. So, we do compliance, auditing, a database management and all of the security infrastructure around nonstop servers. Nonstops are the back end of most large organizations. So, ATM networks, Credit Card Networks, retail payments, food and beverage, manufacturing, telecom. So, any big brand you can think of, any big company you can think of, will have an HP nonstop server in, in their environment.

Interviewer: 03:11 So you're in the back side of the things.

Steve Tcherchian: 03:13 We're on the backside. We're providing all of the security from the authentication layer all the way to data proof protection, privacy.

Interviewer: 03:21 So, I know Tandem computers have been there for a while now. Does this mean that Xypro is quite old as a company too?

Steve Tcherchian:	03:33	Xypro has been around for 37 years now.
Interviewer:	03:35	Wow. Amazing. Amazing. And I think you've been working here for about 15 years now?
Steve Tcherchian:	03:40	I have been 15-16 years. Started in my early twenties. Yeah.
Interviewer:	03:46	And so typically your customers would be banks I would say?
Steve Tcherchian:	03:50	Yeah, pull out your wallet and every logo you see on your cards, it's probably going to be our customer. Every, every store you go into on a weekend is probably our customer. So, people don't realize it but, I heard the averages is, an average person will interact with a nonstop without knowing it about 12 times a day.
Interviewer:	04:11	In The Soviet Union, there was a saying "the fighters of the invisible front".
Steve Tcherchian:	04:18	Yeah, exactly. Exactly right.
Interviewer:	04:21	But this means that, do you guys have individual customers as well? Do you have solutions for individuals too or is it purely companies based?
Steve Tcherchian:	04:29	No, it's business to business.
Interviewer:	04:30	Yeah. Okay. So, the main products that you offer are…? you don't over servers as such, you offer the software.
Steve Tcherchian:	04:41	Yeah. We sell, the software that runs on the hardware.
Interviewer:	04:44	Yeah. So there, as far as I know, there is a security product that you offer, which pretty much builds a wall in front of the server.

Steve Tcherchian: 04:52 Exactly right, yes.

Interviewer: 04:56 Okay, great. Now, I've been talking with Vic about this too, I think we've spent in the evening talking about what he does, what Xypro does in general and I asked him this question whether you do any of the machine learning or deep learning, so called narrow AI. Because it seems like your job as a cybersecurity company can be, from how I see it, a lot of the times enhanced with narrow AI. Do you do any of this?

Steve Tcherchian: 05:35 We're just getting into it right now. So, we do a little bit of it. We've done a little bit of that. There's a lot more we could be doing or we're going to be doing. The benefit to us is, or the beauty of where we are right now is the technologies that we've built generate all of the data necessary for machine learning and for AI. So, without the things that we've built, the data to be able to do machine learning and, to a later point, AI in this space wouldn't exist. So, we're generating all of the data needed for that.

Interviewer: 06:08 Yeah. So, are you developing your own machine learning algorithms or AI algorithms or are you, I know that there is a bunch of different ways to go with this, right? If we look at Google, they purchase little companies who are building their AI solutions and they integrate them. And then there is an external partnership kind of format, right? You buy off the software from another company and of course building your own. So, you guys are focusing on building your own?

Steve Tcherchian: 06:41 Not necessarily. We kind of get an understanding of what's really needed. So, we, if we need to build, buy or partner, all of those are options. So, it might be a combination or a hybrid implementation of all three of those.

Interviewer: 06:55 Right.

Steve Tcherchian: 06:55 We do have some very unique patented technology around how that can be used though. So, what we want to do is when we, when we decided to go down a certain path, is making sure the technology that we choose can execute on the patent that we have.

Interviewer: 07:10 Yeah. So basically, when you're saying hybrid, do you mean as long as it doesn't get to your patented technology you can use the outsource?

Steve Tcherchian: 07:23 Yes and no, kind of, when I say hybrid, it might be that we buy some technology and we extend on it, build our own on top of it, or we partner with somebody and be able to leverage what they've built and what we've built to come up with something new. So, it might not be just building something and implementing it in our products.

Interviewer: 07:41 So, for you specifically, what are the exact things that you think those kinds of algorithms, narrow AI, can help in your daily tasks?

Steve Tcherchian: 07:57 From a security perspective you mean?

Interviewer: 08:00 Yeah.

Steve Tcherchian: 08:00 It's being able to identify anomalies or malicious activity. So, the challenge with security to be captured and logged, that it's impossible for any human to pull a needle out of the haystack. So, because of all these mega breaches, there's all these security compliance frameworks and other best practices that say you've got to be able to log all of this activity. In a large company with tens of thousands of employees every keystroke, every mouse click, every application he opened up, I mean, a single user could be generating gigs and gigs of data a day. Multiply that by tens

of thousands of users, who's going to be able to go through all of that data to know that this is you doing this activity and this is your normal user behavior. But there's another user here with similar activity, but it's a little bit of an anomaly from what we see as normal. Humans not going to be able to pull that out. You're not going to be able to correlate that, that activity and say, "okay, this is skewed by a factor of 0.5, so we need to pay attention to this". That's where machine learning needs to be introduced and used. At a more... We need more rapid adoption than we have right now, so having the machine actually go through that data and identify what the normal activity is to be able to pinpoint the outliers.

Interviewer: 09:28 Aha, learn from normal activity to differentiate.

Steve Tcherchian: 09:30 Profile the system, profile the users, profile the network, profile everything and get an understanding of what normal is.

Interviewer: 09:38 Yeah. And do you think AI can actually help you not from the security perspective, but on working basis? Say you're developing a code, AI is there helping you to develop the code.

Steve Tcherchian: 09:55 I'm skeptical right now because I think that, we haven't really understood the full potential of AI. You know, right now it's just a buzzword and there's companies playing with it. It's like the Internet right back in the, in the late nineties, there were... People didn't really understand what it was and there were a lot of companies trying to figure out what it was and they went out of business, but that set the stage for the next generation who turned up being Myspace and Google and Yahoo and some of the big Internet companies now. I think we're in the same space, same place with AI right now. These trailblazers right now are trying to get an

understanding of what the technology really is. So, to most people it's just a buzzword that if I'm going to use it at a party and sound cool.

Interviewer: 10:38 Yeah, right, yeah.

Steve Tcherchian: 10:39 But these guys are trying to figure out what it can do. So, they're going to probably go out of business trying to figure it out, but what they leave behind that next generation that comes through, is really gonna be able to harness the potential of what AI can do.

Interviewer: 10:53 Yeah, yeah, of course. So, in that case... Okay, I got it how it affects the cyber security, but how do you think, it can help other companies as well. So, again, for the cyber security, okay - massive amounts of data, logging and then AI kind of helps you differentiate normal activity from paranormal activity. And then, for other companies, do you think, AI has the potential to help?

Steve Tcherchian: 11:25 Absolutely. I mean if you look at, I'll use ports for example. The dock workers, those guys, they're all being replaced by machines that go on, offload the containers and that goes on a machine, the machine knows exactly where to take it, puts it there and goes. They can even self-heal now. So, what'll happen is they're filled with sensors, right? So, if they know, if they can predict that a part's going to fail, they send a message out and all of a sudden it starts getting the wheels in motion for everything else down the stream. So, the part gets automatically ordered, it gets shipped out to the location, technician is scheduled automatically, technician comes out, all he's gotta do, take a part up, put a part in and the machine keeps running. So, there's all kinds of uses right now. But again, I don't think we've exploited the full potential of it.

Interviewer: 12:11 And, and that brings up another question. So, there's a lot of, again, buzz in the bad way when the conversation gets to AI. People are like, "oh my God, it's going to come take my job, it's going to fully replace me". And then there is this whole conversation that in near or distant future, the AI is going to replace all of the job places. So, do you think it's going to be that type of situation or AI will be more in a Tony Stark - Jarvis situation when it's augmenting the human activity?

Steve Tcherchian: 12:48 I think it's going to be augmenting human activity now, but longer term, somebody's always going to be pushing the envelope. There's a certain ethical aspect to it because, yes, it is going to displace, it is going to put a lot of people out of work. It's, it's inevitable. It's one of those things that we're going to have to embrace it. This is going to be the new normal. Anything that's repeatable, any job that's repeatable, the same thing over and over, you can just forget about it, in 10 years. So, we do need to embrace that aspect of it, but be able to consciously think about the ethics surrounding it. But just like with everything else, somebody is going to see what else they can do, how far they can push the envelope. Further and further that gets pushed, that ultimately will end up into new normal, right?

Interviewer: 13:34 Yeah, yeah, of course.

Steve Tcherchian: 13:35 And it's going to start replacing a lot more. It's, it's funny if you've seen Terminator 2 - The rise of the machines, it will be exactly that at some point. The machines will be able to, basically, function on their own.

Interviewer: 13:52 Yeah. And do, you think there are certain threats to that?

Steve Tcherchian: 13:56 Of course there is. Yeah. Of course, there is. If a machine becomes aware, the more and more it can learn, the more and more it can become aware... There’re companies out there right now that are, that are inventing or working on code that writes itself. Being able to replace a developer because the code is in understanding of what he needs to do to continue enhancing itself.

Interviewer: 14:18 Aha. So, in the, in this coder situation... So, there is a conversation going on that the AI will replace low-value added tasks, but it will, well, some people say, it will never replace more complicated tasks. Do you think AI will also take on the complicated tasks?

Steve Tcherchian: 14:36 I think as time goes by, we're gonna continue understanding what the potentials of AI is. Just like with any other technology, right. 100 years ago, nobody even knew what a car was. Now the cars are driving themselves. Who would have thought?

Interviewer: 14:56 And with those changes going on in the world, and the companies trying to adapt to ever-changing technology and AI, in this case, it of course affects their business model as such. How do you think AI is going to affect your business model? How is it going to transform your business?

Steve Tcherchian: 15:19 Yeah, we're embracing it. I mean, it's a lot of the companies that we sell to, the things that we make, make people's lives easier. So, our customers are looking at us to make their lives easier. So, if we get an understanding of how to leverage AI and we can provide some solutions and value add for our customers that make their life easier with new technology, it's an opportunity for us. So that's the way we're looking at it.

Interviewer: 15:45 Yeah. So, you're, do you think that the other companies as well, in different fields, when they integrate AI into their daily tasks, it's going to change the way that they do business, right? How is that going to affect the job places of the future? What, your vision? Ok, you came to work, what's going on?

Steve Tcherchian: 16:13 Yeah. It's, tough to say, it's going to vary from industry to industry and the maturity level of that organization. But again, I go back to... Anything that's repeatable, doesn't need to be repeatable, it can be automated and then automation is the first step, right? You automated and then the AI aspect of it can improve on that.

Interviewer: 16:34 Yeah. And when we're talking about replacing humans, that means that you're paying less money, less salaries, this and that. Do you think AI can help companies save money? Like your company and other companies?

Steve Tcherchian: 16:58 Yeah. We've done some financial analysis on this type of stuff, but some of the newer solutions that we're providing, they're focused on leveraging the data for machine learning in AI where if you have to pay for people to do the same amount of work, you buy one piece of software that can replace four people. I don't want to use the word replace but it can do the job of four people and free up the time that those four people are spending doing the work manually that the machine can now do by itself, without any, any oversight.

Interviewer: 17:31 Yeah. There, there are some big companies nowadays that there, claiming that they've saved millions of dollars. General Electric being one of them. So, I want to understand how, AI will be changing the world of organizations from the financial point of view too. Is it going to crumble or is it going to prosper?

Steve Tcherchian: 17:59 Yeah, I think it's... I think we're going to go down, I think we're going to go into a dip first before we come out of it. That's the case with any type of transformation. You're going to go through a valley before you hit a peak. It's because of this current generation of workers, a majority of the workforce is used to working with their hands. All of that, are going to be the first things that are going to be replaced. We've got even insurance companies now as an example. I've got quite a few colleagues that work in the insurance business where, you file an insurance claim and adjuster picks up the phone, takes your information, and then starts handling their claim. Now that's all done by machines. You call in, you file a claim, you give them the information the machine will either accept or deny or put you through the next steps of what needs to happen. Yeah. So now all those people, that all they knew how to be was an insurance adjuster have to do something else. The challenge is that if you're kind of later in your career, it's going to be very difficult to career switch at that point. So, this is something that we're going to be as a, as an economy and as a, as just civilization we're going to have to deal with and figure out what to do. There's states and local government agencies that are trying to figure out how to address this. Do we have to give somebody a living wage or some sort of stipend or something that if they're out of work because of machine replacing, what do we do with this, with this group of people.

Interviewer: 19:33 So what do you think are going to be the future jobs that people are... So, assuming I'm an insurance worker, again, as you said, and then the machine came and took over my job, where do I go to? Which is the field that is most secure from the automation.

Steve Tcherchian: 20:01 Yeah. I don't know if there's one that's secure right now, it's automation threatening everything. Automation is and AI is going to be even a bigger threat. So, what I would say is just stay current, get an understanding and be flexible, of embracing the technology rather than resisting it. It'll be futile to resist it. It's coming whether we like it or not.

Interviewer: 20:28 And that brings up to another question. Over the decades we've seen how different technologies were accepted or rejected starting from phones to long distance calling, radio, Internet. Those technologists were first being rejected, then they got widely accepted and adopted. How do you think acceptance and adoption of AI by the industry will take place? Do you think there is a certain resistance in the industry to adopt it?

Steve Tcherchian: 21:12 If it's a threat to your livelihood, there's going to be a resistance. And a majority of the workforce right now I think is, seeing it as a threat. But you've got people like me who are actively pursuing it and innovating on it and know that it's coming. So, you've got a very small percentage right now that are embracing it. It's like you said, the radio, the Internet, everything else that's come before, there was big resistance to any of this "why do we need it?", "This is a fad!", "It's not going to take off".

Interviewer: 21:48 Yeah.

Steve Tcherchian: 21:48 It is. History has proved every single one of those wrong. So it is, it's coming, it's going to be the new normal. It's going to be the reality of it.

Interviewer: 21:59 So do you think this is about the right time for the companies to start adopting and adjusting their business models?

Steve Tcherchian: 22:07 Yes. Otherwise you're going to end up like… look at what Amazon did to a lot of companies, to Seers, to Toys R Us, to all of these companies. They either ignored Amazon or they thought they were big enough to survive Amazon. And Amazon came and just disrupted that entire business model. This technology is going to disrupt a lot of industries and the way they work. So rather than trying to resist it or think they can outlast, they have to figure out a way to work with it and to leverage it.

Interviewer: 22:40 So, again as of for this the moment there is, as you well mentioned, a lot of buzz around AI. A lot of companies claim they do AI when in reality they're not. Now, when do you think, like an estimate, we will have an actual AI starting to help us on daily basis?

Steve Tcherchian: 23:15 I think we see some of that now. Some of the examples I gave earlier where, the machines that are working in the docks or self-healing machines, being able to predict when, when a part, a component is going to fail and being able to do that. I think we're seeing a little bit of it now. But we haven't harnessed the full potential of AI though. So, once we get over that hump and it might take another three to five years and beyond that, I think we'll be in an area where we're rising out of that, that valley and getting a good understanding of where we can leverage it more.

Interviewer: 23:51 So, let's imagine, you're a CEO of a big company. I come to you and I say, you know what, AI is coming and it's changing the workplaces of the future, changing the market, the world and you need to adapt. What, what would be the steps that CEO, you in this case, would have to take in order to start adjusting?

Steve Tcherchian:	24:22	Yeah. I'd probably take a look at the different parts of my business. Maybe put an exploratory team together to identify what the current state of the technology is and what our current inventory of the business units are, for example and where the technology can be leveraged. But being sensitive too, not necessarily saying we're doing this and we're going to replace your job with it, but presenting it in a way where this is going to make people's lives easier, jobs easier, free up their time so they can focus on more strategic things. Business to business it'll vary, but getting an understanding of how technology can be used within a certain business or vertical or business unit.
Interviewer:	25:04	Right. Okay. Well, I guess that's, all on my part. Do you have any questions?
Steve Tcherchian:	25:16	No, you introduced yourself and your program well prior to the meeting.
Interviewer:	25:56	Ahaha thank you. Well, you know, if you decide to come to Armenia one day, I will be happy to see you. And if you will have any questions, I'll be happy to answer them.
Steve Tcherchian:	26:11	I will absolutely keep your information handy and you too feel free to reach out with anything you need. I'm happy to answer more questions, so if you give me a call, we can chat on the phone about anything, I'd be happy to do it.
Interviewer:	26:24	Great. Thank you so much.
Steve Tcherchian:	26:26	Yeah, my pleasure.

Appendix B

Interviewer:	00:00	Hello Mr. Roden, it is a pleasure to meet you. Do you mind if I record this conversation for the academic purposes?
Mark Roden:	00:05	Sure.
Interviewer:	00:11	Just a couple of more questions, again for the academic purposes. Number one - is it okay if I indicate your name, on the thesis?
Mark Roden:	00:26	Yes, yes.
Interviewer:	00:27	I have to warn you, you, you can choose not to answer to certain questions if you feel like you're uncomfortable with them or that's just something that you cannot say. You're as well free to stop this interview at any time.
Mark Roden:	00:49	Yeah.
Interviewer:	00:49	So, I'll briefly introduce myself and say what I'm currently doing. My name is Tigran Gevorgyan. I am from Armenia. I'm studying, in Erasmus Mundus program in Europe. The program is a collaboration between Salzburg University in Austria as well as Aalborg University of Copenhagen. My final semester is here in Los Angeles in UCLA, where I am a visiting graduate researcher. I'm writing my master thesis primarily on Artificial Intelligence. I'm trying to understand how innovations get adopted, the rate of adoption, and so-called waves of innovations. And I'm looking at Artificial Intelligence through this prism, and trying to understand whether organizations are embracing or rejecting AI. What's

going on in the market and how it has the potential to give opportunity to organizations to operate in new ways, to transform digitally and change the way they do business.

Mark Roden: 02:21 Sure.

Interviewer: 02:21 Although I have a read and watched a lot of videos about Ticketmaster, and it's history, but still, can you please just briefly tell me about the company? What do you guys do?

Mark Roden: 02:41 We ticket live events, so Ticketmaster as part of Live Nation group. Together we're a fortune 500 company. Last I checked was like 330, something like that. We ticket and run live events and Live Nation runs a lot of venues, manages many artists. And that's our jam - live entertainment. As a company internally, we think of four categories, sports, concerts, arts and theater and family. So generally, entertainment falls into those categories and then we help venues, by providing ticketing equipment and sell tickets and helping promoters and artists manage the event lifecycle. So up to and including, you know, the show itself, and then, making sure people can get in. See it doesn't matter if you have a ticket, if you can't actually use it to get into the show. So, if there's getting into the show is the big deal.

Interviewer: 03:53 Right, right. I know that you're a data scientist, but what's your, role in the company, your position?

Mark Roden: 04:02 Right now I'm working on fraud. I'm the tech lead for the fraud team. So, there are people who are trying to steal money from the company either using fraudulent credit cards or any number of other techniques. We make a distinction between fraud as in financial attacks and abuse, which is a violation of the terms of service, to the using a bot

on our systems. There could be both abuse and fraud depending on what the bot is trying to do.

Interviewer: 04:39 Right, right. So, your customers are primarily individuals, right? It's not a B2B platform.

Mark Roden: 04:49 Oh, we have B2B as well. We have both B2B and B2C. So, there's a whole enterprise, part of the organization that is all B2B and then if you consider artists to be a "B" in the B2B, we also have a Live Nation as a huge artist management system as well.

Interviewer: 05:08 I see. But primarily, like the big part of the businesses B2C, right? You're working with individuals who are just going to your websites and buying tickets.

Mark Roden: 05:23 It depends on how you define big. If you're going to go by the bottom line, I mean, you probably could look in earnings reports and they'll tell you where money is a partitioned. I know that development effort is spent on both sides, both sides of the house.

Interviewer: 05:43 I see. So, the main products that you offer are of course tickets, right? Are there any, other solutions and like products that you offer?

Mark Roden: 05:58 Yeah. Most of it is around ticketing, but presence, for instance, presence is a big thing. Like I said, a lot of what we do is how do you get people into the venue and how did you make sure that they didn't steal the ticket, that it's the person who bought it. So, a really interesting way to think about it, if you give a pdf printed tickets and the stadium has 40 entry points, how do you make sure that two people aren't entering from the opposite sides of the venue with the same ticket. So, we have a lot of, systems engineered around for

solving that particular problem for venues and you work out deals with venues for that type of service.

Interviewer: 06:54 Right. I know that you guys, throughout the last years, have been implementing this system - Verified Fan to detect fraud tickets, and combat the people who are buying a lot of tickets at the same time, right?

Mark Roden: 07:13 Verified fan is not fraud. So, fraud is people who are trying to use things like fraudulent credit cards, stolen credit cards. Verified fan is, if we sell this ticket to this person, what is the likelihood that this ticket will appear on the secondary markets? It's a completely legal maneuver, but it is a very miserable maneuver if that person is a broker who buys a thousand tickets and then moves them on to secondary and people can't buy them on time.

Interviewer: 07:50 Right. So verified fan is trying to combat the, the secondary market pretty much. I've read different articles including forums that are saying that you guys are using machine learning and deep learning algorithms for Verified Fan. Can you please elaborate more on that?

Mark Roden: 08:22 I actually don't work on Verified Fan, I can talk to those guys if you're interested. So, you'd have to talk to those guys.

Interviewer: 08:45 Okay. And, and the stuff that you work on, do you guys use AI, Machine or Deep Learning?

Mark Roden: 08:53 Okay, so be very careful, because deep learning is not AI. Deep Learning it's a form of Artificial Intelligence and it's actually very old. But it became recently in vogue after a paper in 2013. I can't remember the guy's name. Basically, it showed that once you take a neural net to some absurd level, absurd depth, it starts becoming a really very useful. I

don't use deep learning. I have not yet seen that for our particular use case it's, any more effective than any other, you know, gradient based approach or any other based approach.

Interviewer: 09:43 Okay. So, do you use AI in your job?

Mark Roden: 09:49 Yes, I do.

Interviewer: 09:50 Can you please elaborate more on what, exactly do you do with AI?

Mark Roden: 09:58 I can only tell you certain levels of specificity here because there are trade secrets that are involved, so I can't go too deep. But if you consider the AI to be a black box, which I think for the purposes of this conversation is, should be sufficient, basically what I do is I lead the team in figuring out what that black box's functionality needs to be. There's the business side, there's the product side, there's the project side. Project is about timelines, product is about what exactly it's supposed to be doing. The business is saying we've gotta be able to prevent this level of fraud and what does that look like, how many agents have to be involved in that. So, there's a whole product definitional aspect of things. And then there is the corralling the data from all over the organization and funneling it into the model so that as purchases are made, we can actually use the model to score purchases. In that way the aim of our model is to properly sort things. I don't know if you know much about the fraud space.

Interviewer: 11:24 I know a bit. I mean like I've never been a fraud specialist but I have a background in IT and IT management. So, I know the basics, but I've never got too deep into it.

Mark Roden: 11:39 Very well. So, the reason my fraud is a hard problem in the AI space is because it is a massive class imbalance problem, right? So, I dunno if you've come across that problem before?

Interviewer: 11:52 No, not really.

Mark Roden: 11:55 So most Artificial Intelligence, a lot of them, deal with roughly equivalent appearing classes. True/false appears in regular proportions or something along those lines. Whereas a class imbalance, like in fraud, would be saying you're going to have some very small percentage of transactions. I can't tell you the exact number of transactions, I'm not allowed to do, but it's some very small numbers. By small number, I mean absolutely less than a 10th of a percent. And of millions of transactions that we have, you have to find the transactions that are fraudulent before the banks do and before the person who's been defrauded does. If you don't, then they issue a charge back and that's money that's taken out of our bottom line and it's a really bad fan experience. We want to be on top of it so that the fans don't feel like we're not paying attention to what's happening to them. It's just miserable, their credit cards are stolen, somebody can use it. So, we want to be on top of that. What we tried to do is we have human analysts who are looking at these transactions. We have millions of transactions and they are very bursty, meaning people aren't buying tickets all the time. People buy tickets when they're on sales. Generally, every hour on the hour starting at 7:00 AM going to 10:00 AM we will have an "on sale" and it will be a massive spike of traffic. So, these are very bursty events and the analysts aren't just looking at through thousands of cases over the course of a month. That's not very representative because one day there might be a huge number of cases and then

the next day maybe not. So, what we want to do is sort those cases so that the most fraudulent orders appear near the top and then the humans will go through and rate things. That gives us a labeled dataset and that's critical. A labeled Dataset is gold in any form of Machine Learning, because that's a human expert who's told you whether or not you got it right. That's the basic foundation where we work.

Interviewer: 14:20 Now, what you're basically saying is AI, is augmenting the human activity rather than taking this task on itself, right?

Mark Roden: 14:35 In this use case - yes. In the abuse use case - no. In the abuse use case, we'll be hit by several billion attacks during the course of like a month. There is no human that can keep up with that. So, what we do is we have a wide variety of tools, some are in house, some are third party, that we use to combat bots. Those are mainly AI with the occasional human looking in and saying "oh, we have a new attack profile coming from here", augmenting things, and then AI picks up on it and then goes from there.

Interviewer: 15:14 Right. So, so generally you would say the after implementing AI in your company, it actually started working for you?

Mark Roden: 15:30 I would go so far as to say that in the abuse case, it's critical for our company to operate. When those systems go down, we can't sell tickets.

Interviewer: 15:46 And what's your thought. AI is helping your company. Do you think AI can also help other companies in other fields?

Mark Roden: 15:57 Yeah, absolutely. Before this I did medical imaging. Actually, my UCLA degree is in medical imaging. There's a lot of AI work being done there. That's actually where Deep Networks and Deep Learning comes really into play as an

image processing. There's a lot of companies that are working in that area, you know, radiation therapy companies, a lot of companies doing stuff there. My boss back in 2000s, wrote neural nets and this neural network product that we deployed in many, many research labs trying to help researchers identify cell-cell interactions. So that was a pretty nifty thing to do and it was very useful for our business. I think, fintech, financials, they're going to and they depend on AI absolutely. In order to be able to make trades at the speed with which they do. I mean, it's all over the place.

Interviewer: 17:03 And, do you think that it's, actually helping you guys and other companies save money as well?

Mark Roden: 17:13 For us - absolutely. That's not even a question. Like I said, we can't sell... We can't operate as a business without it. So, yes.

Interviewer: 17:24 Because you're mentioning that it's like such a big part up your business... The field itself, it's kind of appeared and evolved through the time, which means that you guys had to adjust your business model as a company. Were there problems in the way of integrating AI and adjusting the business model?

Mark Roden: 17:52 Yeah, there are always are. It's an interesting question because Ticketmaster's business model is exceedingly complicated. Most people think "oh, you're just selling tickets" but another way to think of the ticketing markets is as a futures market. Every "on sale" is basically... Some of them are people who are trying to go to a show and some of them are saying "I am buying a financial instrument that will have value that fluctuates with the market and it's basically an option. If I don't invest my options by the time

that the event plays off by the vesting date, then I don't get any value out of this financial instrument". That creates a very interesting dynamic that greatly complicates a lot of business plans. Cause we're not supposed to be running a trading environment, but here we are. So, I think how it affected us though, especially when it comes to things like fraud and abuse, it's in many ways their response. If you're thinking about this as a futures market, as an options market and you have people who are basically looking for holes in that market. If they can figure out ways of getting these financial instruments for cheap and at the expense of other people in the market that actually bolsters that because there's a limited inventory. So, if a lot of demand for that inventory and they can block everybody else out from getting it and they can corner the market on that inventory, then they're going to be able to turn around and move it very, very rapidly. So, as our business becomes more digital, we have to protect it. We have to protect, that we don't allow individual bad actors to soak up all the inventory and make a huge profit off of it. Instead, allow fans and that's the genesis of the verified fan program. It's also why I do what I'm doing - protecting against these bad actors. So, in many ways this is a risk, it's an escalating arms war between people who are trying to constantly break our systems and us trying to protect our systems and to protect the fan.

Interviewer: 20:30 Yeah. And do you think similar problems are going to occur with other companies, in bigger or smaller scale, when they will be integrating AI and adjusting their business model? Like, you know, as you said, you worked in the medical field, you have a perspective over the financial field. So, let's say, me as a company, I'm trying to adopt AI, what problems can there arise for me

Mark Roden: 21:11 Well the base problem is going to be data cleanliness. Okay, actually that's not true. The biggest problem is knowing what the hell you want. And that's a management problem. Whether or not you're using AI or you're doing something else - if you don't have some measuring stick that says "I have to achieve this goal or I have to solve this problem or I have to do this thing in order to meet my quarterly goals or yearly goals, five year goals or whatever the hell goals", you don't have clarity on what it is you need to do and what you want to do, there's no amount of AI is going to help that. A lot people are doing AI because they see everybody else's doing AI and they're like "if they're doing it, I better do it". But if you don't know why you're doing it, then it's a lot of wasted money. There are a lot of consultants who are super excited to spend that money, but it doesn't necessarily help you. If you decide that you're going to do AI, then the next question would be "what are your expectations out of it?" It's not a one and done solution, it's not a fire and forget solution and it depends on what you're trying to use it for. In our case, in the abuse and fraud cases, we have an adversarial relationship with the very small percentage of our users. And that relationship is an escalating arms war. People are constantly trying to game us and we're constantly trying to prevent them from doing that. That requires a level of focus on preventing the gamesmanship. But it also, accepts that we are not going to win all the battles. When people are used to dealing with very deterministic computer programs then you either do this thing or don't do this thing. Now you're in shades of gray. Maybe it'll work some percent of the time, maybe it won't. Maybe the reason it won't is just because somebody is actively trying to prevent it from working as opposed to it just as a bug in the system.

Interviewer: 23:24 Yeah. And that brings to another question. Throughout the last decades, last century, new technologies were arising - the phone, long distance calling, radio and later internet, cell phones, this and that. The history has shown that the new technologies are mostly hard to get accepted and adopted by the market. There are a lot of authors that would claim that there was a certain resistance, by either big companies or the market, the customers to accept new technologies. Do you think AI has certain resistance when it comes to getting adopted?

Mark Roden: 24:22 I actually think it's the opposite with respect to AI. I think that more companies should resist. As I was saying before, I see too many people who are "well I'm going to do it". Is that the right way to solve your problem? Is that a real understanding of the solution that you need? I think a good example of this might be Facebook trying to police their content and trying to use AI tools to do that. Now Facebook's AI teams are amazing. They are amazing. The fact that you can get real-time translations of, you know, Turkish to English and then to Russian and that those make sense is amazing. The fact that those translations are keeping up with zeitgeists - new words that are invented by 14-year-old girls to talk about stuff with each other, that's amazing. I think where they were not prepared, and hopefully they will be, is the nature of adversarial network of many of the people who are using their systems. People are actively trying to break the systems for their own political or commercial purposes. If you try to deploy AI against that to try to scale it out, it's going be really hard. There is no AI yet that is that good at understanding human nature or subtlety. I mean even people have a hard time understanding other people on just pure text. The AIs are going to have a very hard time. Like one of the rules that was floated to Facebook was "well just

hire a bunch of editors" and their response was "nah, we can do this with AI". Well you could or you could literally hire 5,000 human editors who know the language, who know what's going on and can actually look at the content and provide the direction to your AI. Like exactly the same way that I'm using my analysts right now. It provides them direction towards where the fraud is. I don't know if Facebook is doing that internally, but I desperately hope that they are. Because I hope that they're keeping up with this and understand that "we'll just slap some natural language processing on it" is not enough.

Interviewer: 27:03 Yeah. Of course. And in that sense, do you think that AI is kind of changing the world that we live in?

Mark Roden: 27:14 I think it has changed the world we live in. You know the Stanford self-driving car? It's fantastic! You know them?

Interviewer: 27:28 Yeah. There's Stanford, then there is Tesla, there's Google, there is like a lot of institutions that are trying to build it now.

Mark Roden: 27:32 No no no. The self-driving car contest in the late nineties.

Interviewer: 27:36 Oh no, no I haven't heard of it.

Mark Roden: 27:39 Yeah. So, this guy Tom Mitchell, with Carnegie Mellon, he knew a bunch of other guys, they were all involved in this self-driving car thing and they wanted to have a car that self-drives it up a mountain and comes back down. And they succeeded in the 90s. Tesla is trying to do it at scale now and it's extremely impressive. But this has been a thing that has been ongoing for a very long time. Same thing with neuro nets, right? Like the deep learning. When do you think those came about? What do you think the first known is?

Interviewer: 28:15 Well those have been developing for a pretty long time now. I think the first Deep Learning ideas was came out in like 80s.

Mark Roden: 28:29 60s. Well, Deep learning is 2013. Neural nets keep going through cycles. Perceptron networks are very old. AI has absolutely changed our society. It's not even a question to me. The way we get most of our content now, the way that we interact with one another, these human networks and the strength of the connections are being enforced and policed through Artificial Intelligence. And I don't even mean just like Facebook and Instagram. I mean like if you have cops deploying facial recognition technology in urban areas for finding people. There's an Artificial Intelligence now predicting the relationship that a policeman will have with the suspect, whether or not they will even have a relationship. That's a thing that 30 years ago we'd say "no, that's just ridiculous". But that's the point in London, you know. In San Francisco, they just passed legislation to not have that.

Interviewer: 29:40 Yeah. How do you think acceptance and adoption of AI will affect the future job places? So, you came to work, what's happening?

Mark Roden: 30:16 It depends on which industry you're talking about. I think some industries are going to be absolutely impacted. The one that a lot of people talking about is driving. Also, Boston robotics groups, those guys building robots that can do different jobs. Amazon unveiling robots that can do most of the factory worker jobs. So now, we've got jobs that AIs can do and there are other questions than before, questions like where are going to do robot maintenance. Most of where I think human endeavors are going to shift is creative rather

than the repetitive. But at the same time, I do think there's going to be a backlash and I think that the backlash is going to be around, the way that a lot of AIs interact with humans. Think about a recommender system, a recommender system learns your, predilections and then it tries to surface other things to you that based on what it is you want it. It's trying to accomplish the function of a concierge, it's not an actual human interaction. You're not actually making a friend. This company now has all this data about you that a friend might also know, but instead of being judicious about how they use it, the company is using entirely for their own purposes. There's very little in the way of give and take there, right? In order for those relationships to work, there has to be a lot of give and take. In our case at TicketMaster, a fan has to want to interact with us. They have to get something out of it. A big part of the deal for us is we want to make a good fan experience. That is back and forth, right? The fan isn't going to trust us with their data and because of GDPR and CCPA, they don't have to trust us with their data. If they're not going to get anything out of it, if they're not going to gain a benefit, we're not going to be able to say "hey, this person is actually a fan", or "this person actually likes this group" and so they deserve to have a ticket as opposed to this person. So, that's a benefit that a person can see by having a relationship with a corporation where data is taken. But like if T-Mobile takes my data and I don't see any benefit from that, I get nothing from that. Yet they get to use it for AI to shout more ads, to me to try to sell me more stuff to get more stuff out of me. It's intrusive. It's not a relationship T-Mobile sells it to advertisers. These advertisers now want me to do something with them and I have a relationship with the advertiser. But now essentially the equivalent of like a the stranger walking up to you on the street and being like "hey, look what I got" and it turns out

it's all the stuff you want and it's in there and it's like, "how did you know that?" This is very scary. And then you turn around and the guy next to you goes "what about this stuff?" and you're like, all right, am I allowed to know what that guy wants.

Interviewer: 33:58 Yeah, of course, I know what you mean. So, returning just a bit back on what you were saying. So partially I would say there is a resistance to adopting AI from regular workers who are say "oh my God, AI is going to come and replace me, take over my job, the robots are coming and then I'm gonna be left jobless", right. What's your vision on it? Like there are a lot of people who are saying that, you know, AI is going to automate everything and then 40-50% of the job market will be gone because the AI and robots have taken it. The others are saying that the percentage is much lower. Third ones are saying that AI will never take on complicated tasks. It will take on low value-added tasks, but the more complicated stuff is going to be left for humans. What's your vision of it?

Mark Roden: 35:04 There is a lot of rampant speculation right now and a lot of people don't know and there's a lot of uncertainty and that uncertainty generates opportunity for those who are willing to prey on other people's fears. I'm not particularly fearful, maybe I should be, but I'm not particularly fearful that suddenly all of the jobs are going to disappear. I think that we have gone through similar upheavals in the past with other technologies. What I have faith in is our ability as humans to come up with new and interesting ways to feed ourselves. We've become very good at that. Also, AI is not yet creative. AI has a lot of things about it that can appear to be very creative. You can make generative constructs, right? Like if you feed Beethoven's works to AI.... There was

a thing a couple of years back where these researchers fed a bunch of Beethoven's works to a regenerative AI and AI would just come up with new versions of the work. Then they would have classical music listeners sit down and listen and they would say "some of these things are obscure recordings and some of them are AI. Tell us if you can figure it out". The response was that nobody could tell the difference between the obscure ones and the degenerative ones. When you think about it on the surface, that sounds great. But then you think about whether these are obscure because they're just not that good. The AI is just not that good and it's generating something that's not that good. That's why we don't know about those Beethoven recordings, because nobody paid attention to them, because they were kind of mediocre. Or maybe classical music fans are not as good as they think they are at being discerning about things. Is AI a truly a generative thing? Did truly come up with something new and interesting? And how long did it take for us to do that, to make an AI that has become a composer. And if you asked it to draw something, it's like "no, sorry dude, I process signals and I come up with new signals. I don't work in image, I don't walk, I don't dance, I don't come up with witty things to say in conversations". Each one of those things can be different functions, different AIs and they all mimic creativity, but they are not creative. They're staying within the boundaries of what they've been told to create.

Interviewer: 38:24 You're saying that the humans will keep the creativity, but everything else, which is repeatable can be automated. The AI will take over that.

Mark Roden: 38:39 It depends. There's is going to be a couple of things that are going to go into that. One is how cheap are the robots

compared to the humans. Like the first steam engine was invented by the ancient Greeks, but they never used it because it was more expensive than using slaves. So, is generating all these robots and all of these AIs cheaper or not so cheap compared to human labor? I don't know the answer to that. The other thing that is going to happen is we as a society are going to have to address income inequality. If you are going to pool all of the knowledge and have this group of people, a group of technocrats who created the AI and they are the 0.01% who truly understand how all this stuff works and everyone else has a vague understandings, then you'll have that 0.01% controlling all the stuff that's going on. That's a pretty vast inequality. But that's where all the money goes. Then there's going to be serious problems with having the money to buy a robot to do all the stuff that you want it to do, because you don't have any income because a robot took your job. So, in order to have some kind of maintainable cycle, if this will be the wave of the future. If everybody had C-3PO or whatever man servant at their home, they have to pay for it. They have to have the money to repair it. They have to have the money to maintain it. That all requires money and that stuff's not cheap. How is that going to happen if nobody has a job.

Interviewer: 40:41 Big companies, would have the money for that. No?

Mark Roden: 40:49 Yeah but for how long? If the big companies' bottom line depends on people buying something from them and everybody lays off all their workers because they replaced it with AI, then who's buying stuff.

Interviewer: 41:02 Yeah. So, it's like a double-edged sword right.

Mark Roden: 41:07 Yeah. If 50% of the people go out of jobs, then there's nobody to maintain and AIs running.

Interviewer: 41:14 Your market is suddenly becoming smaller too.

Mark Roden: 41:18 Yeah. Like who can afford it. Oh, we'll use the Moore's law and we'll make it all cheaper because of Moore's law. Well then who's going to build it because of Moore's law? The only reason why we can afford iPhones right now is because we are willing to overlook the vast amount of human capital that is being spent on building those damn things.

Interviewer: 41:37 I get what you're saying. Now, I have a more personal question. I saw your profile on LinkedIn. I saw that your Bachelor's, your Masters and later your PhD has a lot to do with biomedical engineering and now you're working for TicketMaster as a data specialist. How is biomedical engineering helping you understand AI better and working in this field?

Mark Roden: 42:28 Biomedical Engineering.. To get that degree I did a lot of stuff. On the face of it, I had to write a dissertation as you and the dissertation involved science. I gathered data from six radiologists about the ability to detect things. Then I had invented an algorithm to reduce noise in mammography images. I had to have all that data put together and I had to design the experiment. See if a majority of radiologists can see a dot, then we can arguably say that the noise reduction algorithm didn't do anything. If they see a dot that wasn't there in the first place then the noise reduction was actually additive and that's a problem. That was what my dissertation work was on. Performing an experiment and gathering data and demonstrating that dose reduction can be accomplished in mammography. That involves a lot of mathematics. It involves a lot of experiment design, it involves a lot of data crunching because images are not small and it involved a lot of physics. A lot of the diffusion

equations turned out to be relatively... They tend to pop up all over the place. Calculus is pretty pervasive. I think the underlying thought in your question is more why did I stop doing that and working in ticketing.

Interviewer: 44:12 Well I wanted to understand how the biomedical knowledge is helping you in ticketing?

Mark Roden: 44:16 Well the other reason why it's helping me is because the American healthcare system is so incredibly screwed up that it is an incredible relief to go to work every day and build a product that people actually want and are willing to pay for. Working in the health care, the money questions around it are just so insane. The idea that I could build a great system that would save a whole bunch of people's lives but it is only going to deployed to the people who can afford it... it just so morally questionable that I just I can't handle it. I worked in ad tech right after I left biomedical engineering. I worked in ad tech for a little while and it was the same thing. It was just like, oh my God, what am I doing? And going to Ticketmaster was a great relief because I had perspectives on these other industries and I can say "look, I am doing a thing. People come to us to get what we have. A lot of times people complain about it and they go to other places and I get that. You know, you can always complain about a wide variety of stuff and TicketMaster has a whole history of being the bad guy. But you know, my job is to make sure that the bad guys are out and they can't steal people's stuff. It feels good to be able to block bad people from stealing. You can't get any crisper in terms of moral mission than that. Like I have made a mammography algorithm that was going to reduce dose by 25% in mammograms, which is a big deal because there's a lot of radiation that's given in those things. I don't know if you've ever talked with your female relatives

about mammograms, but they're uncomfortable to put them out. Yet if you don't do them, you run some serious healthcare risks and it's a big health care issue. The companies I talked to, were like "oh, that's very interesting" and then they never did anything about it. So would have to form my own company to try to get somebody to buy a noise reduction algorithm and go around trying to force this on established set of market players who seem to be totally uninterested in helping people, well at least the way that I'm proposing to do. I would have to try to crack that by figuring out who I have to talk to get this into actual product. All of that was very frustrating. I am not out of biomedical engineering because I find the problem space to be challenging, but the business around it is just repugnant right now. Nobody's ever died because they didn't get a ticket.

Interviewer: 47:45 True. True. Now working in TicketMaster, which is a big company like, how many people work there? Different sources give different numbers. I want to understand the scope.

Mark Roden: 48:11 You’re asking the wrong guy. I know that we're in like 40 something countries, we have offices all over the place. The main countries I deal with is United States, Canada, Mexico, Australia, New Zealand, occasionally the UK and Ireland.

Interviewer: 48:35 And how many people work in ticket master?

Mark Roden: 48:44 Thousands, easily. Beyond that I don't.

Interviewer: 48:50 And in your specific department? How many people deal with fraud?

Mark Roden:	49:00	I can't give you an exact number. But we have tens of people working on that. It's a nontrivial problem and I am not counting the analysts in that sense.
Interviewer:	49:18	So do I get right, that you can't do your job without the analysts?
Mark Roden:	49:25	I cannot. They are specialists and they are very good at what they do.
Interviewer:	49:32	Right. Okay. I think I got the answers to most of the questions I wanted to ask. Do have any questions to me? I'll be happy to answer them.
Mark Roden:	49:48	Yes, I'm curious where you're going with this? It's interesting to me because AI is was what we called it in the late 90s and then it became machine learning and data science and everybody's throwing different statistics out and different versions of the same term. So why are you choosing the word AI and what are you looking to do with this?
Interviewer:	50:14	I guess the word AI is the word that a lot of people know. There is a lot of buzz going on around the word AI and a lot of the time that not actually being true. Like, you know, there are a lot of companies who are claiming that they do AI when in reality they don't. They're like "our AI powered" something, but you look at it and okay, there is some machine learning code in it, but it's not an AI as such, there is far more ads and buzz. It's a buzzword. So, I want to identify what really is AI, how is it coming, where is it going to, how is it going to affect our everyday life? Differentiate that from the buzz that surround the term and get the real academic picture. The different perspectives of the industry versus academy. Industry is claiming that, is already helping them, while the academic authors would say that an AI

doesn't exist right now. The others would say, yes, it exists but it's the beginning stages right now. Third ones would claim that AI has already taken over. So, I want to try to find out what's the truth in all of this and how is that going to affect jobs and businesses of the future.

Mark Roden: 52:15 Fare point. What did you think of my whole market analysis there? What has your research uncovered?

Interviewer: 52:25 You know just two days ago I had an interview with a very wonderful security specialist from a big company here in LA. Basically what he was saying is that their company is just starting to adopt AI. His vision was that AI is gonna come and take over a lot of the stuff that people are doing. That is going to cause increase in unemployment. Yet companies need to embrace it. He was suggesting that whoever is not doing AI should start looking into it, creating teams that are dealing with AI. Companies need to understand what's going on, what can they replace. Anything that's repeatable, those types of jobs will be gone and replaced by robots. So, there are a lot of different perspectives on AI. I've read quite a number of papers on what will be happening that's where my interest comes from too. I mean like there is no single or even two or three different ideas of what's going to be happening. There's are just many people with many opinions of what's happening right now, what's going to be happening in future. The person that I was having an interview with prior to this, he was claiming that we're pretty much in the situation similar to Internet, when the Internet was just appearing. A lot of the companies didn't know about. When they found out about it some refused to adopt to the upcoming change and they're gone now. A lot of the people her heard the buzzword "Internet", but they didn't know what it really was. So yeah, your point of view is

certainly very interesting to me because you're having this mixed vision, I would say. I read books claiming different ideas, but what you're saying is a pretty mixed approach those. So yeah.

Mark Roden: 55:13 Oh, thank you. I'm glad it's interesting. Have you studied McDonald's?

Interviewer: 55:20 From the point of AI? No.

Mark Roden: 55:24 Well, from the point of replacing human workers.

Interviewer: 55:28 No I haven't looked into it.

Mark Roden: 55:31 They replaced a lot of their cash registers with touch screens. You can look at them in terms of technology acceptance. You talk to the franchisees, maybe not too they're excited by having those cash registers and maybe they love them. I don't know. It will be a very interesting thing to see as an introductory case of what it would mean as automation. This is not AI but this automation which replaces jobs that we considered previously to be the realm of humans.

Interviewer: 56:25 I'll tell you something, when I was a kid, I loved superheroes and Spiderman particularly. When I grew up with older, I started loving Iron Man. Why I started liking Iron Man is because, the whole Jarvis system. Tony Stark walking and being like "Hey Jarvis, show me this, put this together and dhow me the results" and do this and that. Do you think in future, people will be just walking into their office and being like "Hey, Jarvis, show me what's going on and then do this and do that" and there'll be a voice being saying "certainly sir" and doing it?

Mark Roden: 57:08 Is that any different than opening up Outlook, and looking at your calendar?

Interviewer: 57:12 Yes. It's talking and it's understanding what you're saying and it does more complicated tasks.

Mark Roden: 57:20 Well, what you have there, you have an interface-to-data. There's a book written in the late nineties, and it's a software engineering book and it talks about patterns in software design. One of the most common patterns is model view controller. So model is the data, view is the way that you look at it, and the controller is how you act upon it. You're proposing that we have data, that's similar, use my voice and hands to interact with it through some sort of holographic projector. I am saying you can do that. Or you can look at a screen, use a mouse and you can still interact with the data. What you have gained is the voice as a convenience mechanism of not having to be on a computer and not having to use a contrived interface. But you actually lose specificity because what happens with people with accents? What happens when people are dealing with "oh, I'm hung over, my voice sounds weird today is Jarvis gonna recognize me" or "I lost my voice because I'm sick". All of these sorts of things that we as humans are very used to dealing with that level of interaction, that's what we mean when we say AI is not there. It's got to deal with all that. Apple guys and the Google guys with Alexa and Siri and all this other stuff, they're gathering so much voice data, but the other day was having a conversation with a South African who couldn't get Alexa to do anything for him. It was just all over the place. Alexa was like "I have no idea what you're saying". But with the mouse you could do the exact same. You can see it on your screen. That's my calendar. It's right there. I guess what I'm saying is that there's the Hollywood

vision of what AI is going to do and there's the abstraction of: there's data, there's the view and there's the control of the data. Those can be relatively simplistic things that can still affect our lives, they don't need to have like a whizzbang interface. All the security stuff that I deal with, all of the credit card stuff that I deal with, it's like looking at the Matrix. It's just like numbers in columns and stuff flying past and sometimes it's like "oh, that line's bad". You have to pick it out but how do you find that needle in that haystack? That's the AI, that's the surfacing of it. That's the tricky part. But then how do you view it? Do you need a Jarvis or the screen? You know what I mean?

Interviewer: 01:00:26 Yeah, yeah. You know, about a month ago I came across this company, I don't remember what was it called. Their software was converting numbers into natural language text. So, you were uploading massive amounts of data in it and it would be generating a report back saying "oh, this, increased this, this decreased". It was actually making up like English sentences all correctly. So, text instead of numbers.

Mark Roden: 01:01:09 Well that's a view on the data. And it's fairly complicated view on the data. NLP is not trivial.

Interviewer: 01:01:21 Haha, yes, well we'll see what's happening with them.

Mark Roden: 01:01:24 Absolutely.

Interviewer: 01:01:27 Alright. Well, it was a pleasure talking with you. Honestly, it's a pleasure. I hope we'll stay in touch as much as possible. Ticketmaster is such an interesting case for me. It's a big company which is doing a lot of good things. It's there for the customers and it's about making people happy and you guys are one of the perfect examples of how you implemented AI

		in different departments. Thank you again for today's conversation. If you'll have questions for me, feel free to write me.
Mark Roden:	01:03:28	If you find anything interesting that you think "Hey, I that guy I talked to one time might be interested in this", let me know. And I'm always interested in keeping abreast of what people are saying.
Interviewer:	01:03:38	Great. Thank you again and I hope you have a good day.
Mark Roden:	01:03:43	Thank you. Have a good weekend.