
Artificial intelligence applications in corporate finance

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Table of contents

Acknowledgements.....	iii
Table of contents	iv
List of figures.....	vii
List of tables.....	ix
List of abbreviations	x
1 Introduction	1
2 Artificial Intelligence Introduction	3
2.1 Artificial Intelligence definition	3
2.2 Artificial Intelligence timeline and main past contributions.....	4
2.3 Sets of methods and technique underlying Artificial Intelligence in the financial domain	6
2.4 Quick classification of the techniques into categories of problems.....	9
2.5 Machine learning	10
2.6 Artificial Intelligence and human differences.....	12
3 Artificial Intelligence market and Governmental funding	15
3.1 Growth of the governments funding and their disparities in term of expected economic gains	15
3.2 Sector shift and development.....	19
3.3 Key role of the private sector and the disparities of gains	20
4 Artificial Intelligence in finance	23
4.1 Main Artificial Intelligence technologies used in finance	23
4.2 Example and explanation of AI's current usages in finance.....	24
5 Corporate Finance.....	29
5.1 Corporate Finance definition	29
5.2 Situational analysis of AI technologies inside the corporate finance	30
5.2.1 Studies and facts of the current utilisation of AI inside the corporate finance.....	30
5.2.1.1 Studies and facts	30
5.2.1.2 Summary of the AI situational analysis inside the corporate finance through studies and facts	32
5.2.2 Current utilisation of AI inside the corporate finance through experts view and knowledge	32
5.2.2.1 Expert view and knowledge	32
5.2.2.2 Summary of the AI situational analysis inside corporate finance through expert knowledge	35
5.2.3 Current utilisation of AI inside corporate finance through example.....	37
5.2.3.1 Example of AI inside corporate finance:	37
5.2.3.2 Summary of the AI situational analysis inside corporate finance through example.....	39
5.3 Future utilisation of AI inside the corporate finance through studies and expert insights.....	39
5.3.1 Insights from papers, reports and experts	39
5.3.2 Summary of AI expectations and beliefs inside the corporate finance	44
6 Survey on the situational analysis and expectations of AI with a special focus on corporate finance	47
6.1 Introduction to the survey.....	47

6.1.1	Methodology of the survey	47
6.1.2	Interpretation of the survey	48
6.1.3	Bias of the survey	49
6.2	Results of the survey.....	50
6.2.1	The population interrogated and their AI knowledge	50
6.2.2	AI in the global world.....	51
6.2.3	The AI and the financial domain	55
6.2.4	AI and corporate finance.....	57
6.2.4.1	Current usage.....	58
6.2.4.2	Expectation.....	59
7	The ethics of AI in corporate finance studied through Environmental, Social and Governance aspects	63
7.1	Introduction to ethics and ESG.....	63
7.2	Environmental aspect	65
7.3	Social aspects.....	65
7.4	Governance aspects	66
8	Bias of the master thesis.....	69
9	Conclusion.....	71
9.1	AI in corporate finance	71
9.2	AI in finance.....	73
9.3	AI in the world and its economic impact.....	73
9.4	What consequences?.....	74
10	Bibliography	77
11	Appendix	I
11.1	Current landscape of AI strategies.....	I
11.2	Most active corporate venture capital groups	II
11.3	Survey analysis:.....	III
11.3.1	Gender distribution	III
11.3.2	Age distribution	III
11.3.3	Country distribution.....	IV
11.3.4	Are organizations using the AI inside their processes?.....	V
11.3.5	Are people using the AI?	V
11.3.6	Are people afraid to lose their jobs?	VI
11.3.7	Are people agree with the job qualification shift towards more computing and cognitive tasks?	VI
11.3.8	Are people ready to follow courses?.....	VII
11.3.9	Are people eager for a public job transition plan?	VII
11.3.10	Do people believe the AI is used in finance?.....	VIII
11.3.11	Would people with financial knowledge use the AI in the future?.....	VIII
11.3.12	Professionals know about the current AI usage.....	IX
11.3.13	Do professional know other usage than chatbots and robot-adviser?.....	IX

11.3.14	Professionals would like to use more extensively the AI in the future.....	X
11.4	The survey and its questions.....	XI
Executive Summary	I

List of figures

Figure 1: Techniques for analysis of financial applications	6
Figure 2: Structure of Artificial Neurons.....	8
Figure 3: Three layer architecture of ANN.....	8
Figure 4: Number of AI papers on scopus by subcategory (1998-2017)	11
Figure 5: Journal articles mentionning "deep learning" or "deep neural network" by nation .	12
Figure 6: AI annual potential value creation across 19 industries	19
Figure 7: Relative activity focus by region and AI research sector in 2000.....	19
Figure 8: Relative activity focus by region and AI research sector in 2017.....	20
Figure 9: Corporate Venture Capital funding to AI startups (2013-2018).....	21
Figure 10: Card Fraud Worldwide (1993 - 2014).....	25
Figure 11: Card Fraud Worldwide per \$100 of Card Volume.....	26
Figure 12: Working skills evolution and the role of the employer	41
Figure 13: Job distribution.....	51
Figure 14: The AI is a hot topic	51
Figure 15: Reasons behind the AI utilization inside the day-to-day lives of the global panel .	52
Figure 16: Reasons behind the AI utilization inside the day-to-day lives of the professional .	53
Figure 17: Willingness to use the AI.....	54
Figure 18: Usage of the AI and the finance departments	55
Figure 19: AI impacts on the employment in finance according to the financial panel.....	56
Figure 20: AI impacts on the employment in finance according to the non-financial panel....	56
Figure 21: corporate finance knwoledge of the professional panel	57
Figure 22: corporate finance knwoledge of the global panel.....	57
Figure 23: usage of the AI and the corporate finance departments.....	58
Figure 24: reasons behind the utilization of the AI inside organizations	59
Figure 25: expected usage of the AI and the corporate finance departments.....	60
Figure 26: reasons behind the expected utilization of the AI inside organizations	60
Figure 27: the AI as a human tool.....	61
Figure 28: employment expectations within the corporate finance	61
Figure 29: expectations of tasks replaced by the AI within the corporate finance	62
Figure 30: Annually published papers on scopus by region (1998-2017).....	69
Figure 31: current landscape of AI strategies	I

Figure 32: Most active Corporate Venture Capital groups in AI (2018)	II
Figure 33: Gender distribution	III
Figure 34: Age distribution.....	III
Figure 35: Are organizations using the AI inside their processes?	V
Figure 36: Are people using the AI?	V
Figure 37: Are people afraid to lose their jobs?	VI
Figure 38: Are people agree with the job qualification shift towards more computing and cognitive tasks?	VI
Figure 39: Are people ready to follow courses?	VII
Figure 40: Are people eager for a public job transition plan?	VII
Figure 41: Do people believe the AI is used in finance?μ.....	VIII
Figure 42: Would people with financial knowledge use the AI in the future?	VIII
Figure 43: Professionals know about the current AI usage	IX
Figure 44: Do professional know other usage than chatbots and robot-adviser?	IX
Figure 45: Professionals would like to use more extensively the AI in the future	X

List of tables

Table 1: Funding strategies from government in AI	17
Table 2: The AI strategies Heat Map	17
Table 3: Willingness to use the AI	54
Table 4: Example of Environmental, Societal and Governance issues	64
Table 5: Country distribution.....	IV

List of abbreviations

AI	Artificial Intelligence
ANN	Artificial Neural Network
CEO	Chief executive officer
CFO	Chief financial officer
COO	Chief operating officer
CVC	Corporate venture capital
GDP	Gross domestic product
ESG	Environmental, social and governance

1 Introduction

This master thesis discusses Artificial Intelligence inside corporate finance with the current usages and its prospects in a near future. It offers a viewpoint on this subject through information retrieved from papers, reports and experts and an evolving survey using qualitative and quantitative analysis.

This thesis talks about topics that impact everyone for two reasons.

Firstly, corporate finance touches everyone as most decisions inside organisations have financial consequences. Should the price of the goods be reduced or increased? What about the volumes? This worker is not productive, is it time to replace him? Client X¹ is not able to pay, is it reasonable to deal with him? All of these small decisions are related to corporate finance and demonstrate how important this particular field is.

Secondly, Artificial Intelligence impacts or will impact the life of everybody. Nowadays, AI is everywhere. People are using it without even knowing it when using their smartphone, searching on the Internet, but also when driving, working, or being on social networks, among others. Indeed, as astonishing as it seems, Artificial Intelligence is behind all those daily utilizations. Moreover, AI is researched all over the world. The amount of papers broaching topics related to Artificial Intelligence and machine learning is growing exponentially. The research in AI helps people and organizations in various fields, from agriculture to finance with an expected market value counted in trillions of dollars.

Before going into the details of the developed topic, there is a real need of understanding what Artificial Intelligence really is. Chapter 2 starts by defining Artificial Intelligence and its timeline to discover previous achievements. It is followed with the techniques and their specifics. Then, the most developed AI mechanism, machine learning, is explained. Finally, the human differences in regards to AI are outlined.

Chapter 3 is about government funding and the expected economic disparities between countries. Then, the private sector is considered through its investments and public impacts.

Next, Chapter 4 focuses on Artificial Intelligence in finance. This fourth Chapter begins with the main Artificial Intelligence techniques used. Then, the financial core businesses and the

¹ The Client X means any customer

current Artificial Intelligence usages are briefly explained and illustrated with concrete examples.

Chapter 5 concentrates on AI inside corporate finance. It starts with a complete definition of corporate finance, which is followed by a situational analysis of AI inside the domain divided into 3 sections: the first subdivision displays numbers and facts from studies and reports, the second one focuses on the knowledge and views of experts and the last subpart highlights the real impacts through concrete examples. This subdivision is followed by expectations and beliefs about the future of AI in corporate finance according to papers, reports and experts.

Chapter 6 goes on with a qualitative and quantitative survey led among 167 respondents. It starts with a description of the methodology and the statistical tools employed to confirm the accurate utilisation. Then, the results are divided into 3 different sections to follow the same division as the previous chapters: the first section discusses the overall AI and its global impacts, the second section looks into Artificial Intelligence inside the financial domain, and finally, the last part focuses on the situational analysis and expectations of AI within corporate finance.

Then, ethics is approached through Environmental, Social and Governance aspects inside Chapter 7. This is detailed in accordance with the ESG concept in order to follow a corporate valuation method advised by the CFA Institute.

Chapter 8 is on the bias of the master thesis.

To conclude, Chapter 9 compares the results generated by the survey and the information retrieved from papers, reports and experts. It enables to get perfect views on the current situational analysis and on the future expectations of AI in finance and, more precisely, in corporate finance.

2 *Artificial Intelligence Introduction*

2.1 *Artificial Intelligence definition*

To understand correctly what Artificial Intelligence is, we use four definitions coming from different sources and different periods.

First of all, Artificial Intelligence has been defined by Marvin Minsky, one of the pioneers, as “the science of machines, which carry out tasks requiring intelligence when performed by humans” (Minsky, 1968; Richard Pastryk).

Then, John McCarthy another pioneer has defined it as “the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable.” John McCarthy also added that Artificial Intelligence is not only about simulating human intelligence as we are able to learn by simply observing our own methods. (McCarthy, 2007)

Additionally in a report from Research and Markets: “Artificial Intelligence (AI) represents machine-based intelligence, typically manifest in "cognitive" functions that humans associate with other human minds. There are a range of different technologies involved in AI including Machine Learning, Natural Language Processing, Deep Learning, and more. Cognitive Computing involves self-learning systems that use data mining, pattern recognition and natural language processing to mimic the way the human brain works”. (Research and Markets, 2017)

Finally, the Oxford Dictionary defines Artificial Intelligence (AI) as “the theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages” (Oxford, 2019).

The pioneers, Marvin Minsky and John McCarthy, have quite similar definitions. From their definitions we can bring to light Artificial Intelligence as “the sciences of machines and engineering which carry out tasks requiring intelligence when performed by humans, without being limited to human Intelligence simulation.”

The two last definitions, from the report of Research and Markets and the Oxford Dictionary, are based on the pioneers' vision and add components with more concrete technologies and human abilities.

In conclusion, Artificial Intelligence can be defined as “the sciences of machines and engineering which carry out tasks requiring intelligence when performed by humans, without being limited to human Intelligence simulation. There are ranges of different technologies involved in Artificial Intelligence including machine learning, natural languages processing, deep learning and so on. Those technologies permit self-learning systems, perception, speech recognition, decision-making and translation between languages.”

2.2 Artificial Intelligence timeline and main past contributions

Before going further, here is a brief history of the researched topic.

Researchers started to work on Artificial Intelligence after World War 2. In 1947, Alan Turing, an English mathematician, gave the first lecture about what is currently described as Artificial Intelligence. He thought it was better to research programming computer instead of building machines. (McCarthy, 2007)

In 1950, Alan Turing created the “Turing Test”. This test argues that a machine is intelligent if and only if it can pretend to be human to a knowledgeable observer (Turing). However, John Searle, an American philosopher, called to pay attention to this notion of intelligence after the only Turing Test success. According to him, this test is a necessary condition but not a sufficient one. He explained that one can use complex and adequate language without understanding it. (Richard Pastryk) In addition, Daniel Dennett's² book *Brainchildren* analyses all the types of Turing Test which have been carried out. He found out that some people easily believe a dumb program to be intelligent. (Daniel Dennett, 1998)

In 1956, a year to remember, the term ‘Artificial Intelligence’ was coined, which was followed by the well-known Dartmouth Summer Research Project on Artificial Intelligence organised by John McCarthy, Marvin Minsky and other scientists of all AI related fields. This event coincides with the real birth of the research in Artificial Intelligence. (Deloitte, 2017; Shi, 2011)

² Daniel Dennett is an American philosopher, writer, and cognitive scientist born in 1942.

In the late 1950s and early 1960s the research was focused on general problem solving and on search algorithms. This means that systems were following general rules to solve problems. In 1956, Allen Newell, J.C. Shaw and Herbert Simon built a General Problem Solver system. Marvin Minsky published a paper entitled “Steps Towards Artificial Intelligence” in 1961. Ross Quillian introduced the semantic network for knowledge representation in 1968. The International Joint Conferences on Artificial Intelligence (IJCAI) was founded in 1969. (Minsky, 1982; Shi, 2011)

In the early 1970s, natural language understanding and knowledge representation were the main topics inside Artificial Intelligence. In 1972, Terry Winograd detailed a program for understanding natural language. In 1974, Marvin Minsky developed an important knowledge representation theory. In 1977, the paper “The art of Artificial Intelligence: Themes and case studies in knowledge engineering” was published by Edward Freigenbaum. (Shi, 2011)

However between the mid 1970s and the mid 1990s, the funding for Artificial Research decreased and led to the ‘AI Winters’ due to the lack of developed computers and the enormous amount of data that needed processing. (Shaan, 2018)

In the late 1990s, Artificial Intelligence was in prosperous development with the help of several countries and plans such as the Fifth Generation Computer Systems project in Japan and the 863 National High-Tech Programs in China. In 1997, IBM’s Deep Blue computer defeated the reigning world chess champion. (Shaan, 2018; Shi, 2011)

In the early 2000s, the dotcom bubble led to the second funding crisis for Artificial Intelligence. (Shaan, 2018)

Nowadays, Artificial Intelligence and machine learning are progressing and they become extensively used in many areas. This has been made possible thanks to three areas: firstly, the exponential gains in computer processing power and storage ability; secondly, the explosion of data with the commonly named Big Data Revolution; and finally, the research in the techniques underlying Artificial Intelligence which have kept improving and led to an increasingly better accuracy of the forecast and classification. Those 3 technical reasons are combined with governmental and corporate decision plans as well as huge funding. At the top of the chain, there is China that aims to create a domestic market of \$150 billion and to be the world leading AI center with the help of Alibaba, Baidu and Tencent. Europe called for \$24 billion to be invested by 2020, which is combined with countries national willingness to extend their own markets. (McKinsey, 2018; Shaan, 2018; Shi, 2011)

All this research and progress have enabled Artificial Intelligence machines to assist and help humans. The next section is going through the sets of methods developed with a brief description of the main techniques underlying Artificial Intelligence.

2.3 *Sets of methods and technique underlying Artificial Intelligence in the financial domain*

During the past few years, in the area of finance, researchers aimed to help the sector through trends prediction, fraud detection, behaviour identification, portfolio management, risk management, stocks prediction, goals evaluation and so on. As a guide, they use three sets of methods (see Figure 1). (Bahrammirzaee, 2010; Dunis C. and al., 2016)

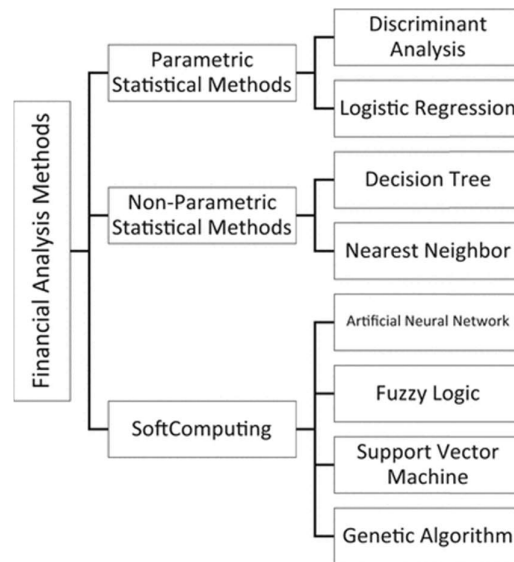


Figure 1: Techniques for analysis of financial applications

Source: Dunis C. and al. (2016)

Firstly, there is the parametric statistical method which is a division of statistics. The purpose is to integrate the data collected to draw inferences about the parameters. Inside this category, there are the discriminant analysis, which classifies the data according to occurring groups, and the logistic regression, which predicts the occurrence by modelling the relationships between dependent and independent variables. (Dunis C. and al., 2016)

Secondly, there is the non-parametric statistical methods which are less restricted in terms of assumptions than the parametric statistical methods mentioned above. Here, the data does not

have to fit a normal distribution. The two techniques used are included in what is called the decision tree, which is a classifier that supports the decision-making process, and the nearest neighbour, which means to find the nearest or closest point in a feature space. (Dunis C. and al., 2016)

Lastly, there is soft computing. This group is directly related to Artificial intelligence by being a set of methods based on human neurology. Inside this category, there are the techniques underlying Artificial Intelligence with the likes of the Artificial Neural Network, the Fuzzy Logic, the Support Vector Machine, the Genetic Algorithm and the Expert System. In order to get a better understanding, the five next paragraphs will explain their modus operandi. (Dunis C. and al., 2016)

The Artificial Neural Network mimicks the human brain and its biological neurons. The brain works as the following: each neuron is constituted with dendrites which are the small branches receiving the information from other cells (Aydogdu, 2018). Then, the axons carry the outputs and forward them to other neurons. When the strength of a signal is exceeding a particular value, an impulse is generated as an output. The Artificial Neural Networks use a similar approach by using at least a three-step layer. (Dunis C. and al., 2016)

The input layer distributes the input to the hidden layer that stores the input in the form of weighted interconnections. The Formula 2.1 gives the average input contained inside the hidden layer. (Dunis C. and al., 2016)

$$a = \sum_{i=0}^n xiwi \quad (2.1)$$

Where:

- x_i denotes the input to the neuron
- w_i denotes the weight of the neuron
- n denotes the number of inputs
- a denotes the average input

The representation of the weighted interconnections process is shown in Figure 2.

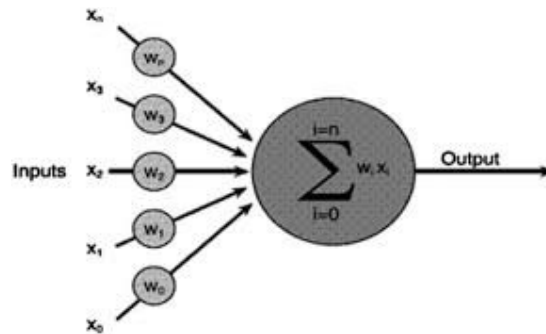


Figure 2: Structure of Artificial Neurons

Source: Dunis C. and al. (2016)

Finally, in Figure 3, those weighted interconnections are forwarded to the output layer.

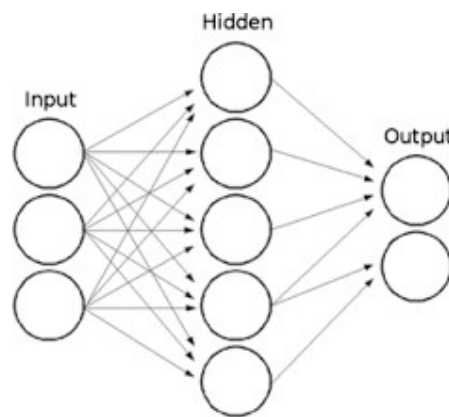


Figure 3: Three-layer architecture of ANN

Source: Christian Dunis & al. (2016)

The Fuzzy Logic is a computing method which deals with approximate values instead of exact and fixed reasoning. The values used are classified between 0 and 1 and are based on the degree of truth. Each rule in a fuzzy logic system follows an “if – then” structure. (Maeen and al., 2017)

The Support Vector Machine is related to learning algorithms used for data analysis and pattern recognition with the aim to classify and regress. It uses the concept of a hyperplane to define the boundaries of a decision that separate the objects. (Dunis C. and al., 2016)

The Genetic Algorithm mimics a natural process of selection. It permits to solve problems. It is mostly used in optimisation. To solve the problems, it uses techniques such as selection, mutation, inheritance operations and crossover. (Dunis C. and al., 2016)

The Expert System uses a knowledge-based system in order to find solutions and solve problems in a particular domain. It uses an inference engine to process the facts associated with a particular problem and associate them with a relevant knowledge base. It facilitates the decision-making process by being characterized as capable of reasoning, drawing conclusions and dealing with uncertainties. Hence, the Expert System is particularly useful in the financial domain. (Bahrammirzaee, 2010; Dunis C. and al., 2016)

After explaining briefly five of the main techniques underlying Artificial Intelligence it is essential to know that a Hybrid Intelligence System exists. This concept is really important as it combines the techniques that have been highlighted above. (Dunis C. and al., 2016)

The next section gives a quick classification of those techniques inside individual categories of problem analysis which helps to understand the way those techniques are really used. Machine learning, which involves teaching systems to think through technologies such as Artificial Neural Network, is explained in the section that follows the next one.

2.4 Quick classification of the techniques into categories of problems

There are many sub-fields inside Artificial Intelligence. The most important ones and most closely related to the financial domain are classified by problems analysis and briefly explained below.

Creation and use of knowledge bases through the so-called knowledge engineering and the expert systems tools use the accumulated knowledge to generate solutions to specific problems. It is generally used in a narrow domain. (Richard Pastryk)

Forecasting through AI is broadly used with several methodologies and techniques given that conventional methods such as analytical, statistical or econometric methods are inefficient for some groups of problems. The tools applied to mimic the brain are mostly the Artificial Neural Networks, inference systems based on Fuzzy Logic and hybrid combinations of different methods. (Richard Pastryk)

Natural Language processing and speech recognition are certainly the best known concepts among world population with the Virtual Assistant such as Siri and Google Home for example (Richard Pastryk).

Image classification and recognition do not work sufficiently with mathematical and statistical tools. To allow a good classification and recognition, which nearly matches the human brain, the artificial neural networks are the most suitable tool. (Richard Pastryk)

Grouping consists in identifying group structure of objects in a multidimensional space of features. The tools used are mainly the SOM neural network being a type of Artificial Neural Network and the genetic algorithms. (Richard Pastryk)

Robotics is replacing humans in tasks that are difficult and repetitive, hazardous, requiring exceptional precision and so on. Those robots are equipped with a bunch of Artificial Intelligence technologies for perception, problem solving, complex tasks and others. It is of great importance as there are great expectations. (Richard Pastryk)

In optimisation issues and research strategies, Artificial Intelligence completes the common mathematician tools by performing genetic algorithms and heuristic search strategies (Richard Pastryk).

The last group is the automatic conduct of an intelligent conversation with the chatterbots. The most advanced chatterbots are close to passing the Turing test (Richard Pastryk).

2.5 *Machine learning*

The goal of the pioneers like Marvin Minsky and John McCarthy is still on its way as they aimed to create autonomous Artificial Intelligence capable of advanced learning and exceeding the human intelligence. This objective leads to the machine learning systems which are the nearest to that ideal. Moreover, machine learning systems are broadly researched (see Figure 4) and used today as they are underpinning most of the automated systems. (Osoba and al., 2017; The National Science and Technology Council, 2016; Yoav Shoham and al., 2018)

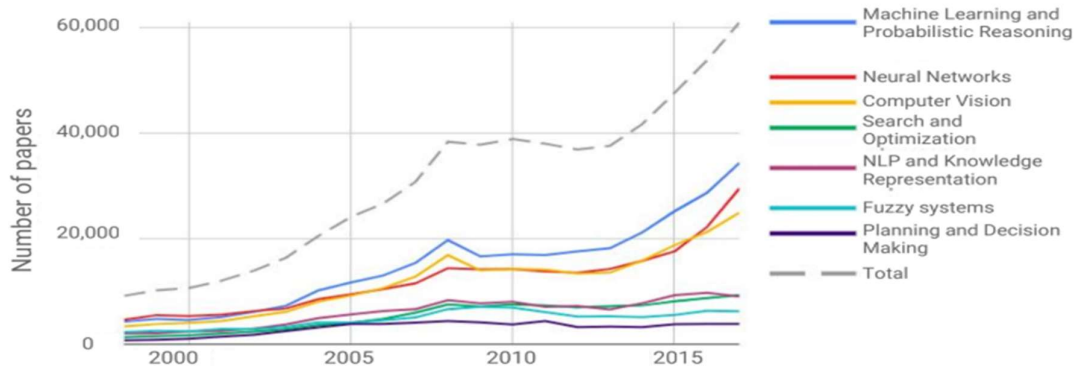


Figure 4: Number of AI papers on scopus by subcategory (1998-2017)

Source: Yoav Shoham and al. (2018)

The basic notion of a machine learning system is a machine that seeks to improve its performance on tasks realisation based on the observed data. Data is the real key ingredient of the machine learning system, as the system will predict an output from inputs without being explicitly programmed to do so. It is achieved by only focusing on a bunch of learning data. (Ghahramani, 2015; Perpète Lionel, 2007)

The main technique behind this learning tool is the Artificial Neural Networks. Nevertheless, there are other methodologies such as the Support Vector Machine. Moreover, the accuracy of predictions in data mining and machine learning can be improved through backward propagation inside the Artificial Neural Networks. (Ghahramani, 2015; Perpète Lionel, 2007; Rouse, 2015)

Deep Learning is a sub-division of Machine Learning, which consists of dividing the neural network into underlays. Deep in a machine learning corresponds to the addition of structures that allow catching complex and non-linear elements. This sub-division of machine learning combined with the current technologies leads to the best results in regards to the learning capabilities of machines. Hence, the number of publications exponentially increased. This demonstrates the importance of deep learning progresses (see Figure 5). (Ghahramani, 2015; Perpète Lionel, 2007; Deloitte, 2017; The National Science and Technology Council, 2016)

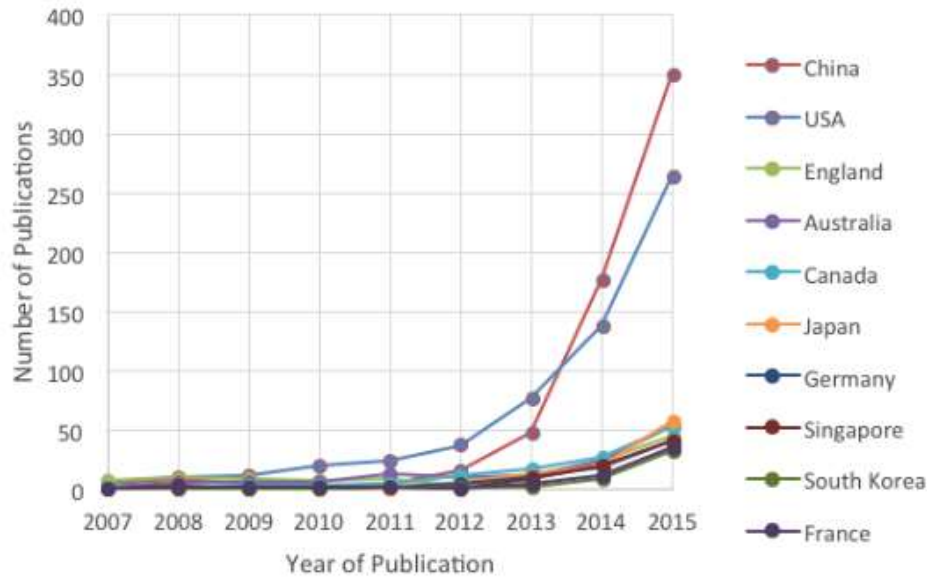


Figure 5: Journal articles mentioning "deep learning" or "deep neural network" by nation

Source: Yoav Shoham and al. (2018)

2.6 Artificial Intelligence and human differences

It is important to notice all the work and research still needed to reach the pioneers' ideal. The next parts will show why Artificial Intelligence systems still have not reached the pioneers' goals and why they are still different from the human brain.

First of all, to say that the machines are currently thinking like humans is inexact. The learning abilities and the accuracy of the machine are only depending on the amount of data collected. The more data there is to analyse and to collect, the better the accuracy. Moreover, the algorithms are reliable only if the data used to train the machine is really complete and representative of the reality of the deployed environment. Thus, in order to keep the data pertinent, the machines need human judgement. (Deloitte, 2017)

Furthermore, little progress has been made in the general Artificial Intelligence that is functioning well across numerous cognitive domains. Progress can be seen mostly regarding "narrow Artificial Intelligence" that performs well on specialized tasks. (The National Science and Technology Council, 2016)

Modern Artificial intelligence is based on computer statistical inferences. Consequently, it is not approximating or simulating what human intelligence is believed to be. (Deloitte, 2017)

According to researchers in both medical diagnosis and meteorology, there are three human deficiencies that lead to a superiority of computers in certain decision-making processes. The first two elements are described as human limitations. The human cannot remember everything on a long-term basis and does not have the ability to execute complex mathematical and logical calculations. Humans have to settle for limited reasoning and memory abilities. Moreover, machines and computers are never tired. Thus, they can work with the same correctness for days on end. The last deficiency is a cognitive bias in decision-making. It results from the reticence to revise a view following contradictory information. In addition, human thinking is most of the time not rational. It does not take into account all the pertinent information unlike what computers do with their statistical models. Furthermore, most human judgements rely on various mental rules that give plausible judgements. Those are often doubtful due to human feelings and biases. (Deloitte, 2017; Van Winkle, 2011)

However, the scientists who studied the brain found that the human brain is composed of two hemispheres. The left half is associated with analytic, quantitative functions and language-oriented thinking while the right half is associated with intuitive, creative and non-verbal thinking. Both sides are interacting together thanks to the corpus callosum. The biggest difference with the computer is located right there. The machine, contrary to humans, is only composed with the left hemisphere and is not able to be intuitive and creative. While the unknown process of interaction between both hemispheres will never be perfectly understood, Artificial Intelligence would not be as close to the human brain creativity as pioneers would expect it to be. (Doswell, 1986)

For now the psychologist and computer scientist Licklider was right to think that machines could complement the human intelligence. In 1960, he said humans and machines would work in a symbiosis to improve efficiency. In 2016, Barack Obama and the White House published an analysis confirming that most Artificial Intelligence systems would collaborate with humans to achieve optimal performances. (McKinsey, 2018; The National Science and Technology Council, 2016)

In conclusion, until today, no one has been able to perfectly understand the human brain and to insert a creative, intuitive and non-verbal thinking to Artificial Intelligence systems. Nonetheless, machines are performing better and better. As a consequence, their applications in the day-to-day life are relatively increasing. Moreover, the goal of a machine understanding the brain is stepping up as machine learning is far more developed than it was in the past

thanks to the big data revolution, the computer processing power, the storage ability and the improvement of the techniques underlying Artificial Intelligence. Furthermore, this fast-paced development is also permitted and enhanced by governmental and corporate decision plans underpinned with huge funding. (Deloitte, 2017; McKinsey, 2018; Shaan, 2018; Shi, 2011)

3 Artificial Intelligence market and Governmental funding

3.1 Growth of the governments funding and their disparities in term of expected economic gains

After understanding the concepts and the current usages of Artificial Intelligence, let's dig into the economic stakes. This sub-chapter will be dedicated to the global markets of Artificial Intelligence with governmental funding and strategic plans followed with a view on the expected future beneficiaries.

According to a study published by McKinsey in September 2018, Artificial Intelligence could add \$13 trillion to the global gross domestic product, known as GDP, by 2030. This would constitute a growth of more than 1.2% per year. Those big figures come close to another prediction from PricewaterhouseCoopers, usually named PWC, which would give a potential upside of 14% growth to the global GDP by 2030 representing a total of \$15.7 trillion. (McKinsey, 2018; PWC, 2017)

In addition to these reports, International Data Corp expects an increase of the Artificial Intelligence market of \$33.5 billion for 2019. (Greenwald, 2017)

Nevertheless, this expected rocket growth would not be feasible without funding and strategic plans. Some of them are explained below and show the different paths chosen to boost the countries' internal AI development.

In China, the government is prioritizing Artificial Intelligence through their 13th five-year plan from 2016 to 2020. It targets a domestic market of \$150 billion by 2020. In addition they would also like to be the largest Artificial Intelligence hub by 2030. Furthermore, they have the ambitious willingness to be the economic and military leader through the use of Artificial Intelligence. (McKinsey, 2018; Yoav Shoham and al., 2018)

In Asia, excluding China, \$2 billion will be invested by 2022 only in research and development (McKinsey, 2018).

In Europe, the EU called \$24 billion to be invested by 2020 and \$10.4 billion for the six-year period between 2021 and 2027. Moreover, countries are launching national initiatives. The French government plans an investment of \$1.85 billion supported by the willingness to double the numbers of people studying and researching Artificial Intelligence. Germany and the United Kingdom have committed to spending respectively €3 billion and £1 billion. Concerning Belgium, no plan has been launched yet. However, AI4Belgium, a group of 40 specialists in Artificial Intelligence recently mandated by the government, recommends a minimum investment of €1 billion by 2030. (Arnaud Martin, 2019; McKinsey, 2018; Yoav Shoham and al., 2018)

In the United States, Artificial Intelligence funding has considerably increased from \$282 million in 2011 to \$9.334 billion in 2018. In 2015, the US Government invested \$1.1 billion in Artificial Intelligence research and development technologies. Three years later, in 2018, approximately \$5.4 billion have been invested in AI-focused companies. Today, The United States is the world leader in Artificial Intelligence. Americans want to keep focusing on long-term investments in order to improve the quality of life for the American people and to maintain the economic and national security of the United States. The current President Donald Trump ratified an Executive Order launching the American AI Initiative in February 2019. However, this statement did not include any specific figure. This is certainly due to The United States' willingness to stay evasive in their plans in order to protect their own interests. (Arne Holst, 2019; The National Science and Technology Council, 2016; Office of Science, 2019)

Furthermore, only 18 countries (see Figure 31 in Appendix 11.1) really launched a public Artificial Intelligence strategy plan as of December 2018 (Tim Dutton, 2018).

However, only 9 governments had fully funded AI strategies at the end of 2018. As it can be seen in Table 1, the funding varies significantly. It goes from \$25 million for the Australian government to nearly \$2 billion in South-Korea with the creation of 5 new Artificial Intelligence centres and six new graduate programs which should be able to train 5,000 AI specialists per year. (Tim Dutton, 2018)

Table 1: Funded Strategies

Country/ Region	Release Date	Official Strategy	Funding (July 2018 US\$ exchange rates)
Australia	May 2018	Australian Technology and Science Growth Plan	AUD\$29.9 million (US\$21.6 million)
Canada	March 2017	Pan-Canadian Artificial Intelligence Strategy	C\$125 million (US\$95 million)
Singapore	May 2017	AI Singapore	S\$150 million over five years (US\$91.5 million)
Denmark	January 2018	Strategy for Denmark's Digital Growth	DKK 75 million in 2018, followed by DKK 125 million each year to 2025 (US\$117 million, US\$19.5 million)
Taiwan	January 2018	Taiwan AI Action Plan	NT 36 billion over four years (US\$1.18 billion)
France	March 2018	France's Strategy for AI	€1.5 billion over five years (US\$1.75 billion)
EU Commission	April 2018	Communication Artificial Intelligence for Europe	Increase annual investment in AI to €1.5 billion by end of 2020 (US\$1.75 billion)
United Kingdom	April 2018	Industrial Strategy: Artificial Intelligence Sector Deal	£950 million from government, academia, and industry (US\$1.24 billion)
South Korea	May 2018	Artificial Intelligence R&D Strategy	2.2 trillion (US\$1.95 billion)

Table 1: Funding strategies from government in AI

Source: Tim Dutton (2018)

The AI Strategies Heat Map shows that research and industrialization are the most highly prioritized strategies inside all the plan settled (see Table 2) (Tim Dutton, 2018).

Table 4: AI Strategies Heat Map

	Research	AI Talent	Future of Work	Industrial Strategy	Ethics	Data	AI in Gov't	Inclusion
Australia	High	High	Low	High	Low	Low	Low	Low
Canada	High	High	Low	High	Low	Low	Low	Low
China	High	High	Low	High	Low	Low	Low	Low
Denmark	High	High	Low	High	Low	Low	Low	Low
EU	High	High	Low	High	Low	Low	Low	Low
Finland	High	High	Low	High	Low	Low	Low	Low
France	High	High	Low	High	Low	Low	Low	Low
Germany	High	High	Low	High	Low	Low	Low	Low
India	High	High	Low	High	Low	Low	Low	High
Italy	High	High	Low	High	Low	Low	Low	Low
Japan	High	High	Low	High	Low	Low	Low	Low
Mexico	High	High	Low	High	Low	Low	Low	Low
Singapore	High	High	Low	High	Low	Low	Low	Low
South Korea	High	High	Low	High	Low	Low	Low	Low
Sweden	High	High	Low	High	Low	Low	Low	Low
Taiwan	High	High	Low	High	Low	Low	Low	Low
UAE	High	High	Low	High	Low	Low	Low	Low
UK	High	High	Low	High	Low	Low	Low	Low

Table 2: The AI strategies Heat Map

Source: Tim Dutton (2018)

The large economic benefits of 1.2% average global GDP growth during the next 11 years brought by Artificial Intelligence would surely lead to wider gaps among countries. Countries

can be divided into four groups according to a survey led by McKinsey in 2018 on 41 countries. This investigation simulated the impact of AI on the world economy and categorized countries with their standard deviation to the average threshold. It brought four groups out. The first group would benefit the most from the Artificial Intelligence development (McKinsey, 2018).

As expected, the Active global leader, group 1, is composed of China and the United States. They should benefit more than the others thanks to their strong Artificial Intelligence enablers, such as high digitalization, innovation and connectedness thanks to a strong connection with the world and AI specialists. In addition to those enablers, their power is also combined to their world leading position in term of global trade and to scale effects which make significant investments possible. (McKinsey, 2018; PWC, 2017)

The second group includes economies with strong comparative strengths. Those countries are from Central and North Europe (Belgium, Estonia, Finland, France, Germany, Iceland, Netherlands, Norway, Sweden, UK), Asia (South Korea, Japan, Singapore) as well as Israël, Australia, New Zealand and Canada. They are well positioned thanks to the robust foundation of their enablers. Some of them are highly motivated as they are facing a slowing productivity growth and high labour costs (Germany, UK, Belgium, Japan,..). Others are always following the novel business models and trends entering the markets (Finland, Singapore, South Korea,..). (McKinsey, 2018; PWC, 2017)

The third group refers to economies with moderate foundations that have the potential for economic gains. Their biggest problem is that their starting position is lower due to their current weaknesses and international positions. This group contains the likes of India, Italy, Spain and South Africa. (McKinsey, 2018)

The last group comprises economies that need to strengthen foundations. They have no incentive to develop the automation and to substitute the labour as the wages are rather low. Those economies have more incentives to reduce the poverty than invest in Artificial Intelligence. The non-exhaustive list of countries contains Brazil, Bulgaria, Greece, Indonesia and Zambia. (McKinsey, 2018; PWC, 2017)

Be that as it may, the forecasts given above offer a better understanding of the global market of AI without bringing out guarantees for the future as every country can move away according to their future choices. (McKinsey, 2018)

3.2 Sector shift and development

According to a study led by PWC, the three sectors that will benefit the most from Artificial Intelligence are Healthcare, Automobile and Finance. Moreover, McKinsey estimates the potential annual value created from the AI techniques to be between \$3.5 trillion to \$5.8 trillion across 19 industries as shown in Figure 6 below. (McKinsey, 2018; PWC, 2017)

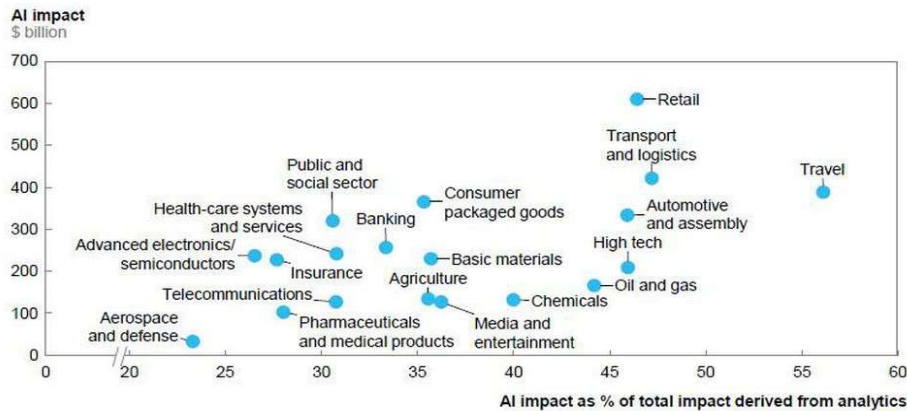


Figure 6: AI annual potential value creation across 19 industries

Source: McKinsey (2018)

The global research is more or less well distributed within all the sectors, even if the evolution between 2000 and 2017 is showing a shift in some areas. In China, research shifted from engineering and technology to more agricultural sciences. It reflects their leading position as the largest food producer. In Europe and in the United States, after a past focused on social and agricultural sciences, there is a new tendency towards concentrating more on medical and health sciences and on humanities (see Figure 7 & Figure 8). (Yoav Shoham and al., 2018)

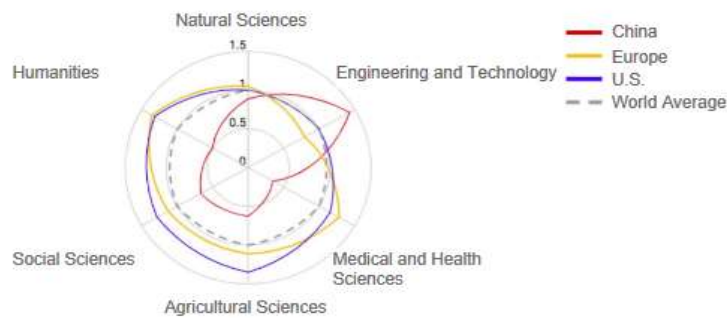


Figure 7: Relative activity focus by region and AI research sector in 2000

Source: Yoav Shoham and al. (2018)

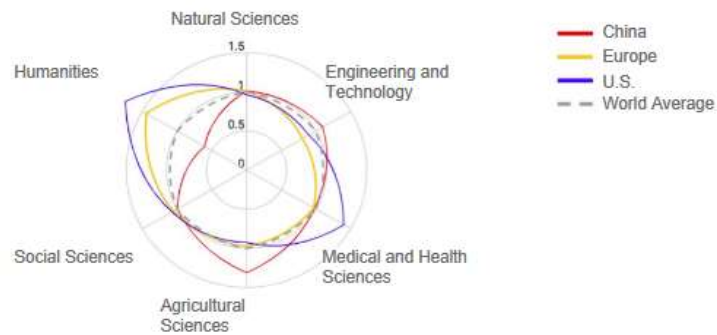


Figure 8: Relative activity focus by region and AI research sector in 2017

Source: Yoav Shoham and al. (2018)

3.3 Key role of the private sector and the disparities of gains

Nowadays, some companies have more power than whole countries. Consequently, it is not surprising to have big private players such as Microsoft, Alphabet (Google), Amazon, Alibaba and Baidu to foster and lead the development of Artificial Intelligence further than ever.

In the United States, private companies play a major role in AI development and contribute to most of its funding. Amazon and Alphabet invested respectively \$16.1 and \$13.9 billion in Artificial Intelligence research and development in 2017. To put these numbers in perspective, the National Science Foundation, the Defense Advanced Research Projects Agency and the U.S. Department of Transportation together only spent \$5.3 billion. (Tim Dutton, 2018; Yoav Shoham and al., 2018)

A national China team composed of Alibaba, Baidu, Tencent and IFlytek is pushing Artificial Intelligence forward. To demonstrate the importance of this group, Alibaba alone announced plans to invest \$15 billion. (Tim Dutton, 2018; Yoav Shoham and al., 2018)

Beside these direct AI investments, corporate venture capital funding in Artificial Intelligence start-up grew by 27% in 2018 with 291 deals to reach a \$5.1-billion-investment (see Figure 9) (CB insights, 2019).

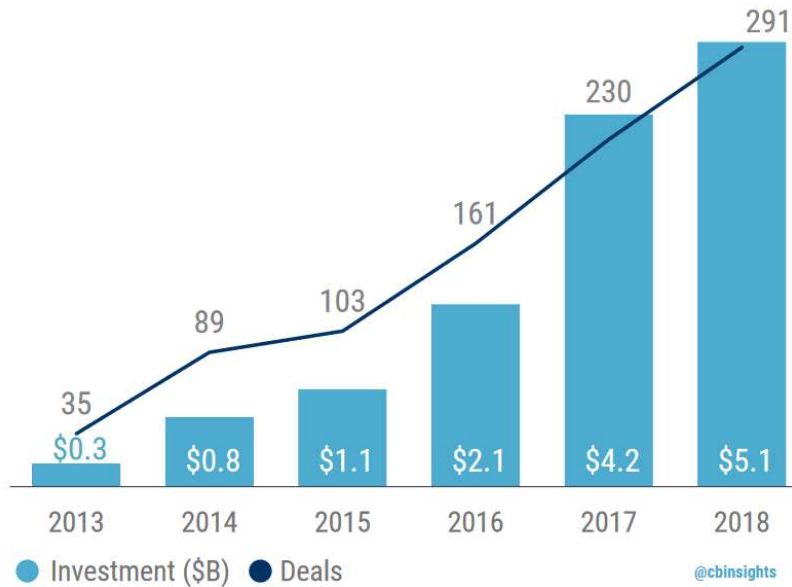


Figure 9: Corporate Venture Capital funding to AI startups (2013-2018)

Source: CB insights (2019)

The giant Baidu, the most active one, made 13 unique Artificial Intelligence investments while Google Venture, which is Alphabet’s venture arm, and M12, formerly Microsoft Ventures, are second with 11 deals each (see Figure 32 in Appendix 11.2) (CB insights, 2019).

The last piece of information given to illustrate the previous figures comes from SoftBank’s Vision. It is an investment fund specialized in technology created in 2016 by Softbank in partnership with Saudi Arabia. The fund is investing most of its \$100 billion directly in Artificial Intelligence. (Yoav Shoham and al., 2018)

As there are differences between government gains, there should be huge disparities in the rewards of the Artificial Intelligence usage inside the private sector too. On the one hand, the front-runners — companies with strong starting digital base and higher propensity to invest in Artificial Intelligence — could potentially double their cash flow by 2030. On the other hand, the laggards, companies that drag behind, could suffer a 20 percent cash flow decrease. Nevertheless, the development of Artificial Intelligence could shift market shares drastically from laggards to front runners and lead to unequal distribution of the benefits. (McKinsey, 2018)

4 *Artificial Intelligence in finance*

After spending time understanding Artificial Intelligence, its current utilisation and its importance inside the private and public sector with their economic and political issues, it is now time to move forward and learn about Artificial Intelligence in finance. This topic has been introduced in Chapter 3 with the high expectations surrounding AI inside the financial sector.

Chapter 4 displays the importance of Artificial Intelligence in finance with the main technologies used before illustrating it with some of the current usages through explanations and concrete examples.

Before starting, it should be pointed out that Artificial Intelligence has already been broadly used and shows a better accuracy than traditional statistical methods. Nevertheless, the outperformance is not absolute. (Bahrammirzaee, 2010)

4.1 *Main Artificial Intelligence technologies used in finance*

There are two types of Artificial Intelligence techniques that are widely used inside the financial area: the Artificial Neural Networks and the Expert System (Bahrammirzaee, 2010; Dunis C. and al., 2016).

The Artificial Neural Networks proves to be a powerful tool in finance to help to handle dynamic financial markets through prediction, forecast and decision making. However, machine training is executed with past data which may never be repeated. (Bahrammirzaee, 2010; Dunis C. and al., 2016)

The Expert System has been observed to be useful thanks to its flexibility and its ability to solve a variety of problems. It leads to ease the decision-making process by means of its knowledge based system and its prediction ability. However, the Expert System is not able to learn through experience and to deal with non-linear data. (Bahrammirzaee, 2010; Dunis C. and al., 2016)

Besides, in order to create Hybrid Intelligence system, those methods can be combined together or with other Artificial Intelligence programs, such as the Fuzzy Logic and the Support Vector Machine which are really useful for data analysis and pattern recognition. It

enables to overcome the weaknesses of each other and enhance the strengths of the different systems by adapting the technologies to the usage. (Bahrammirzaee, 2010; Dunis C. and al., 2016)

4.2 Example and explanation of AI's current usages in finance

Now, let's take a look at the current usages in finance with the investment banking, the portfolio management, the fraud detection, the loan and insurance, sales and finally the customer services.

According to numbers from an article published in 2019 in the famous Wall Street Journal, from the United States, 85 percent of all transactions are triggered by computers including 55 percent realized through high-frequency trading. Consequently, it only leaves 15 percent of all transactions initiated by investors. The most famous prevailing application is the algorithmic trading system which involves complex Artificial Intelligence to make extremely fast trading decisions. This Artificial Intelligence system has roots dating to the late 1970s. The trades are based on assets and risk analysis and are operated at super-speed without emotional alterations. In addition, many of these programs can operate completely alone with great success and profitability. A good example is BalckRock's Aladdin program which helps clients to manage risk and capital relating to their financial instruments. (Faggella, 2019; KPMG, 2017; Lin and al., 2014; Varnholt Burkhard, 2019)

Moreover, Aladdin is also able to scan social networks and the trade reports to give information on listed companies. It functions as a tool in order to make better investment decisions. In addition to that, several companies base their investment strategies on unusual information such as iSENTIUM. This company analyses social networks to detect the overall feeling and mood of the population to invest according to this new type of data. (KPMG, 2017; Varnholt Burkhard, 2019)

To sum up, the impact of Artificial Intelligence on the investment banking field is positive. It is not only deployed as a tool to make more accurate and better decisions but it also boosts the trade rapidity and the liquidity at the same time. Subsequently, it allows the financial employees to spend more time focusing on more specialized tasks without cutting jobs. (Faggella, 2019; KPMG, 2017; Varnholt Burkhard, 2019)

In portfolio management, some companies have robot-advisor systems to categorize clients and help them to find the right investment according to their goals and risk tolerance objectives. Nevertheless, the term ‘robot-advisor’ is misleading and confusing our view as it does not involve any robot at all. In general, it is an algorithm which points out what a client is looking for by virtue of their personality, objective and characteristics. This advice gains clearly more recognition as the millennials do not require the human presence. (Faggella Daniel, 2019)

In the fraud detection domain, machine learning earns credit as there are innumerable ways to breach security. Thus, the learning systems help to fight fraud by detecting unique activity or behaviours and flag them for security teams (KPMG, 2017). For example, Equifax noticed an improvement of 15% of the accuracy of their analysis which is decreasing the error cost of the firm. (Faggella Daniel, 2019). According to Artificial Intelligence experts in security, machine learning in that particular domain will be a necessity in the future, as the card fraud worldwide is expected to reach \$31.67 billion in 2020 according to the Nilson Report 2015 (see Figure 10).

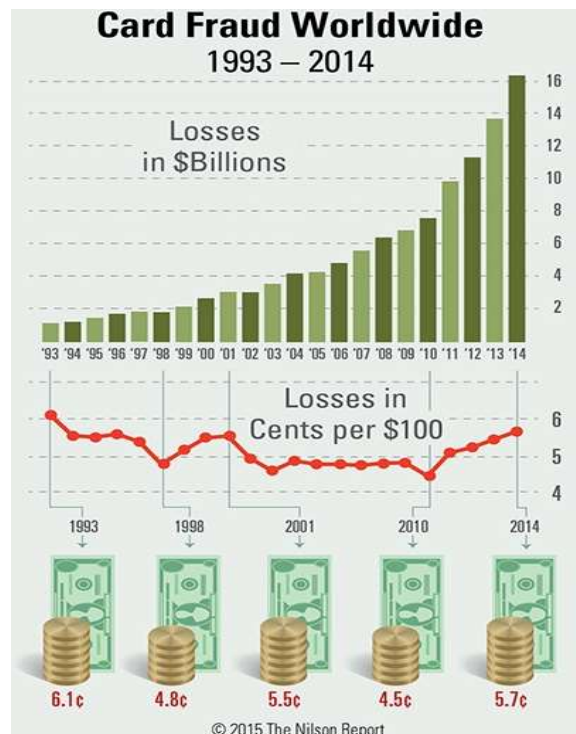


Figure 10: Card Fraud Worldwide (1993 - 2014)

Source: Nilson Report (2015)

On top of that, the Nilson Report of 2017 shows the exponential increase of the fraud per every 100 dollars (see Figure 11).

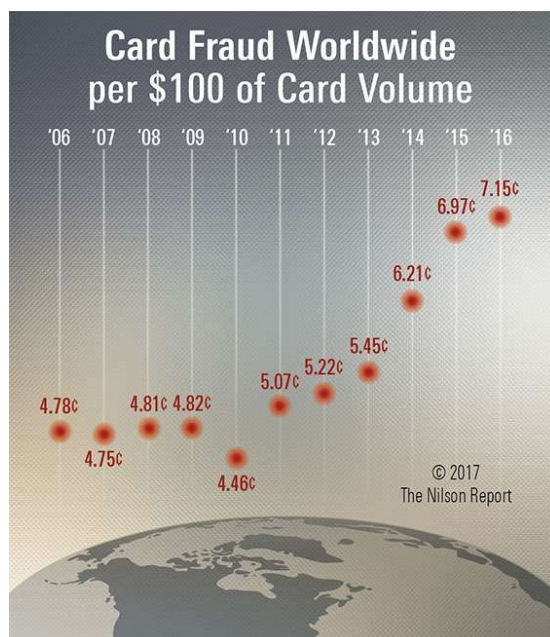


Figure 11: Card Fraud Worldwide per \$100 of Card Volume

Source: Nilson Report (2017)

In loan and insurance underwriting, the machine learning systems have already been applied in large banks and insurance firms. The algorithms are able to process a large amount of data, to predict and to forecast. It allows them to make better decisions and calculate more precisely the likelihood that the firm has to cover the default or to insure the client. To do that, some large companies are analysing sociological and behavioural data. For example, the insurance provider Intact uses a program “Ma conduite” to retrieve geo-tracking data of their clients, that way adapting their insurance premium through machine learning technologies. Another example is the worldwide company AXA which is analysing 70 sociological variables to stand out the risk of traffic accident thanks to the Artificial Intelligence system. (KPMG, 2017)

Moreover, in the same field, natural language processing technologies help to analyse and extract the information lying inside contracts. A concrete example is the Artificial Intelligence system COIN, named for contract intelligence, of JP Morgan. This program allows JP Morgan to save 360,000 hours of lawyers work per year. In other words, this is beneficial for JP Morgan and their lawyers as they can focus on work with higher added value. Normally,

those technologies should be increasingly more available on the market obviously increasing the common usage of the AI in the future. (Faggella, 2019; KPMG, 2017; Son, 2017)

In the financial sales area, some Artificial Intelligence technologies are analysing behavioural and sociological data. This data is especially used by the salesmen as a tool in order to improve the client targeting in order to push up the sale by advising the most suitable product. For instance, UBS, a Swiss multinational investment bank, exploits the technologies of Scream, a Singaporean company. This AI system analyses the behaviour of people in numerous countries, reads all the articles in the country targeted and examines the customers' research on Google to highlight what most of the clients are looking for. (KPMG, 2017)

Last but not least, the customer services are really important in a bank's day-to-day life. To improve it and answer the customers' requests as soon as possible, some banks are deploying chatbot which use natural language processing technologies. For example, the Canadian National Bank uses a chatbot on Facebook Messenger to answer questions and to process small tasks such as financial advising and appointment booking. On the one hand, this allows a better customer relationship and loyalty thanks to the Artificial Intelligence. On the other hand, it allows the Canadian National Bank to give higher added-value tasks to the employees. (KPMG, 2017)

In conclusion, AI is indeed a good help to increase human jobs and similarly improve the productivity. This results from a symbiosis between humans and Artificial Intelligence systems. Nevertheless, this Chapter was only considering a non-exhaustive list of AI utilizations within the financial sector in the purpose to illustrate the current usages of the AI.

5 *Corporate Finance*

Chapter 5 defines Corporate Finance before analysing the current Artificial Intelligence technologies and utilization prevailing inside this specific financial domain.

The first part discusses the meaning of Corporate Finance. Namely, one definition emerges from 3 definitions in order to fully understand what Corporate Finance stands for. Then, the second part examines the situational analysis of Artificial Intelligence with its impact on business, jobs and employment. The third and last part considers the future and expectations in terms of Artificial Intelligence within the corporate finance domain.

5.1 *Corporate Finance definition*

As it is explicitly stated above, let's see what corporate finance means according to textbooks and literatures.

Firstly, according to the lectures given at HEC-Liège in Advanced Corporate Finance, "Corporate finance theory deals with all the decisions that a business can make and that could have an impact on the firm value. Every decision that a business makes has financial implications, and any decision which affects the finance of the firm is a corporate finance decision." (Lambert, 2018)

Secondly, the glossary of the website Vernimmen.com, created in regards of the French best-seller book "Finance d'Entreprise" from the famous Pierre Vernimmen, offers the following definition: "Corporate finance designates the activity and the department within a bank providing advisory services to clients in relation with the sale, purchase and Merger of companies, but also their Listing and overall financial strategy." Moreover, the book Corporate Finance Theory and Practice, also based on Pierre Vernimmen's book, indicates the main purposes of a corporate finance decision. Above all, the aim is to create value for the company. For this reason, this decision is beneficial for the corporation only if it improves the value of capital employed. As a result, the goal of a financial strategy is to secure economic profits by outperforming the market and to get at least positive returns in regards of the risk taken and the required rate of return. (Vernimmen and al., 2005)

Finally the book Corporate Financial Strategy enlightens what corporate finance is by means of the corporate financial strategy, as the title suggests. The financial strategy focuses on the financial aspects of strategic decisions regarding the interests of shareholders and the capital markets. Besides, this book does not forget to take into consideration the interests of internal and external stakeholders related to companies inside the strategic decisions. Furthermore, those decisions need to foster on the relationships among all the stakeholders at a microeconomic level. The absolute goal of all corporate decision is to create shareholders value by obtaining a return at least equal to the required rate of return. (Bender R. and Ward K., 2009)

To summarize those three complementary definitions, corporate finance carries on all the decisions — at a microeconomic level — a business makes and which could impact the firm value in regards to the interests of internal stakeholders, including shareholders, external ones and the capital market. Every decision a business makes, through advisory services or not, has financial implications, and any decision affecting the finance of the firm is a corporate finance decision. The absolute goal is to create value for the shareholders by achieving a return at least equal to the required rate of return and thus trying to outperform the market in regard to the risk taken.

5.2 Situational analysis of AI technologies inside the corporate finance

This second section is divided in three sub-sections. It starts with the studies and facts. Then it displays the current stock-take through the expert minds and knowledge. Finally, it is followed by some examples of the day-to-day business applications. On the whole section, the impact of Artificial Intelligence on employment, jobs life and business is studied.

5.2.1 Studies and facts of the current utilisation of AI inside the corporate finance

First of all, it seems necessary to understand how Artificial Intelligence is used in corporate Finance nowadays. To do so, some studies led by big companies, experts and professors will give an insight with numbers. Then, a brief summary is made and bring to light the important information.

5.2.1.1 Studies and facts

- The first study comes from a German professor and researcher Kai Reinhardt. He plies his trade at HTW Berlin and is specialized in the economic sector for digital organizational development. He also works in the private sector by advising international corporations and administrations on restructuring in the digital era including AI's impact on organizations. This study is giving some information about the AI technique used and the degree of utilization inside companies.

According to a worldwide study led by doctor Kai Reinhardt on 164 financial management experts, 40 percent of the companies are already using Artificial Intelligence. Out of this, 62 percent are exploiting it in the financial management business process which only represents a bit less than 25% of the interrogated companies. The technologies used are 45 percent machine learning, 27 percent robotic process automation and, surprisingly, only 25 percent for the expert system. (Reinhardt and al., 2018)

- The second research springs from the CFO indicator that interrogated 160 CFOs. This one gives information about tasks filled by AI.

Nowadays, non-value added tasks, which are mainly manual data gathering, consolidation, verification and formatting, represent nearly 80% of corporate finance. As a consequence, it leaves behind only 20% for analysis. (CFO indicator, 2017)

- The third analysis arises from Grant Thornton who led a survey on 304 CFOs or senior financial position from companies with revenues in between \$100 million and \$20 billion. It shows the main domains where AI is used.

Nowadays, the three top processes which are already automated thanks to Artificial Intelligence are the accounts payables/receivables, the financial reporting and control and the treasury and working capital management. (Grant Thornton, 2018)

- The fourth investigation comes from a researcher from Gartner, a US global research and advisory company. It issues numbers on the tasks performed, the degree of utilization and the firm goals behind it.

According to Gartner's researcher, 90% of companies are investigating chatbot to ease customer services. However, only 4% have really used them. Furthermore, this technology removes non-value-added tasks performed by humans. Hence, it reduces corporation costs. For instance, Hewlett-Packard started to use a Microsoft bot in July 2016 in order to train it, save costs and improve customer satisfaction. (Greenwald, 2017)

5.2.1.2 Summary of the AI situational analysis inside the corporate finance through studies and facts

To summarize, according to studies, Artificial Intelligence is more than necessary inside corporate finance as 80% of the tasks managed by the financial analysts are repetitive. For instance, data crunching, controlling and formatting are not representing high-value added tasks for organizations. An additional piece of information said that only less than 25% of businesses employ Artificial Intelligence inside their financial processes. Nevertheless, 15% of corporations use AI inside their overall business. The three main current usages of AI inside the financial management are deployed in the accounts payables/receivables, the financial reporting/controlling and the treasury/working capital management.

Moreover, only 4% of companies use chatbots to improve their customer services and save costs by scaling down non-value added tasks performed by humans. Consequently, it represents a small proportion in relation to the 90% of companies which are thinking about its implementation.

To complete the summary, the technologies exploited are 45% machine learning, 27% robotic process automation and 25% expert system.

5.2.2 Current utilisation of AI inside the corporate finance through experts view and knowledge

After the first part dedicated to the studies and their figures, let's go through financial and engineering expert view and knowledge about the current utilizations of AI inside the corporate finance. This section starts with a wide spectrum of expert minds and ends with a summary to gather all the information given.

5.2.2.1 Expert view and knowledge

- The first expert, Claire Gascogne, is a journalist from the Financial Times with a specialisation in finance and cities. She is talking about the CFOs' role evolution and the help received by Artificial Intelligence.

The role of the chief financial officer has considerably changed during the past decade, evolving towards a far more strategic role. The stakeholders, shareholders and consumers are demanding more from the CFO. Therefore, they have to answer the requests faster than ever with more data, more insights and more forecast. Hopefully, to be faster and at the same time more accurate, Artificial Intelligence helps them with forecasts, industry trends and other predictions over time. (Gascoigne, 2018)

- The second opinion arises from the study of Grant Thornton which focuses on CFOs' responsibilities.

The CFOs have to assume responsibilities towards the technologies adopted as they are responsible for data and performance risk metrics. As a result, they bear the risk associated with the new technologies. (Grant Thornton, 2018)

- The third opinion is given by the famous Tech Trends and its analysts in the 2018 edition. AI's impact on business management is explained.

Business process automation in companies is useful to add a more robust risk management strategy. It decreases human errors and allows tracking, monitoring and detecting. At the same time, it leads to faster, more efficient and smarter answers. It is exploited through robotics, natural language processing and machine learning. For instance, IoT sensors on the factory enable a better optimization of the shipping and inventory processes. As a consequence, supply chain operations are more accurate and more efficient. Thus, the finance manager makes better decisions through more precise forecast and planning. (Deloitte, 2018)

- The fourth opinion springs from Patrick J.D. Taylor, co-founder of Oversight System which helps companies, such as Alphabet and General Electric, to improve their corporate finance process through Artificial Intelligence. He personally works with Alphabet and General Electric. This opinion speaks about the optimization of the customer relationship, the fraud fighting improvement and the transaction process via machine learning, robotic process automation and natural language processing.

The transaction process optimization through Artificial Intelligence is not mandatory as a CFO or another analyst is able to manage accounts payable and accounts receivable processes. However, the robotic process automation and the natural language processing behind the bots leads to optimize the customer relationships thanks to expeditious processing and autonomous tracking of all the possible mistakes such as a duplicated or wrong payment.

While the manual error correction could take hours, the machine learning technology tracks down at a high speed the relevant information, finds the source of the problem and suggests which payments are going together without permitting fraudulent transaction. Consequently, the transaction process which is influencing the corporation cash-flow and the customer satisfaction is improved through the Artificial Intelligence usage. (Taylor, 2018)

In other words, automation combined to the Artificial Intelligence system is faster and more reliable than a unique analyst. It redesigns the business, it enhances what humans do and considerably boosts the processes by increasing the productivity and the correctness. (Taylor, 2018)

- The fifth mind is the one of Jon Arnold, independent tech analyst, Dave Isbitski, Amazon Chief Evangelist for Alexa and Echo, and Colin Davis, general manager of Alexa Business. Their views are broached in an article by Matthew Finnegan who is the former editor of Computerworld UK with a special focus on financial services, retail II sector, cloud computing and virtualisation. This report is on virtual assistant usage with its impact on the corporate finance and on the employment.

For a couple of years, advanced speech recognition technologies combined with machine learning and cloud computing have allowed individuals to use virtual assistant such as Alexa. Many other big names of the technology sector, like Amazon, Google, Apple and IBM, have spent billions of dollars on delivering an easier daily routine. Lately, the natural language processing technology has evolved by being able to understand the context. This evolution is called natural language understanding. Nowadays, the speech recognition system passes 95% of accuracy. It will probably not evolve as much as in the past and would surely never reach the 100% of precision. In fact, it does not have to be more accurate as it is deployed inside businesses as a tool. (Finnegan, 2018)

It started to enter work life with business virtual assistant thanks to 4 mains usages. Firstly, the speech-to-text which can be used for email dictation for example. Secondly, the text-to-speech has the abilities to create personal podcast. It allows to review papers and documents while commuting. Thirdly, there is speech recognition. This one is about conversational interaction which could be employed to search files, issue commands or to create calendar meetings. Lastly, the speech analytics permits to assume a human resource job with sentiment analysis. As a result, those four usages could undoubtedly help the analysts and the executives in their corporate tasks by making better decisions while gaining time and accuracy. It

enhances human jobs with multi-tasking as the virtual assistant searches on its own while the financial officer is executing more human cognitive tasks without losing focus. Thus, the Artificial Intelligence demonstrates its ability to work seamlessly in collaboration with the human workforce in order to increase productivity. (Finnegan, 2018)

- The sixth insight comes from an English professor named Rick Payne. He is the director of a research program on finance business partnering, analytics, Internet of Things and the strategy behind the CFOs' role.

According to him, the CFOs' role has changed as technology has always been at the centre of the shift since computers' introduction in 1950. Nevertheless, the switch is increasingly changing with data analytic, chatbot, robotic process automation and other Artificial Intelligence systems. The late changes lead the CFOs to make more efficient decisions while their stewardship role is maintained. (Victor, 2018)

- The last view is given by a paper published in the Journal of Internet Banking and Commerce by professors of computer engineering.

Above all, using Artificial Intelligence tools to make a business more intelligent through its decision making is certainly an advantage for companies. It deploys with expert system, fuzzy-logic and Artificial Neural Network mechanisms. Those technologies increase the rapidity and the quality with trust. Furthermore, those systems can be used at different levels of the organization. The senior manager can analyse the current state of the company, set the goals and control the performance. Then, the executive could improve their decisions and their impacts thanks to more accurate forecasts in an area of uncertainty and ambiguity. Moreover, the supply chain management gets a better picture of their weaknesses and strengths. It could impact positively the suppliers and partners. Finally from a customer perspective, the management could identify the best targets, categorize the customers, improve the external communication and make clients feel more comfortable with the company through good policies. (Maeen and al., 2017)

5.2.2.2 Summary of the AI situational analysis inside corporate finance through expert knowledge

The section above allows a complete understanding of the current experts' thinking and knowledge. Now, let's highlight the more important information out of the opinions given.

This is decomposed in 3 parts with the CFOs' role evolution, the automation of the business through AI and the virtual business assistant.

The CFOs' role has changed over time even if the stewardship role has been maintained. It is evolving towards a strategic role with more responsibilities while the requests from stakeholders, consumers and shareholders are abounding. Therefore, they have to execute the work faster than before while paying attention to a broader and deeper insight within the whole company process. Nevertheless, Artificial Intelligence and the big data allow being faster with more accuracy in their decision thanks to better forecasts and industry trends even in areas of higher uncertainty. This has mainly been allowed by means of machine learning, expert system, robotic process automation and natural language processing techniques. However, the CFO has to bear the risk associated with the adoption of the new technologies and is not forced to use the AI as the CFO is most of the time able to realize the jobs by himself.

Artificial Intelligence with robotic process automation, natural language processing, expert systems, fuzzy logic and machine learning enables well-automated business process. This process automation contains faster and more effective tracking, monitoring and controlling. The bots are able to flag the errors inside the process and suggest a way to solve them. Moreover, all the data of the automation through the AI is stored on the cloud. Obviously, the management can make more precise forecasts and better planning thanks to those data. Thus, it improves the company manager's decisions. Last but not least, it redesigns the business, enhances what analysts undertake and considerably strengthens the processes by being more efficient, more effective and faster. Consequently, the company cash-flow and the stakeholders' satisfaction are clearly improved.

The speech recognition system, passing 95% of accuracy, combined with the ability to understand the context, with the evolution of the machine learning and with the cloud computing permits to launch the business virtual assistant with four main current usages, the speech-to-text, the text-to-speech, the speech recognition and the speech analytics. The two last capabilities have lately been highly improved. It respectively permits to get better conversations and sentiment analysis. As a consequence, thanks to those four abilities, the analysts can realize multi-tasking and foster on the most human cognitive tasks. The virtual assistant is demonstrating the ability of Artificial Intelligence to work seamlessly in

collaboration with the human workforce in the purpose to increase productivity, accuracy and the decision-making process.

5.2.3 Current utilisation of AI inside corporate finance through example

The next part focuses on some concrete current utilizations of Artificial Intelligence inside corporate finance through examples and their observed impacts. This section is followed by a summary.

5.2.3.1 Example of AI inside corporate finance:

- The first example comes from Gappify, a US company that uses a robotic process automation system in accountancy.

In 2017, Gappify launched a bot, named Alan, using Artificial Intelligence designed to assist business accountants. Alan can complete various tasks such as accounts payable, accounts receivable, payroll and other cash management functions. This tool deploys robotic process automation to help corporate accountants in more value-added missions such as analytical and strategic tasks. It permits to autonomously handle number crunching and repetitive manual parts of the jobs as well as specialized and ad hoc tasks including vendor record clean-up for example. It increases the company reliability in regard to their client thanks to quicker, more precise and smoother processes. (PRWEB, 2017)

- The second example is about the bot named Pegg from the US accounting firm Sage.

Pegg manages automatically invoices, tracks payments and conducts other accounting tasks operating through Messenger and Slack, two messaging portals. Furthermore, it also improves considerably the productivity through its conversational chatbot. On top of that, it integrates the key workflows and the business process, therefore helping to command and communicate more easily thanks to natural language processing and machine learning. (PYMNTS, 2016)

- The third example is a virtual assistant deploying AI chatbot techniques which comes from the company Tradeshift, a US company from the software sector.

Tradeshift helps businesses thanks to a virtual assistant which manages the transactions and the treasury by making use of an Artificial Intelligence chatbot. It eases the financial management thanks to the conversational technology. (PYMNTS, 2016)

- The fourth example comes from the Italian company Enel active in the energy sector.

In order to make real-time decisions, companies need to improve their infrastructure and attach Artificial Intelligence technologies with predictive and prescriptive analytics tools to their daily business operations. A good example of this shift is the Italian company Enel that operates worldwide. They began to employ the cloud using virtual data storage for each division with central links. This enables a full digitalisation of their operations and an extensive usage of the Artificial Intelligence. It proved to boost their activities thanks to the data collected. For example, they launched a digitalised report analysing more than 1,000 financial control objectives each month through voice recognition. (Cooper Tim, 2018)

- The fifth example comes from the virtual business assistants which are already on the market.

As explained before in Matthew Finnegan's paper, there are already some examples of virtual business assistants namely Amazon's Alexa for Business, Cisco's Spark Assistant, Microsoft's Cortana, Voicera's Eva, Nuance Dragon and IBM Watson Assistant. They allow multi-tasking from the analysts who leave the repetitive tasks, such as web searching, data crunching and report writing, to the virtual assistant. The human cognitive tasks are fulfilled by the corporate finance analysts. Hence, the virtual assistant and Artificial Intelligence are working in collaboration to increase productivity. (Finnegan, 2018)

- The sixth example comes from an automobile lending US company.

The system named ZestFinance allows to lend more than in the past at a lower risk through the use of machine learning system. It helps the company to cut annual losses by 23%. (Bachinskiy, 2019)

- The seventh example is illustrated by the notorious JP Morgan.

Inside JP Morgan, they are using Artificial Intelligence, primarily the robotic process automation and machine learning, to perform non-value-added tasks such as data extraction, compliance including know-your-customer regulations, documents understanding and so on. (Bachinskiy, 2019)

- The last example is a non-successful one from Microsoft with the chatbot named Tay.

In contrast to the previous example, Artificial Intelligence has already struggled in some businesses. This is especially true for the chatbot named Tay conceived by Microsoft. Tay

was able to converse normally with Twitter users, answer their questions and make a series of statements. Even if the chatbot passed successfully all the tests before being implemented, its ability to learn and adapt to users through data ingestion allowed users to manipulate its behaviour. After a couple of days, Tay was adapted to Twitter's public and made offensive statements on the social network's interface. (Osoba and al., 2017)

5.2.3.2 Summary of the AI situational analysis inside corporate finance through example

The examples given above demonstrate the Artificial Intelligence utilization as a tool for humans who can focus on higher value-added missions. Multi-tasking has been allowed thanks to the execution of non-value-added tasks by AI while the repetitive, data crunching and non-human cognitive parts have been removed from the analysts' jobs. It has been enhanced by the usage of chatbots and virtual business assistants in the financial industry. Both improve stakeholder satisfaction via faster answers and help the manager within their decision-making process by the means of machine learning, expert system and natural language processing.

Nevertheless, the last example with the chatbot Tay illustrates that Artificial Intelligence is not an absolute fail-proof system.

5.3 Future utilisation of AI inside the corporate finance through studies and expert insights

After the current usages of Artificial Intelligence in corporate finance and its impacts on the employment and business, let's focus on the future through survey answers and beliefs from papers, reports and experts.

To follow the previous pattern, this sub-chapter contains two sections. It starts with the insights from papers, reports and experts and it ends with a summary.

5.3.1 Insights from papers, reports and experts

- The first thought comes from the CFO indicator previously used on the current utilisation of AI in corporate finance. It speaks about automation, AI as a human tool and the barriers to technology deployment.

According to the last quarter report of the 2017 CFO indicator, the key drivers of automation are the quick and high quality insights for executives and operational stakeholders (40%) above the decision support enhancement (26%). Then, the improvement of the finance productivity (16%) and the accuracy of the financial related job (12%) are followed by the costs reduction with only 2%. From a societal point of view, the last driver is undoubtedly the one to remember, as CFOs are not implementing technologies to cut jobs. Nevertheless, a study led by the U.S. workforce figures out that 47% of jobs are at high risk due to automation in spite of the unwillingness of workforce reduction. Besides, companies that have a degree of automation higher than 70% are six times as likely to generate revenue growth of at least 15% per year. (CFO indicator, 2017)

A large stake of CFO, 89% of respondents, predicts AI going much further in terms of its impacts in the corporate finance function within the next five years. Moreover, they plan to use AI as a human combination without cutting jobs. One CFO talks about lowering human repetitive and routine missions, which could then be run by Artificial Intelligence. Consequently, the employees' freshness would be used on more specialized tasks depending on the type of industry. It should impact management growth and profitability positively. (CFO indicator, 2017)

The biggest barriers, according to CFOs, are the time needed for the technology deployment, the team skills and the expenses. In order to fight the skills barriers, the new recruits should be adaptable to new technologies, able to measure, define and tracks KPLs and then have high relational capabilities. Moreover, they express their will to keep the senior team at work and encourage them to follow the technological waves. (CFO indicator, 2017)

- The second belief and study comes from the 2019 Deloitte Global Millennial Survey. They speak about the skills and employment of financial analysts before analysing the human job through AI deployment.

The worldwide study on 13,419 millennials and 3,009 generation Z people from Deloitte reveals that only 20% of the panel believe to have the required competencies to work in the modern place. It is due to Artificial Intelligence's development which has already changed most jobs by focusing exclusively on human skills. Furthermore, 70% of the studied

population believe to have parts of the required skills and assume to be able to develop their own capabilities in order to increase their value on the job market.

According to the respondents, the evolution of those working skills should be enhanced through employers and educators. Then, the individuals should learn by themselves and through governments' plans (see Figure 12). Moreover, 49% would quit their jobs within 2 years if they have a choice. The third top reason is the lack of learning and development opportunities inside companies. Thus, the combination of the enhancement of the employees' skills through companies and the fact that 49% would quit their jobs due to the lack of training should really motivate corporations to improve their workforce skills development program. (Deloitte, 2019)

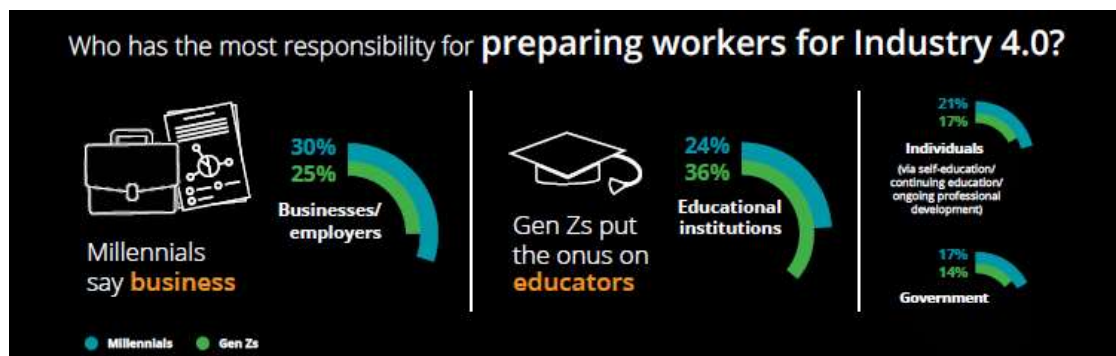


Figure 12: Working skills evolution and the role of the employer

Source: Deloitte Global Millennial Survey (2019)

Deloitte's study confirms the general belief that Artificial Intelligence will enhance the jobs as only 15% of people think those new technologies will replace or decrease their jobs responsibilities. (Deloitte, 2019)

- The third study is from Grant Thornton and was mentioned earlier. This study is on the investment planning and the impact of AI on employment.

According to Grant Thornton's survey, Artificial Intelligence with advanced analytics in corporate finance is ranked as the highest priority for future investments as most of companies have already started the automation wave. In general, 20% of the CFOs are expecting to adopt it within 5 years. In addition to that, the main processes should be the financial planning and analysis, budgeting, forecasting, corporate development, strategic planning and financial reporting and controlling.

On top of that, the majority of respondents would prefer to maintain and train the existing staff to manipulate this new technology (Grant Thornton, 2018).

- The fourth thought is from the German professor and researcher Kai Reinhardt mentioned earlier. He gives his opinion about AI and accountants as well as about the AI expectation on other corporate finance jobs.

In term of competencies and roles, the accountant will certainly be substituted by Artificial Intelligence as the job is repetitive and can be easily automated. (Reinhardt and al., 2018)

However, Artificial Intelligence should not cut jobs in other parts of Corporate Finance. Generally speaking, the role of the financial analyst and the tax examiner should remain as significant as it is. Furthermore, most of the roles should increase in significance as they are more transformational oriented and demand more cognitive reasoning. Those roles are namely chief financial officer, financial controller, risk manager, compliance manager, fraud examiner and treasury manager. (Reinhardt and al., 2018)

Subsequently, five years from now, according to the research, Artificial Intelligence will massively influence the financial management. (Reinhardt and al., 2018)

- The fifth point of view springs from Dominic Policella who is the chief revenue officer at BOARD International, a leading global software vendor of business intelligence, analytics and customer portfolio management unification solutions, whose clients include H&M, Coca-Cola and KPMG.

According to him, CFOs are required to lead the transition from Excel to Artificial Intelligence with strong automation and predictive analytics. To benefit and use Artificial Intelligence as much as they can, AI should be implemented and integrated to the business planning process by the means of forecasts, automatic action suggestions and plans to optimize the decision. (Policella, 2018)

- The sixth insight comes from Rick Payne who was quoted previously. He talks about the adoption of technology.

There is a real need to ask the right questions before implementing technologies according to Rick Payne. Technology has to improve effectiveness, provide customer value and increase the value of the company while keeping in mind what the risks and benefits of its implementation are. The start and end of the transformation goes through the human being. Indeed, there is a real necessity to understand the business finance's needs and to be on the

same page inside the team. The disruption will arise with better technologies and the CFOs have to examine their company's evolution with the utilization of robotic process automation, cloud computing and specialized financial oriented software technology. (Victor, 2018)

Moreover, companies have different needs in regard to their size, resources and digitalization level. For instance, AI and the advanced analytic tools can suit perfectly a large firm with a big amount of data available while another company still needs to focus on basic financial analysis as the risks and benefits are not worth it yet for them. (Victor, 2018)

- The seventh point of view arises from an article reporting different experts' opinions. It was published by Tim Cooper who won the award of the freelance financial journalist and writes in well-known journal such as the Times, The Raconteur, the Spectator, The London Evening Standard, the Guardian Weekly and the Telegraph. He also wrote a couple of financial reports with big companies of the sector namely JP Morgan, EY, Barclays Stockbroker and KPMG.

According to David Anderson, a UK strategist and financial leader at Deloitte, the role of chief financial officer is evolving with the rise of Artificial Intelligence. Thereby, their competences need to be more oriented towards tech know-how, adaptability and a love of risk.

Johanna Robinson, vice president of finance at Gartner, said their jobs would be enhanced if they could use correctly Artificial Intelligence tools. She added that it could improve companies' profits by making smarter decisions, more accurate investment evaluations and faster risks/opportunities identifications. (Cooper Tim, 2018)

Kati Dinnis, CFO of Palladium, an Australian company which helps clients in 90 countries on their social impacts and their economic profits, explained that the big data gives more opportunities to drive the strategy inside a company despite the financial jobs' increasing complexity. (Cooper Tim, 2018)

- The eighth insight is given by the Tech Trends report of 2018. It looks at the impacts of Artificial Intelligence on employment and job mission.

In the near future, productivity will considerably increase as humans will fully work with machines thanks to their complementarity. Artificial Intelligence and automation should remove the repetitive tasks and increase human performance on certain missions. Hence, humans would focus more on empathic, social and emotional parts of the jobs.

According to the authors, the organisation of tomorrow has to rethink the management of new talents and create a workforce composed of hybrid human and machine. (Deloitte, 2018)

- The ninth point of view derives from the Chartered Institute of Management Accountants and its CEO Andrew Harding.

The association believes Artificial Intelligence will change financial jobs but will not destroy them. According to Andrew Harding (2016), businesses need to take innovation as a big opportunity to enhance the quality of life, which is beneficial for companies.

- The last insight is given by Patrick Taylor, the co-founder of Oversight System, as mentioned previously.

According to Patrick Taylor, Artificial Intelligence could be used by executives and help corporate finance teams by making better decisions and identifying opportunities in order to improve procedures and company policies. Artificial Intelligence systems, including Siri and Alexa, are broadly used by consumers, which demonstrates a higher propensity towards those daily tools. A virtual business assistant within a corporate board meeting could be imagined. This is especially true as it could be able to access company data, analyse, answer questions and give its opinion about topics and decisions while being more rational than a human. Consequently, this would ease the financial analysts/executives and help to make smarter decisions with more complete information. (Taylor, 2018)

5.3.2 Summary of AI expectations and beliefs inside the corporate finance

The paragraphs below sum up the future beliefs and expectations arising from different experts' insights and studies.

The key drivers behind the expected usages of AI inside corporate finance are for the improvement of the decision supports, the higher accuracy of the analysis and the better insights brought to the management and the operational stakeholders. In details, the investment priority will be given to the financial planning and analysis, budgeting, forecasting, corporate development, strategic planning and financial reporting and control. Furthermore, the CFOs are requested to lead the transition and to bear the risks. Above all, it is recommended to be careful, as AI implementation's necessity is different from one company to another depending on their different level of digitalization and automation.

The short- and long-term purpose is to develop massively AI as a tool in order to enhance human jobs. Thus, routine tasks are expected to be removed from human jobs while they would realize higher value added and cognitive tasks. However, accountancy is likely to be automated due to its repetitiveness. Nevertheless, as most of the jobs are transformational activities demanding cognitive reasoning, they should gain in significance. Those jobs are among others chief financial officer, financial controller, risk manager, compliance manager, fraud examiner and treasury manager. Moreover, companies should indeed create synergies thanks to the human and Artificial Intelligence collaboration. It would lead to a higher productivity and economic benefits with a risk downplayed through better decision-making processes.

To optimize the result and the decision-making process, experts recommend integrating Artificial Intelligence in the business process by the means of forecasting, controlling, action suggesting, planning and reporting. Hence, it would improve procedures and company policies. Nowadays, individuals exhibit a higher propensity towards the Virtual Assistant, thus helping this technology to enter the business world. Generally speaking, a system which could access company data, analyse, answer questions, suggest action and give its mind about topics and decisions while being more rational than a human brain could undoubtedly help the corporate finance. The key AI techniques deployed would be the robotic process automation, the expert system, the natural language processing and the machine learning systems.

The required skill for a new talent inside the corporate finance is clearly the adaptability as the financial role is quickly evolving. On the one hand, new employees are demanding more training to the corporations in order to enhance their analytics and digital skills. On the other hand, companies want them to be prepared when they are hired. Nevertheless, most companies are planning to maintain the existing staff.

6 Survey on the situational analysis and expectations of AI with a special focus on corporate finance

6.1 Introduction to the survey

An online survey has been launched in order to compare the current utilization of AI in corporate finance with what literature, reports and articles conveyed in Chapter 5. Moreover, this pool permits to collect the feeling, opinion and knowledge of the respondents on Artificial Intelligence and its current and expected impacts on the overall fields, namely finance and corporate finance.

6.1.1 Methodology of the survey

As stated before, this survey was broadcast online. Thus, everybody who clicked on the survey link could fill the form. It was conveyed through targeted e-mail, internal network of financial companies and the social networks LinkedIn and Facebook.

The survey was targeting everyone as everyone is or will be impacted by AI in their day-to-day life.

Nevertheless, several questions could differ according to the background and the knowledge of the respondents in order to improve the user journey and the efficiency of the results.

In addition to the different paths possible, this study was implemented to allow a division between professionals and non-professionals of the field. A professional is someone who has enough knowledge about the financial field or about Artificial Intelligence. This distinction permits to study the differences of feeling and thinking towards Artificial Intelligence and to improve the accuracy of some specific answers.

The study was decomposed in six blocks.

- Your background:

The only real purpose of this block is to classify the results regarding the knowledge and to notice trends depending on variables such as the age and the gender.

- Artificial Intelligence:

This part is on the participants' overall knowledge of AI. Moreover, it gives information on the respondents' utilization of AI in the day-to-day life and inside companies.

- Artificial Intelligence with a focus on Finance:

This part is devoted to the participants' current and expected overall knowledge and usage of AI inside the financial area. In addition to that, it allows a differentiation of the respondents' opinions between AI in finance and in corporate finance.

- Artificial Intelligence with a focus on Corporate Finance:

This part is on the participants' current and expected overall knowledge and usage of AI in corporate finance. This is the most complete and accurate part in the survey as this represents the major subject of the master thesis.

- Artificial Intelligence and employment:

In this block, the questions are asked in the purpose to get the feeling of the respondents towards AI and employment. Moreover, it allows knowing if the respondents are or will be ready to follow requalification programs and evolve with new technologies.

- Additional Information:

This last part was not mandatory but really useful to know if the survey was clear for the respondents. If it was clear enough, answers could be used, as the questions were understood.

6.1.2 Interpretation of the survey

The interpretation of a study depends on variables such as the distribution, the level of confidence and the error margin.

In order to use the information and normalize the respondents' answers to a global population, a survey does not only need to be understood. It also has to receive enough answers in regards to the total population.

According the Theorem Central Limit and the Law of Large Numbers, which is applicable only to the quantitative questions, an independent random sampling distribution of the sample means is approximately distributed as a normal distribution and becomes centred more tightly

around the total population average when the sample becomes larger. In practice, 30 elements in the sample is enough to use the theorem. Thus, interrogating more people would reduce the error margin but does not affect considerably the distribution. (Huikari Sanna, 2017)

Another statistical tool to use before interpreting the results is the error margin that differs according the level of confidence, the population and the sample size of the survey. For this study a level of confidence of 95% was chosen. In other words, 95% of the targeted population would answer this survey as the people who filled it. As there are 167 answers in regards to a total population of millions of people the error margin is equal to 7.58%. The error margin is the positive and negative deviation to the results given by the respondents in regards to the total population. A margin error of 7.58% means that an answer given by X% of the sample would have been given by a bracket of people between $\{X\% - 7.58\% ; X\% + 7.58\%$ inside the targeted population. (CheckMarket)

An additional piece of information is the clarity of the survey. 86.84% of the respondents found the study clear. This information contributes to the robustness of the survey, as it was well understood by the respondents.

Finally, this survey was launched in a way to allow a comparison between professionals and non-professionals. The purpose is to improve the robustness of the answers by using only respondents who know what the studied field and AI actually are. The concept of ‘professional’ is explained in the second paragraph of part 6.2.1.

6.1.3 Bias of the survey

However, each survey has some biases due to the possible mistakes made. Here is a non-exhaustive list of the biases related to this survey.

This survey tends to be more focused on the developed countries, mainly on the European Union and North America. From this results a cultural and cognitive bias due to the way thinking gets impacted by the geolocation.

There is a bias of representativeness due to the English language of the survey, which results to a smaller targeted group than expected. To fight this bias, the most difficult words were used with synonyms and the text entries could be filled in French (Osoba and al., 2017).

There is certainly also a bias of methodology. This one could come from a question not as clear as it should be, a bad reasoning from the respondents and so on.

The last bias that could occur is an emotional bias from the people who are pro AI.

6.2 Results of the survey

This Sub-chapter shows and interprets the results of the survey launched according to Chapter 6.1. In each section, the facts, the experts' knowledge and the impacts on employment are stated. It is divided into four sections in order to follow the model of the previous parts of this master thesis. First of all, it starts with the population interrogated and their AI knowledge. Then, the results of the impact and view of the respondents on AI in the overall field are studied. It is followed by a first focus on the financial area in its entirety. To conclude, the survey is analysed by decomposing the situational analysis and the expectation towards Artificial Intelligence within corporate finance.

6.2.1 The population interrogated and their AI knowledge

From the 167 people surveyed, 50.3% are men and 49.7% are women (see Figure 33 in Appendix 11.3). Out of this, 89% are between 18 and 34 years old. The remaining 11% are aged between 34 and 64 years old (see Figure 34 in Appendix 11.4). Even if the study was conveyed mostly in Belgium (63.47%), some respondents come from other countries: 6.59% from the Netherlands, 3.59% from Germany, 2.99% from France and the United States of America, 2.4% from the United Kingdom, 1.8% from Finland, 1.2% from Italy, Poland and Romania and 19 other countries share the final percentage with 0.6% for each of them (see Table 5 in Appendix 11.5).

The professions registered at the beginning of the survey and the people with a good knowledge of corporate finance and Artificial Intelligence permit to define what a professional is. Moreover, according to the Oxford Dictionary, a professional is “someone connected with a job that needs special training or skill, especially one that needs a high level of education” (Oxford, 2019). Hence, in this study the professions where people are considered as professionals are those in the financial industry, the educational services, engineers and computer scientists. They represent a total of 38% with 63 respondents out of 167. Figure 13 shows the distribution of jobs of the professional panel with 20.63% in

corporate finance, 17.46% in marketing, 15.87% in law and order, 14.29% banking, 11.11% in auditing, 4.76% in accountancy, 4.76% in IT and engineering, 4.76% in educational services, 3.17% in insurance and 3.17% in public administration and services. In the following chapter, the panel of people mentioned above will be referred to as professional.

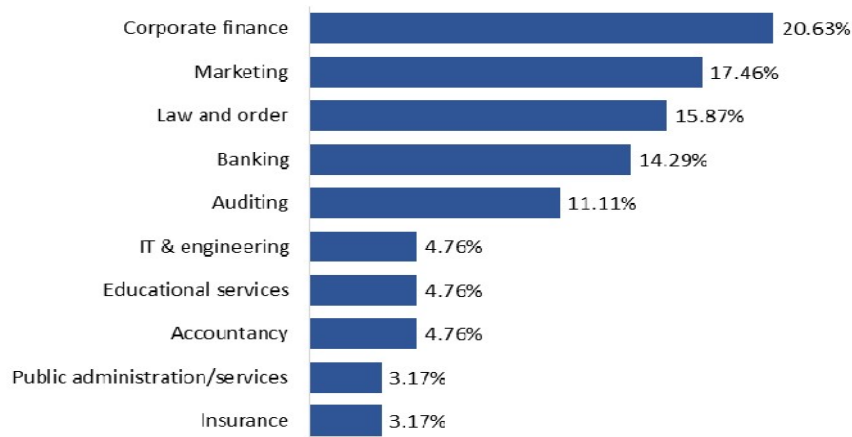


Figure 13: Job distribution

Source: Survey results

6.2.2 AI in the global world

This survey confirms that AI is a hot topic as 93% of the respondents hear about Artificial Intelligence at least once per week (see Figure 14).

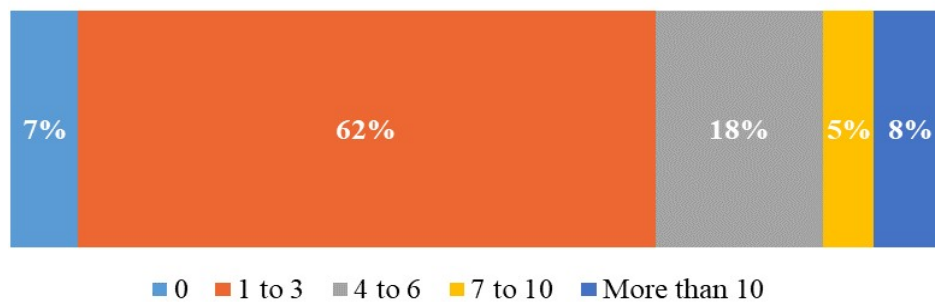


Figure 14: AI is a hot topic

Source: Survey results

The study also proves the importance of AI inside the corporate world. Only less than one third of the professionals (30%) are sure their organizations do not use AI in their processes and 35% of them do not know if people are using it. Thus, it can be fairly said that, currently, more than 35% of companies are using AI in their processes. (Figures 35 in Appendix 11.6)

Moreover, 35% of the people interrogated personally use Artificial Intelligence (see Figure 36 in Appendix 11.7). Inside companies, the respondents use Artificial Intelligence among others for neuroimaging, to automate their daily processes, with chatbots, to filter emails, to create reports, for social media marketing, for data crunching, with robot-advisor, for risk management and with automatic video analysis systems. Furthermore, in the daily routine, some people use AI on the Internet through predictive search, car driving with automatic control, home automation, LinkedIn proposition matching, with facial recognition and through virtual personal assistants such as Siri, OK Google and Alexa.

Those applications mentioned above enable, according to the global panel, to crunch data, to do repetitive tasks, to ease the jobs, to be faster and to create new models. Then, in sixth place, it is useful for reducing the costs. When these answers are compared to the professionals', they are quite similar. In particular, their top four is the same. However, they do not use it as much as the global panel to create models. In contrast, they use it more to realize the administrative part of their jobs. Below, Figures 15 and 16 represent the reasons why people use AI in percentage of responses respectively for the global panel and for the professional panel.

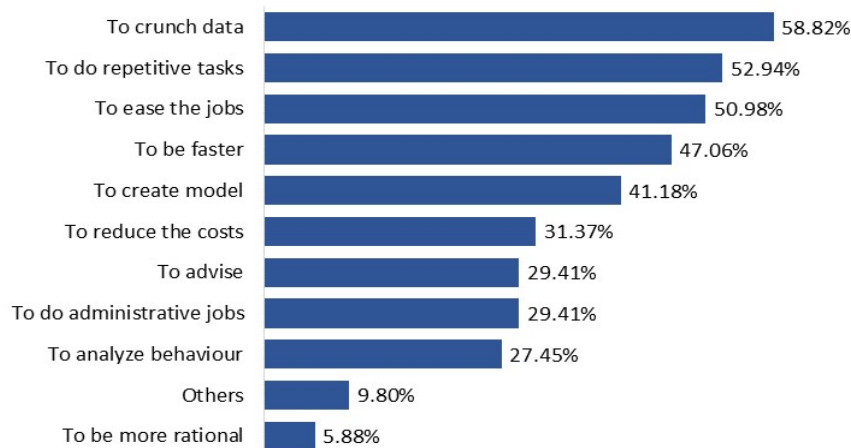


Figure 15: Reasons behind the AI utilization inside the day-to-day lives of the global panel

Source: Survey results

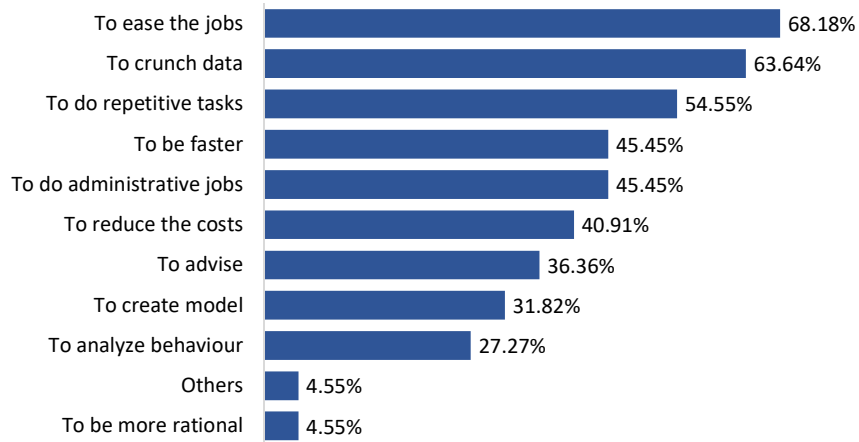


Figure 16: Reasons behind the AI utilization inside the day-to-day lives of the professional

Source: Survey results

To complete this information, let's dig into employment within the global world. People are not afraid to lose their jobs, as 65% of them answered so. Nevertheless, 28% are slightly afraid to lose their jobs. It only leaves 7% of the surveyed people to be actually afraid. For them, the arrival of AI inside their workplace is a real threat for their jobs. (Figure 37 in Appendix 11.8)

However, some reports forecast positive impacts on the job market with a shift of the qualification towards more computing and cognitive tasks (Deloitte, 2019). It has been approved by 121 respondents leading to a confirmation of 72% of the population (see Figure 38 in Appendix 11.9). Some people highlight the fact that technological revolutions always lead to job creation and add that people will need to learn new skills in order to adapt.

Besides, to fulfil this adaptation, 93% of the panel is ready to follow courses to stay up to date to the new technologies (see Figure 39 in Appendix 11.10).

In complement to this willingness to learn continuously, 85% of the population are in favour of a job transition plan if they need to change their skills and jobs (see Figure 40 in Appendix 11.11).

Before going through a more financial related analysis, let's take a look at the eagerness to use Artificial Intelligence with a special focus on finance and corporate finance. As it is represented in Figure 17 and Table 3, there is the same tendency for the global as well as the professional panels to exploit Artificial Intelligence extensively. Nevertheless, the

professional panel has a higher percentage than the global population. The similitude goes even further as both panels, global and professional, have a greater percentage for the overall AI usage with respectively 82 to 89%. Then the Artificial Intelligence utilization in corporate finance comes with respectively 74 and 84%. Finally, AI in the financial domain in its large spectrum arises with 69 and 79% respectively for the large and professional panels. The most interesting part of this analysis is about the small number of people who would never use AI. There is a maximum of 2% for the large panel and 0% for the professional panel thus demonstrating the willingness to put AI to work.

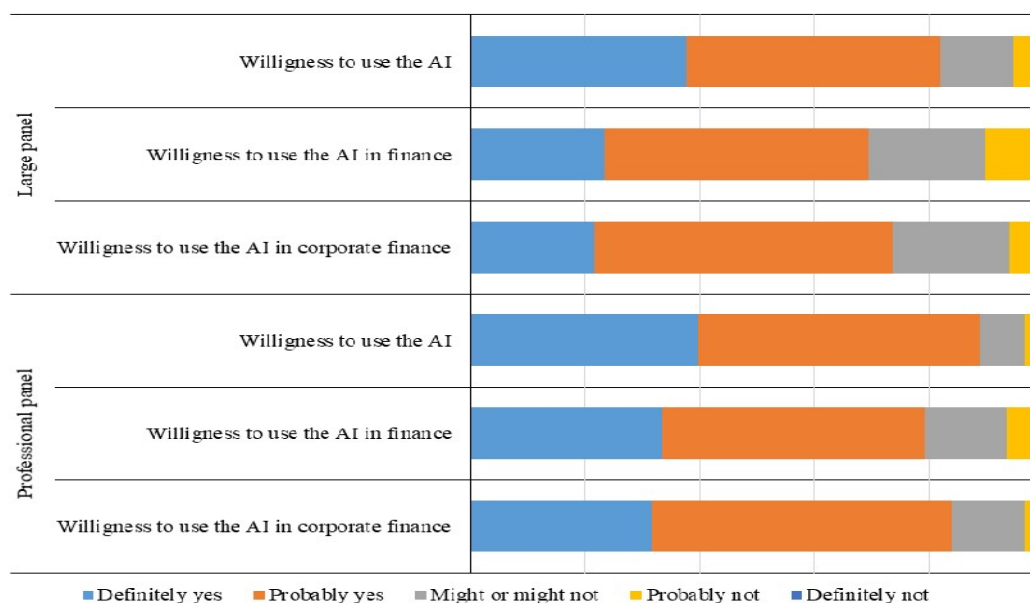


Figure 17: Willingness to use the AI

Source: Survey results

	Large panel			Professional panel		
	Willingness to use the AI	Willingness to use the AI in finance	Willingness to use the AI in corporate finance	Willingness to use the AI	Willingness to use the AI in finance	Willingness to use the AI in corporate finance
Definitely yes	38%	23%	22%	40%	33%	32%
Probably yes	44%	46%	52%	49%	46%	52%
Might or might not	13%	20%	20%	8%	14%	13%
Probably not	4%	8%	5%	2%	5%	2%
Definitely not	1%	2%	1%	0%	0%	0%

Table 3: Willingness to use the AI

Source: Survey results

6.2.3 The AI and the financial domain

In this sub division, a view is given on the opinion of the respondents and the population inside the financial area.

Before starting, it is essential to understand how much people know about finance and AI. In Appendix 11.12, Figure 41 displays that only 25.15% of the global population are certain that AI is used in finance. Then, 45.51% believe AI is certainly a part of the financial world with an additional 19.76% who do not know at all if it is currently used. Finally, 9.58% of the respondents answered that AI is probably not used in the financial domain. It supposes that the global population is not aware of the current financial world's usages, as it has been explained in Chapter 4. In order to get a correct view of AI inside the financial domain, people who are not certain of the utilization of AI in finance have been removed from the sample for this unique section. Henceforward, the panel used for this section is composed of 25.15% of the global panel, which constitutes a total of 42 people. Those are considered to have a good knowledge of the financial area.

According to those 42 people, investment banking and trading are the two financial fields where AI is the most used. Then, people employ it inside commercial banking and corporate finance to a lower extent (see Figure 18).

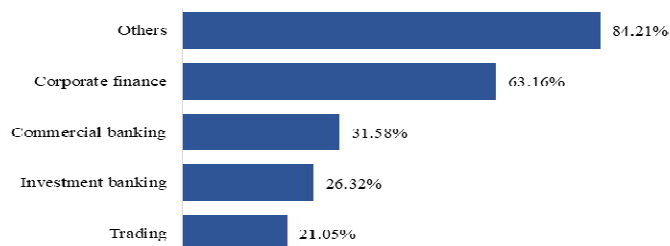


Figure 18: Usage of the AI and the finance departments

Source: Survey results

One of the central questions about Artificial Intelligence is on its future utilization. Obviously, the respondents would use AI in finance, as 85.72% answered they would (see Figure 42 in Appendix 11.13). Conversely, only 2.38% would probably not use it. This highlights the key role expected for AI in our economy and the financial area.

The last impact studied in this section is on employment. Those people with financial knowledge answered with 61.9% that AI is set to have a positive societal impact. Within this

percentage, 35.71% bet on a big positive impact. However, 21.43% believe employment will suffer a negative impact, with 2.38% of them expecting this impact to be really negative (see Figure 19).

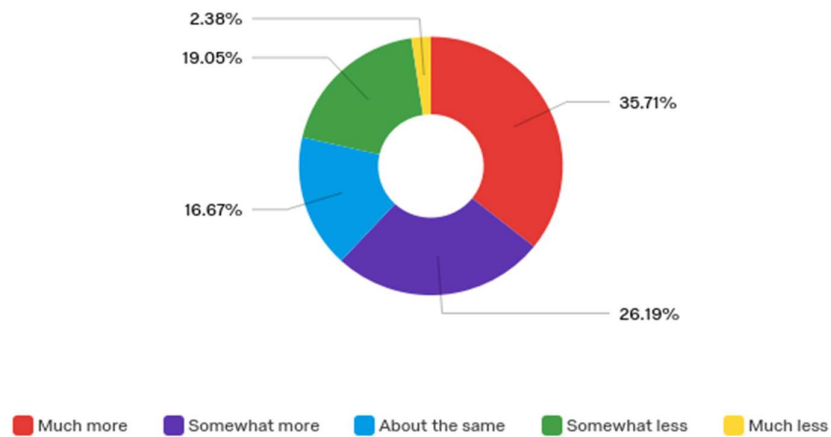


Figure 19: AI impacts on the employment in finance according to the financial panel

Source: Survey results

In regard to the job market, there is a negative feeling inside the population observed inside the remaining panel. This population predicts a big positive impact at 12% and a small positive impact at 36%. The percentage left is composed of people thinking about a quasi-zero impact at 28.8%, a small negative impact at 20% and a big negative impact at 3.20%. As a matter of fact, there is a real contrast between the people who know the field and the people who do not (see Figure 20).

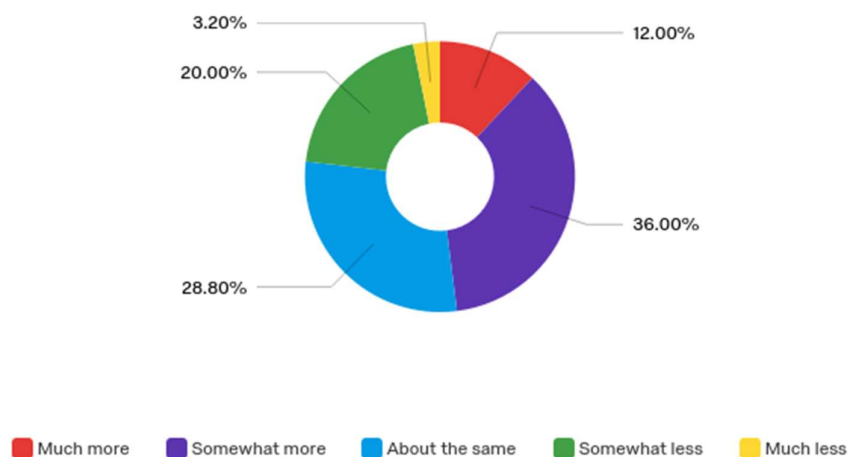


Figure 20: AI impacts on the employment in finance according to the non-financial panel

Source: Survey results

6.2.4 AI and corporate finance

To study and understand correctly the state of the art of Artificial Intelligence inside corporate finance, the answers of this subdivision come from the professional panel. Figures 21 and 22 compare the knowledge of corporate finance of respectively the professional panel and the global panel after giving a definition given to add robustness to the separation of panel. Therefore, the professional panel has a better knowledge of the field and the answers are expected to be more accurate.



Figure 21: Corporate finance knowledge of the professional panel

Source: Survey results

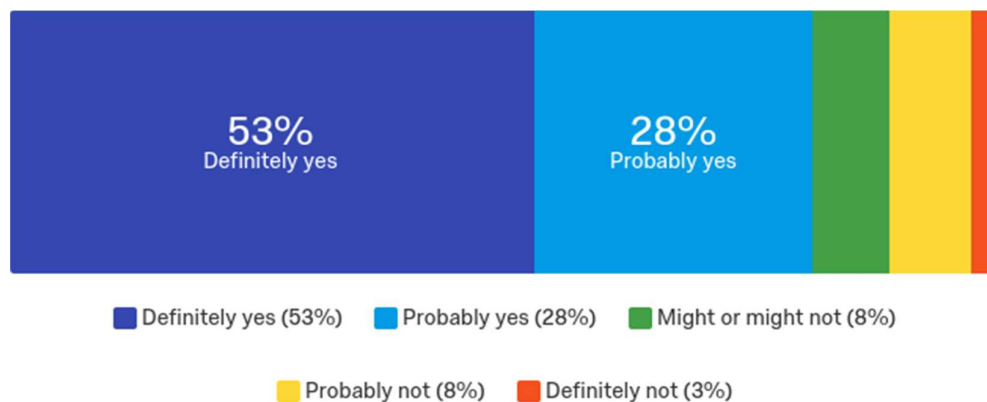


Figure 22: Corporate finance knowledge of the global panel

Source: Survey results

This sub-chapter is divided into two sections in order to study closely and separate more efficiently the current usages and the future expectations.

6.2.4.1 Current usage

Before going further, it is important to notice the good knowledge of the sample representing the population. Only 5% of the panel think AI has probably not been already used inside this specific domain (See Figure 43 in Appendix 11.14).

According to the professional panel and their knowledge, AI in corporate finance is especially exploited in financial planning, business modelling, optimization and valuation. Surprisingly, AI systems are not used as much as expected to make strategic decisions (see Figure 23 in % of responses).

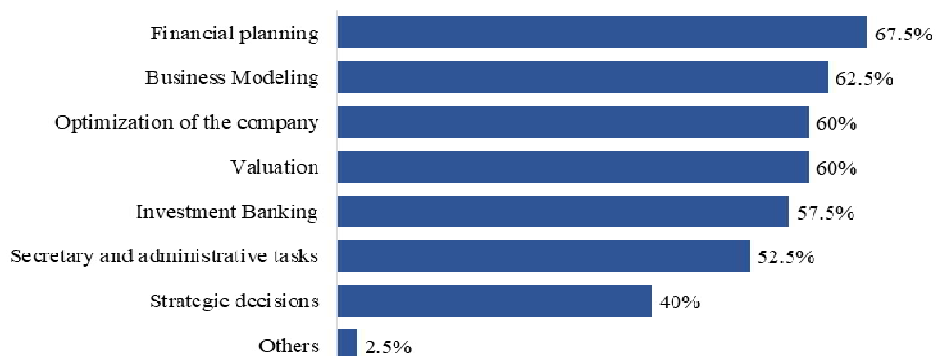


Figure 23: Usage of the AI and the corporate finance departments

Source: Survey results

The reasons behind the use of AI inside organizations are to be faster and to create models as 70.97 and 67.74% of responses demonstrate. Then, the top five is completed with three utilizations (to ease jobs, to crunch data and to do repetitive tasks), which illustrates the tendency to use AI to help and let the worker focus on more human cognitive tasks. This trend is followed by the frightening usage of AI with the purpose of reducing the cost. It means gaining productivity or cutting jobs. Nevertheless, only one half of the respondents aim at using the AI to reduce the costs. The last point that needs to be highlighted, concerning Figure 24, is the low usage of AI in order to help the human inside their decision-making processes. It is achieved by analysing behaviour, advising, optimizing strategies and being more rational.

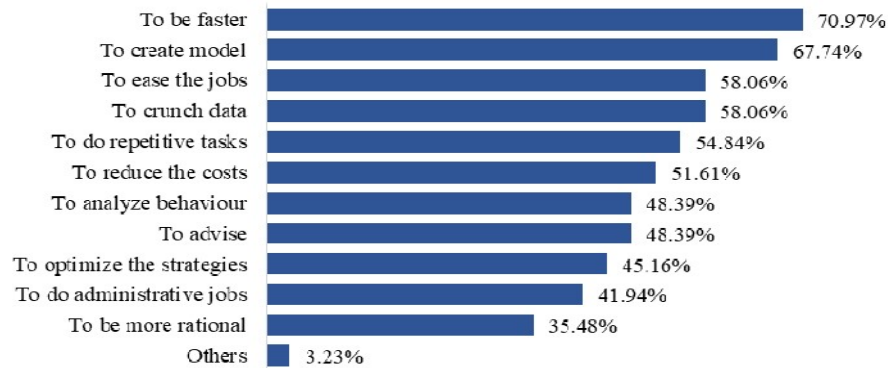


Figure 24: Reasons behind the utilization of the AI inside organizations

Source: Survey results

To conclude this section, the main usage of AI in corporate finance is conducted through Robot-advisor and chatbots, as 76% of the panel chose it (see Figure 44 in Appendix 11.15). However, there are other usages for fraud detection, business trend prediction and quantitative analysis. Those reflect well what has been discovered in the upper paragraph with AI being a support for the human primarily by saving time and facilitating the job.

6.2.4.2 Expectation

After talking about the current impact and reality of Artificial Intelligence within the corporate finance, it is time to look further at the expectation surrounding AI in this specific field.

The impact of AI is expected to be larger in the future than it is currently. It was already demonstrated (see the last paragraph of Chapter 6.2.2), through the eagerness to use AI in corporate finance in the future with up to 84% of the professional panel (see Figure 17).

More concretely, 78% of the professionals would like to use AI more extensively in this field in the future (see Figure 45 in Appendix 11.16).

This statistic is not really astonishing as AI is expected to generate 1.2% of the global GDP growth for the next 12 years (McKinsey, 2018). However, it is startling to observe the willingness to deploy AI inside the same departments within the corporate finance in the future. This willingness is demonstrated by comparing Figures 25 and 23, which have exactly the same ranking illustrating the situational analysis (see Chapter 6.2.4.1).

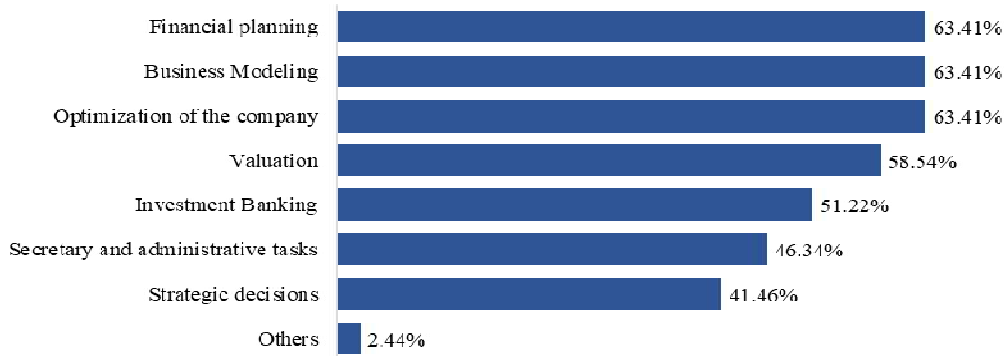


Figure 25: Expected usage of the AI and the corporate finance departments

Source: Survey results

The future implementation of AI in the fields mentioned above should foster the efficiency by gaining time and reducing the costs at respectively 75.61 and 70.73% of responses. The second purpose could have a negative impact on employment if and only if Artificial Intelligence systems are not used as a tool for the human. Then, as it is the case for the goals behind the current utilization, the last three elements of the top five show a trend to use AI in order to help and let the workers focus on more human cognitive tasks. The final tendency, seen in Chapter 6.2.4.1, to help humans in their decision-making processes should still not be the first purpose underneath the future AI implementation in corporate finance. (See Figure 26)

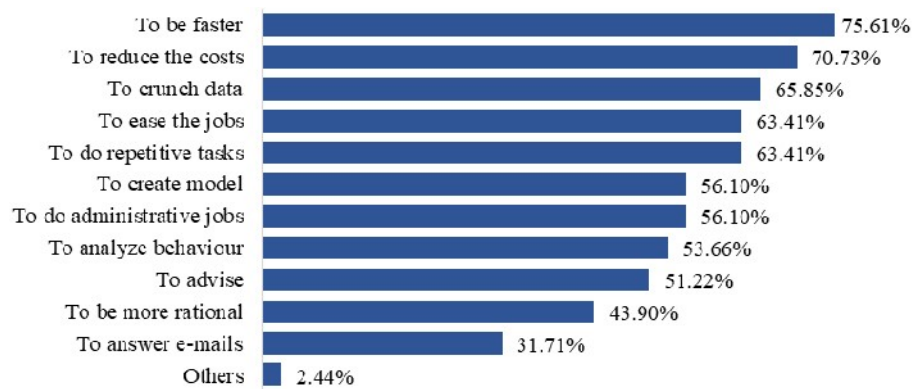


Figure 26: Reasons behind the expected utilization of the AI inside organizations

Source: Survey results

To confirm what is found out above, Figure 27 conveys that 87.80% of the respondents expect AI to be a tool helping to perform a better and faster job. On the contrary,

simultaneously, 21.95 % still expect AI to replace some jobs, as it would be a machine capable to conduct the whole job.

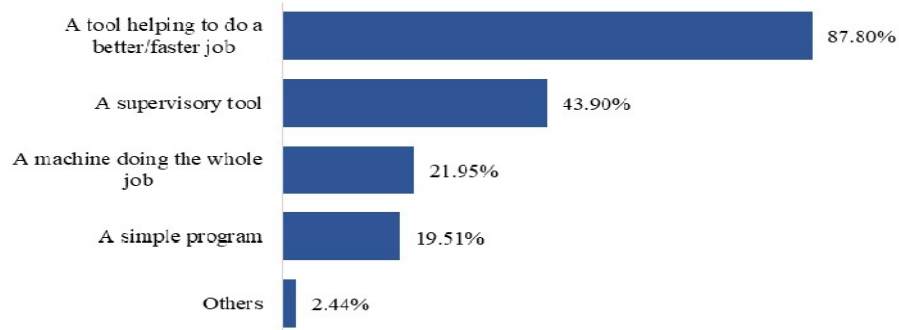


Figure 27: The AI as a human tool

Source: Survey results

An additional piece of information on expectations within the corporate finance in terms of employment exemplifies a big contrast within the financial area. Only 22.22% of professionals foresee a positive impact of AI on the corporate finance employment against 61.9% in the global financial area as exhibited in Figure 19. Therefore, the professionals believe the impact of the AI to be negative in this specific domain with 41.27% of the responses (see Figure 28).

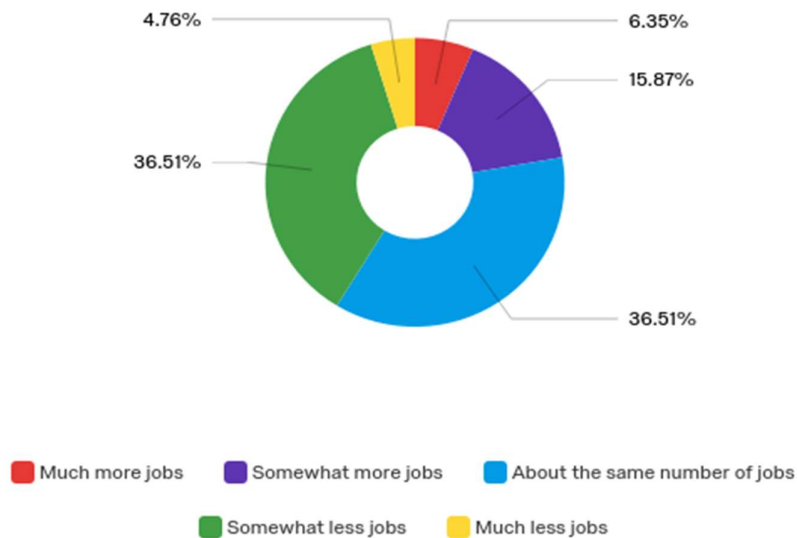


Figure 28: Employment expectations within the corporate finance

Source: Survey results

To complete the statistics revealed on employment, the tasks replaced by AI should be the repetitive tasks, followed by the administrative tasks, the quantitative tasks and the missions related to the industry and market analysis with respectively 82.54%, 66.67%, 58.73% and 53.97% of responses (see Figure 29).

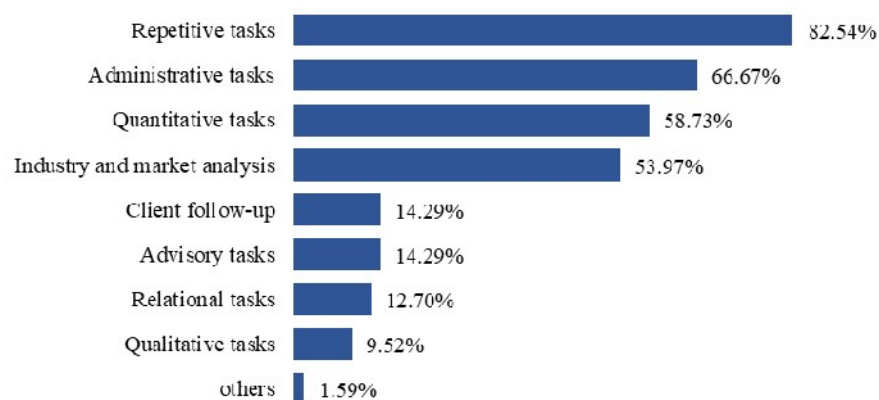


Figure 29: Expectations of tasks replaced by the AI within the corporate finance

Source: Survey results

To conclude, let's take a look at the expectations of the professionals of the fields. As it has been mentioned above, most professionals would use AI to help the human by performing repetitive tasks, data crunching and overall tasks that can be executed more quickly by machines. This involves bringing automated data to the valuation and business modelling process with for example the beta, the risk free rate, the sales and other underlying elements being parts of the model to fill. This help would be performed by Artificial Intelligence systems while the financial worker would execute simultaneously the judgement and human cognitive jobs. In addition to that, some of them said that it could be used to predict and forecast the future after crunching the data. Furthermore, they also foresee AI as a supervising tool to help fighting fraud, to stay in compliance with the standards, to identify the mistakes inside models and to make faster and better due diligence. They emphasize their unwillingness to remove the human element of strategic decision-making and to let the machines play a key role over the human as it goes against morality. However, some respondents suppose that AI would take an advisor role to facilitate the decision-making process with behavioural analysis and trends forecast while being more objective than the human mind. To end the survey analysis, as some people stated it, AI will be used to create more value for their shareholders by increasing the productivity and the effectiveness.

7 The ethics of AI in corporate finance studied through Environmental, Social and Governance aspects

7.1 Introduction to ethics and ESG

According to the Oxford dictionaries, ethics are the “moral principles that govern a person's behaviour or the conducting of an activity” (Oxford, 2019). Those principles have a huge impact on the value of a firm, as partners, investors and customers are requiring more responsibility towards the world. Consequently, companies need to integrate the environmental, societal and governance issues into their decision-making processes and their investments. (Louche and Lydenberg, 2011)

First and foremost, let's talk about the Environmental, Social and Governance aspects of ethics. The ESG differentiates itself from the socially responsible investment, which is screening the socially bad industry, as it is not only based on the negative part of the moral and ethical criteria. Furthermore, the ESG, term coined in 2005 in a study named “Who Cares Wins”, assumed that its factors impact the finance of corporations. ESG analysis takes into account simple and intangible elements such as how corporations respond to climate change, treat their workers, manage their supply chains, build trust and foster innovation. (Kell, 2018)

On top of that, the importance of investing in ESG is increasing considerably. Nowadays, this investment represents \$20 trillion in asset under management around only a quarter. (Kell, 2018)

In order to get an opinion about what the concept of ESG is, Table 4 reveals examples of environmental, societal and governance issues.

Environmental (E)	Societal (S)	Governance (G)
• Emissions	• Stakeholder relations	• Board structure
• Environmental policies	• Working conditions	• Independent directors
• Environmental management systems	• Respect for human rights	• Independent leadership
• Toxic chemicals	• Diversity	• Separation of chairperson and CEO
• Genetic engineering	• Workplace health and safety	• Remuneration
• Pollution	• HIV/AIDS	• Shareholder rights
• Water	• Product safety	• Accounting quality
• Energy efficiency	• Treatment of customers	• Audit quality
• Hazardous and solid waste	• Labour relations	• Board skills

Table 4: Examples of Environmental, Societal and Governance issues

Source: Louche and Lydenberg (2011)

In practice, the corporate social responsibility leads to dilemmas as companies try to balance the competing goals of business, nature, society and finance (Louche and Lydenberg, 2011). Those goals are often in conflict and not always easy to combine as there are a couple of barriers before achieving a more sustainable form of capitalism (Gore AI, 2017).

What is more, several people claim that ESG is a trend that will lose steam in the future. Nevertheless, 3 points prove the contrary (Kell, 2018).

Firstly, transparency and technologies will certainly not vanish. Moreover, their importance should increase in the future. Both allow a better interpretation of non-financial information through Artificial Intelligence and the increase in the amount of data available. (Kell, 2018)

Secondly, environmental changes, such as climate change, are going to be more valuable due to the appreciation of the value of natural assets. As a result, corporations will need to manage their resources more efficiently. (Kell, 2018)

Lastly, investing in ESG allows the investors to express their values and preferences while getting financial return empowered by technological tools, which strengthens the fairness of the analysis. (Kell, 2018)

As it is briefly demonstrated, the ESG should persist. Generally speaking, the ESG analysis allows reflecting the investors' preferences. In addition, AI is able to understand the strategies which underpin economic interests with respect to products, industries and partnerships.

Consequently, the combination of ESG analysis and AI enhances the decision-making process and helps to lean towards a better balance between ESG issues, investors' preferences and financial benefits. (Joshi, 2019)

After an introduction to the ESG and its increasing importance, the following parts of Chapter 7 briefly study and explain the impact of Artificial Intelligence in corporate finance on the Environment, Social and Governance issues.

7.2 Environmental aspect

Among the factors which have financial relevance, the environmental factor with a special focus on climate change is certainly the most important one. It could have multi-billion dollar economic consequences. Moreover, people are pushing towards more transparency and for the Task Force on Climate-related Financial Disclosures. Transparency is a key factor in order to develop solutions as AI needs data to find new solutions. Thus, to improve the decisions toward a better environment, companies need to increase their level of disclosure (Kell, 2018)

An example of disclosure expected by investors comes from Amazon. The company has disclosed its global carbon footprint and is launching several plans thanks to their 200 scientists and engineers dedicated to finding new positive solutions to help its clients, but above all, the earth. In addition to that, a team of German scientists is trying to teach machines to understand cause and effect in order to make more environmentally and socially friendly decisions (Delcker, 2019).

7.3 Social aspects

The use of Artificial Intelligence in workplaces is increasing as technology keeps evolving. The further development will mainly depend on society's perspective. (MAD Team, 2019)

In the workplace, some of the easy repetitive tasks are going to be realised by machine such as entering data, verifying the exactitude, receiving and transmitting information and so on. All those boring parts of the jobs should be left to machines. In a way, it will destroy jobs. However, even more positions should be created for the likes of computer scientists, coders and technicians. The overall results should be an increase of the efficiency in workplaces and new job opportunities created by AI. (MAD Team, 2019)

A lot of people display their multi-tasking abilities inside the financial world. Each 15 minutes, some people switch from one project to another while answering calls, e-mail or listening to a conversation. However, the neuroscientist Daniel Levitin is formal. Multi-tasking does not work because our brain is only able to perform a task at a time. To help people, companies such as Apple, Microsoft, Google and Amazon, launched business virtual assistants. Those allow the systems to perform non-human cognitive tasks while the human focuses on more value-added missions. In this way, multi-tasking is performed by the means of a machine-human environment. (Finnegan, 2018; Gross, 2019)

From a societal point of view, AI combined to the huge amount of data results in better decision-making in order to fix efficiently common problems like traffic jams and the spread of diseases. (MAD Team, 2019) Nowadays, Artificial Intelligence systems help medicine. For instance, Google bots help to detect lung cancers. The accuracy of the diagnosis is improved by removing false positives, and these bots detect 5% more cancers if used alone and 11% if used in collaboration with radiologists. (Ross, 2019)

Nonetheless, Artificial Intelligence could be misused. As shown earlier, Microsoft's robot Tay demonstrates how robots can be operated maliciously (Osoba and al., 2017). Moreover, machines are able to understand and read human actions in order to make decisions. Thus, misbehaviours and manipulations from malicious users could impact society negatively (MAD Team, 2019).

In conclusion, the positive impacts of AI on society are not refutable. Nevertheless, it is impossible to predict if AI will be used to the advantage or the detriment of society as malicious people could misuse it (MAD Team, 2019).

7.4 Governance aspects

Nowadays, some investors try to invest responsibly. A responsible investment is a process which tries to influence corporations' behaviour on issues related to the environment and society. (Kell, 2018) The ultimate purpose is to get financial return through sustainable development with a long-term value creation for the investors, the environment and society (Louche and Lydenberg, 2011).

A responsible investment is a well-known concept in finance. It has a couple of synonyms with some small distinctions between them. Firstly, there is the ethical investment which

stresses on the religious part of decisions, on the environmental impacts and on sustainability. Secondly, the ESG investment veers towards societal aspects such as human rights and the work-life balance. The last synonym is the sustainable investment which emphasizes the governance issues with a particular focus on the shareholders' rights. To summarize, the responsible investors believe every stakeholder has some importance and they encourage executives to manage the company with a long-term perspective. (Louche and Lydenberg, 2011)

Henceforth, responsible investors understand how data from the environment and society combine with the corporation's interface to help executives to manage risk more efficiently and make better decisions (Louche and Lydenberg, 2011). Therefore, Artificial Intelligence in corporate finance is a useful tool and becomes more and more interesting in order to come in with satisfying decisions taking into account ESG issues and economic impacts.

Last but not least, the integration strategy is an approach used by responsible investors to analyse the company's profitability prospects and its stock valuation. This method analyses the ESG factors and intangible assets in order to inform the investors about the reliability and valuation of the company. Thereby, the Artificial Intelligence system discussed earlier to improve the quality of the valuation through better forecast and prediction is a useful tool inside the investment process. Currently, machine learning and big data allow unlocking insights to apply ESG data in addition to the financial data. (Kell, 2018) Furthermore, this approach has recently been gaining ground thanks to large European public and private investors such as pension funds, mutual funds, private equity, foundations, banks and insurance companies. By using more extensively this valuation approach in their final investment process, executives tend to be more careful about their impacts outside the firm, this way helping to improve the level of corporate social responsibility investment planning disclosure. (Louche and Lydenberg, 2011)

8 *Bias of the master thesis*

This thesis tends to focus on the developed countries, mainly from the European Union and North America, and the cutting-edge countries from a technological point of view like China and India. This is due to the highest number of papers coming from those countries. As it is illustrated in Figure 30, there is around the same number of papers published in Europe than in the rest of the world. When the US and China are added, this tendency is even larger. As explained in Chapter 6.1.3, it leads to a cognitive and cultural bias.

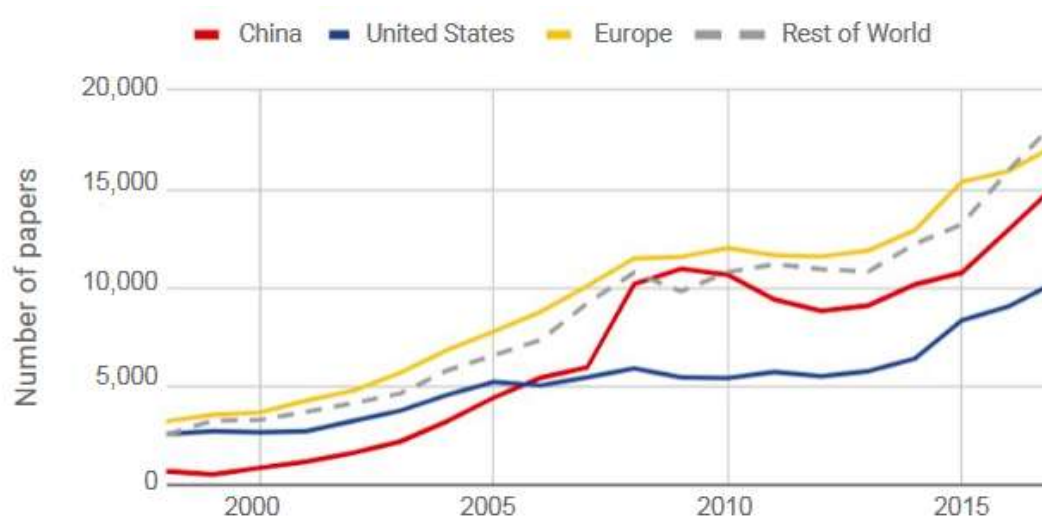


Figure 30: Annually published papers on scopus by region (1998-2017)

Source: Yoav Shoham and al., (2018)

Moreover as stated in Chapter 6.1.3, there is also a bias of representativeness due to the use of English in the survey and a bias of methodology due to the respondents' reasoning and the clarity of the questions.

Finally, the last bias that certainly occurred is an emotional bias from the papers, reports and experts that are in favour or against AI's various utilizations. This last bias has been mitigated by analysing positive and negative elements.

9 *Conclusion*

The purpose of this master thesis was to study the current usage and prospect of AI in corporate finance and the impact of AI on the future of analysts in corporate finance. To get the best view out of this thesis, the literature with facts, experts and examples has been deeply analysed before being supported and mitigated with a survey answered by 167 anonymous people. The conclusion is divided into four parts in order to bring out the most important information. The first part about AI within corporate finance is split up in four parts by focusing on the social aspects, the expectations and the situational analysis with its current impact before finally going through AI technologies used in corporate finance. The second part focuses on AI within the financial fields. The third part is on AI inside the overall fields by explaining the world economic fight against AI. Finally, the last paragraph will highlight the consequences.

9.1 AI in corporate finance

In corporate finance, jobs are expected to be destroyed in the future as 80% of the tasks performed by analysts are repetitive. Thus, the social impact of AI is considered negative in terms of employment. However, those annoying repetitive tasks performed by AI systems will allow the analyst to focus on more human cognitive missions with higher value added. Simultaneously, human workers should work in symbiosis with the machines. Those AI systems would not be set to work alone but would be deployed as a complementary tool for the analysts. Moreover, as Doswell explained, machines are and will never be able to perform human cognitive tasks due to the fact that they only have the quantitative part of the brain inside their code. Furthermore, the corpus callum, where both hemispheres of the brain join and interact, is still not understood. Thus, it is impossible to implement the qualitative part of the brain into AI systems. In conclusion, the societal impact of AI within corporate finance is mixed. On the one hand, jobs will be destroyed. On the other hand, people will have more responsibility by focusing on higher added-value missions.

As the survey demonstrated, the population is eager to use AI inside this specific financial domain and will certainly use it more extensively in the future. Surprisingly, the survey shows the willingness to keep using AI in the same fields, i.e. financial planning, business modelling

and optimization. The future utilisation of AI should focus on efficiency by being faster and reducing the costs. Then, as is the case for the purpose behind the current utilization, there should be a large tendency to use AI to help and let the analysts focus on more human cognitive tasks. To do so, AI would bring automated data and would realize tasks like data crunching, model creation, trends prediction and behaviour analysis. Thus, AI will be used to create more value for shareholders by increasing productivity and effectiveness while reducing the cost of employment.

After the expected social impact and the future AI utilization in corporate finance, the situational analysis is decrypted. The current usages of AI within the corporate finance are not extensive compared to the utilization of this technology in finance and in the overall fields. Nowadays, AI in corporate finance is mostly applied to financial planning, business modelling, optimization and valuation. Surprisingly, AI systems are not used as much as expected to make direct strategic decisions even if it is broadly used inside the decision-making process as described by experts. Organizations apply it mainly through chatbots, virtual assistants and robot-advisers that allow the analyst to focus more on human cognitive tasks as stated in the second paragraph. However, there are other usages with fraud detection, business trends prediction and quantitative analysis. Those reflect well what has been found out in terms of AI helping humans mostly by saving time and making jobs easier. In addition to that, AI improves considerably stakeholders' satisfaction. The productivity and stakeholders' satisfaction enhance the value creation for the shareholders, which is the major objective of the corporate finance.

To create this shareholder value through AI, big improvement has been necessary since the first time the term 'Artificial Intelligence' was coined in 1954. It has been allowed thanks to government and company funding. There are three main AI technologies in corporate finance. Firstly, the Artificial Neural Networks, with the machine and deep learning, which allows dynamic financial market prediction, forecast and decision making. Secondly, the Support Vector Machine with its learning algorithms is deployed for data analysis and pattern recognition. Finally, the Expert System makes use of its ability to solve a variety of problems. To go further, those technologies permit Natural Language processing, speech recognition, forecasting, robotic process automation, optimisation, creation and use of knowledge bases to serve the financial area. Currently, the recent improvement has been focusing mainly on machine learning in order to go deeper in the number of layers as it is the most developed technique.

9.2 *AI in finance*

In the whole financial domain, the main techniques and technologies behind the concept of AI are the same as those used inside corporate finance. However, the utilization of AI is more developed and used in other parts of finance than in corporate finance. The fields where AI is the most used are investment banking and trading. Artificial Intelligence has roots dating to the late 1970s in high frequency trading. It permits to analyse assets and risks without emotional alterations. Nowadays, even the behaviours on social networks are analysed to trade according to the feelings and mood of the population. AI in investment banking is also used as a tool to improve the accuracy, the liquidity and the decision-making process. To give more information about the current financial usage, AI is used in portfolio management with robot-advisers to categorize clients and find suitable investments. Moreover, AI reduces the costs and improves customer satisfaction with chatbots in the banks' day-to-day process. At the same time, it improves sales through more targeted offers. Furthermore, it is also applied in loan and insurance, especially thanks to machine learning as it allows processing a large amount of data, prediction, forecast and behavioural analysis. Undoubtedly, it reduces the default cover and improves decisions through more precise probability calculation. Besides, it is also common in the fraud detection through machine learning due to the incalculable ways to breach security. In that particular area, it should become a necessity as the card fraud increases exponentially. On the one hand, people are less eager to use AI in finance. On the other hand, they think AI will play a major role in the future. Finally, AI is expected to ease jobs and improve productivity without cutting more jobs than those created.

9.3 *AI in the world and its economic impact*

Now, let's draw a conclusion on AI in the overall fields. AI researchers are shifting their focus sector. China tends to specialize in agricultural sciences after spending more than a decade focusing on engineering and technology. After fostering research in social and agricultural sciences, the United States and Europe are doing research in medicine, health and humanities. This move from agriculture is not astonishing as the biggest expected economic benefits of AI are in healthcare, automobile and finance. Moreover, the expected average growth is up to 1.2% of the global GDP during at least 10 years. It should be enhanced by the machine learning systems and its Artificial Neural Network technologies which are

mentioned more and more often in the related literature. This technological revolution pushed by Artificial Intelligence systems could not be realised without funding. Each country tried to be the front runner and implement its own strategy plan. There are two actual front runners, namely the United States and China which set the pace thanks to their enablers, such as high digitalization, innovation, connectedness and world leading trade position. On the one hand, there is China that invests more than the United States. It aims to be the largest Artificial Intelligence centre by 2030 with the willingness to be the first economic and military leader through AI. Thus, China makes every move to reach this objective. One of its main strategies to achieve its goals is to unify its giant private companies that are Alibaba, Baidu Tencent and IFlytek. On the other hand, there is the United States which is the current leader in Artificial Intelligence. Moreover, it is also the first global economic and military power. The first US AI initiative was launched in February 2019 without any concrete plan or strategy. Nevertheless, the US invested largely inside the governmental instance such as the Defence Advanced Research Project Agency and in AI focused companies. Above all, the United States can rely on their private sector with the likes of Microsoft, Alphabet, Amazon, Intel and IBM. Those companies are investing more than heavily in AI. Obviously, they are aware that the front runners will receive the largest benefits.

9.4 What consequences?

In conclusion, corporate finance has not developed its AI potential yet and will start to increase its usage in the next couple of years. The consequence behind this investment will certainly be negative in terms of employment even if AI is used as a tool managed by analysts. However, the first objective behind corporate finance, the creation of value for shareholders, should be achieved for to several reasons. Above all, AI will improve productivity, reduce the costs and permit to work quickly. Finally, analysts will focus more on human cognitive value added tasks by removing the repetitiveness of the job.

Nevertheless, there are two major unknowns. The first one resides in the improvement of AI technologies with the exponential development of machine learning. The second one is about the continuous economic and military fights between China and the United States. This fight is conducted by their private sectors. Consequently, it seems obvious to ask when and where those two powerful states will stop their fights and which will be the final leader in terms of

AI development. It would indeed generate huge economic consequences on the value of companies.

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11 Appendix

11.1 Current landscape of AI strategies

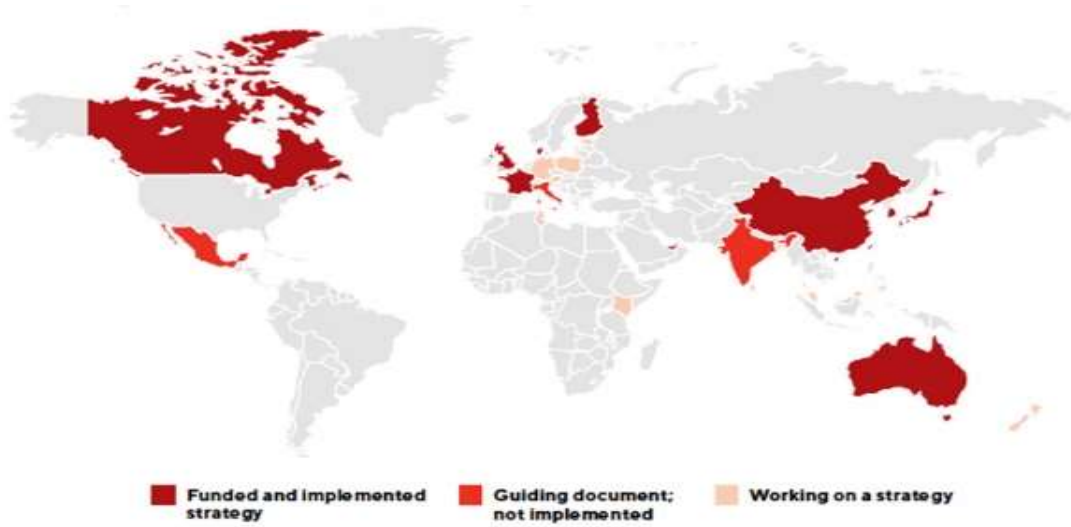


Figure 31: Current landscape of AI strategies

Source: Tim Dutton (2018)

11.2 Most active corporate venture capital groups

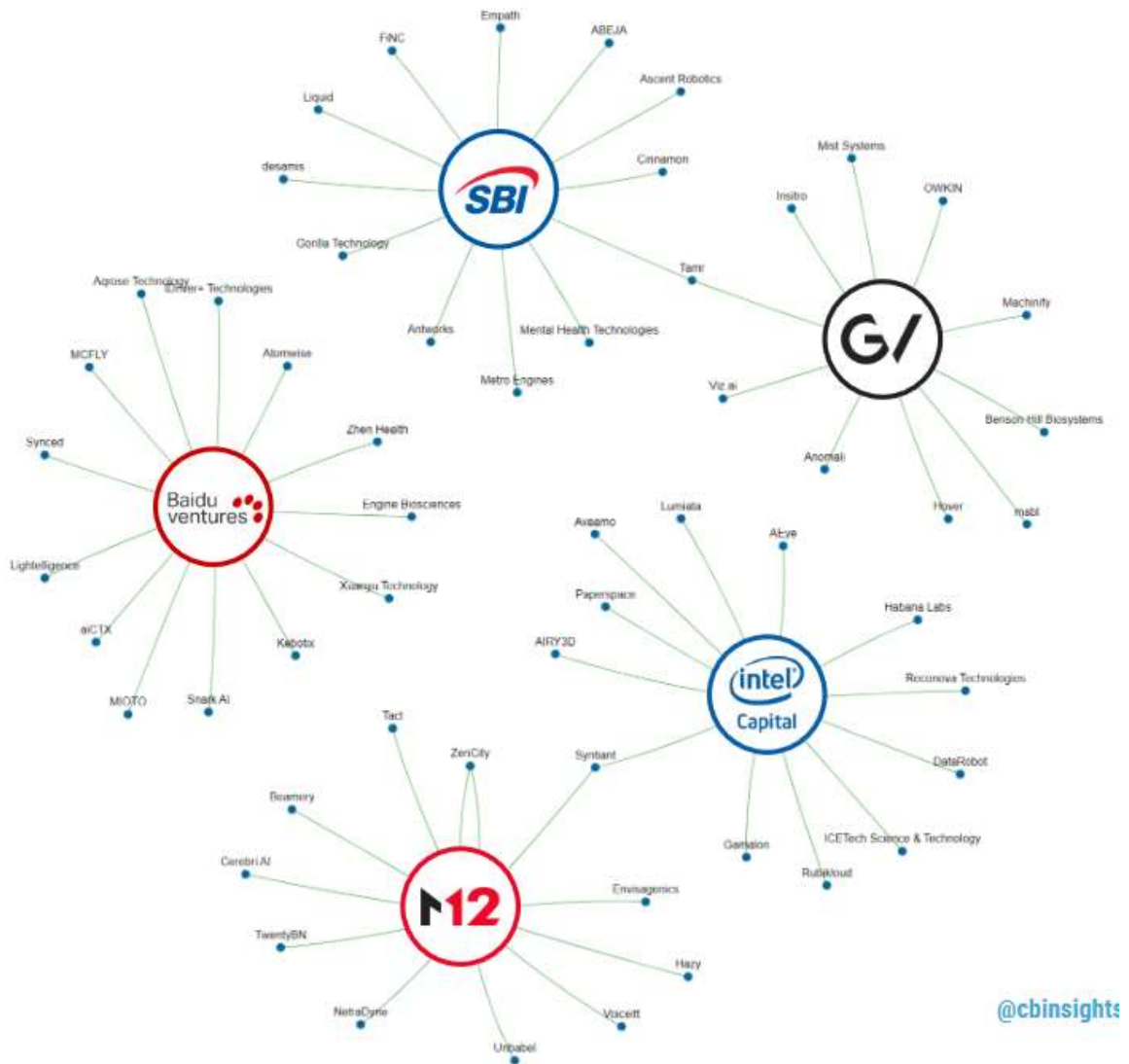


Figure 32: Most active Corporate Venture Capital groups in AI (2018)

Source: CB insights (2019)

11.3 Survey analysis:

11.3.1 Gender distribution

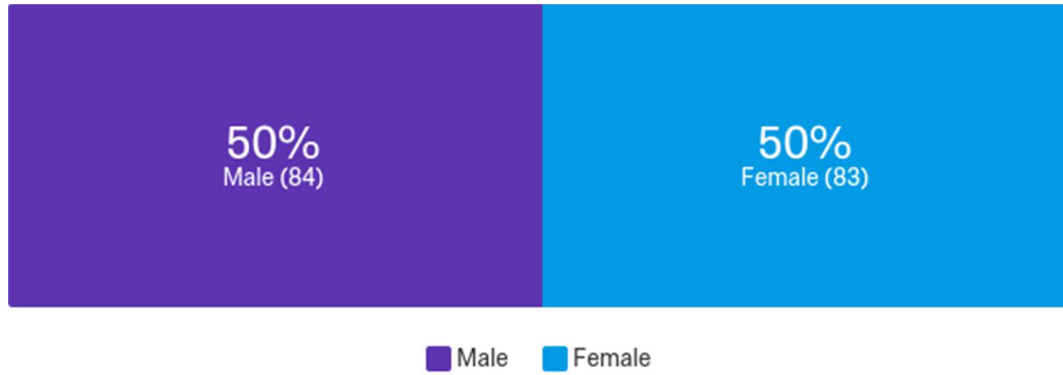


Figure 33: Gender distribution

Source: Survey results

11.3.2 Age distribution

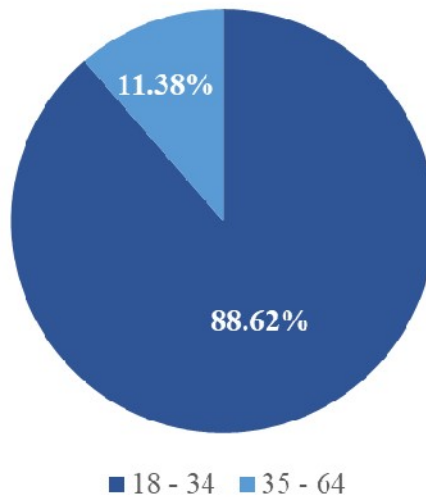


Figure 34: Age distribution

Source: Survey results

11.3.3 Country distribution

Countries	Distribution in %	# of answers
Belgium	63.47%	106
Netherlands	6.59%	11
Germany	3.59%	6
France	2.99%	5
United States of America	2.99%	5
United Kingdom of Great Britain and Northern Ireland	2.40%	4
Finland	1.80%	3
Italy	1.20%	2
Poland	1.20%	2
Romania	1.20%	2
China	0.60%	1
Brazil	0.60%	1
Morocco	0.60%	1
Mozambique	0.60%	1
Czech Republic	0.60%	1
Portugal	0.60%	1
Russian Federation	0.60%	1
San Marino	0.60%	1
Ireland	0.60%	1
Serbia	0.60%	1
Norway	0.60%	1
Denmark	0.60%	1
Egypt	0.60%	1
Afghanistan	0.60%	1
Canada	0.60%	1
Viet Nam	0.60%	1
Australia	0.60%	1
Zimbabwe	0.60%	1
Luxembourg	0.60%	1
Total	100.00%	167

Table 5: Country distribution

Source: Survey results

11.3.4 Are organizations using the AI inside their processes?

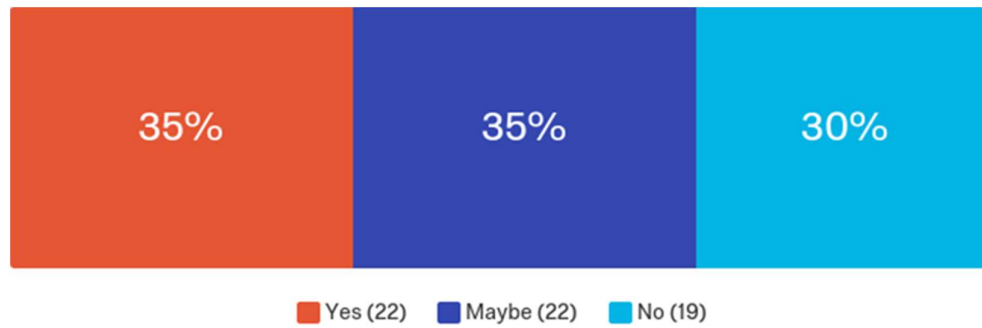


Figure 35: Are organizations using the AI inside their processes?

Source: Survey results

11.3.5 Are people using the AI?

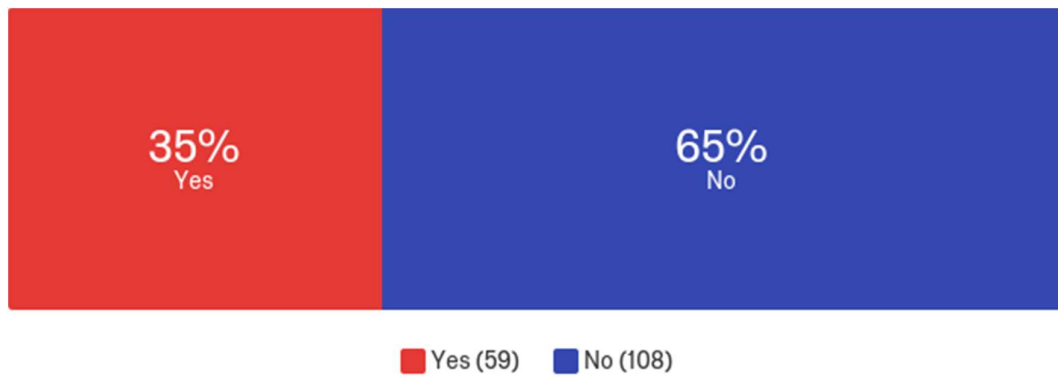


Figure 36: Are people using the AI?

Source: Survey results

11.3.6 Are people afraid to lose their jobs?

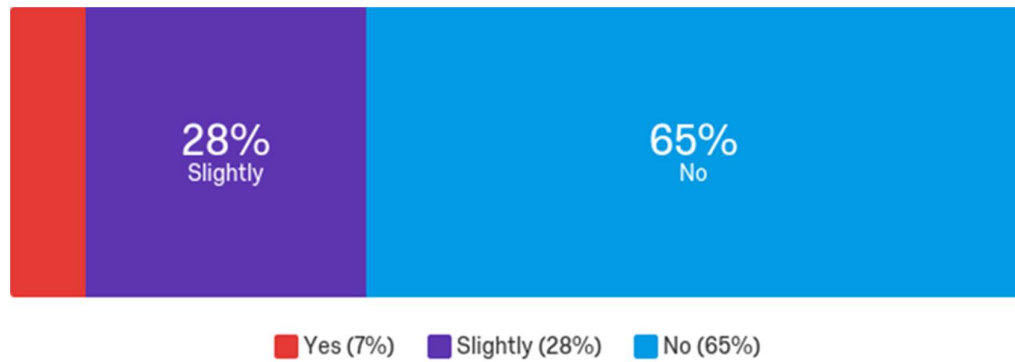


Figure 37: Are people afraid to lose their jobs?

Source: Survey results

11.3.7 Are people agree with the job qualification shift towards more computing and cognitive tasks?

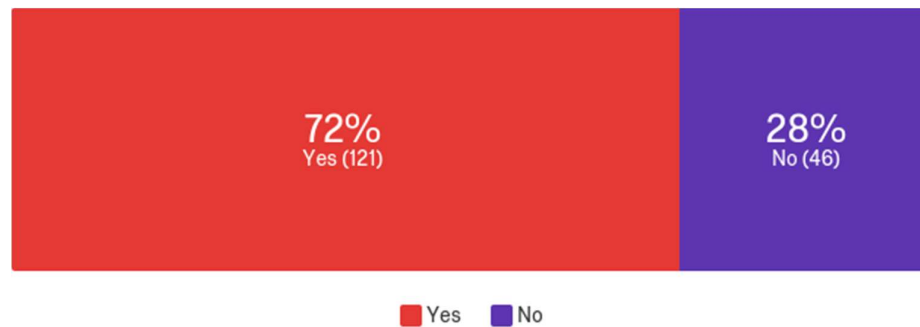


Figure 38: Are people agree with the job qualification shift towards more computing and cognitive tasks?

Source: Survey results

11.3.8 Are people ready to follow courses?

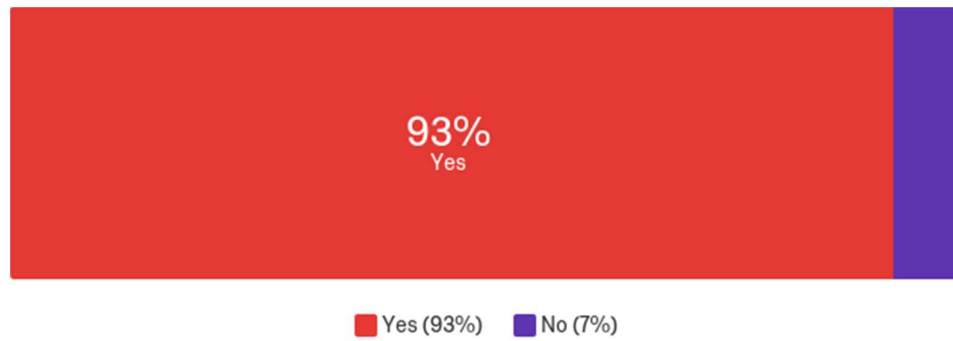


Figure 39: Are people ready to follow courses?

Source: Survey results

11.3.9 Are people eager for a public job transition plan?

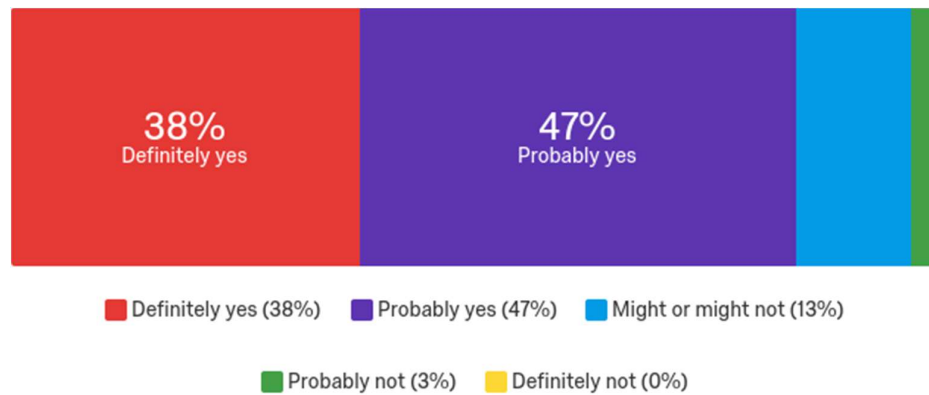


Figure 40: Are people eager for a public job transition plan?

Source: Survey results

11.3.10 *Do people believe the AI is used in finance?*

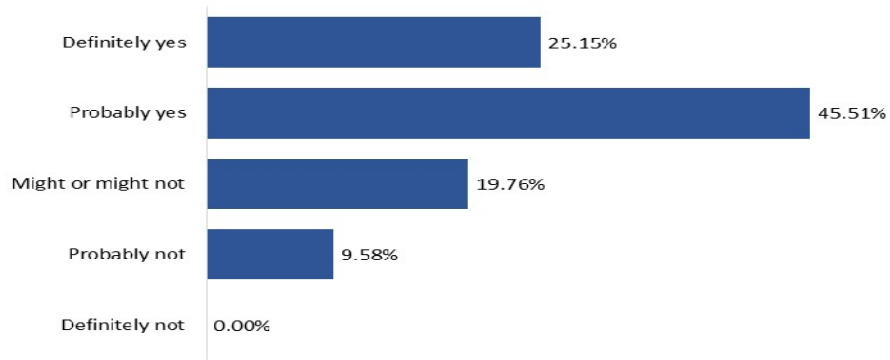


Figure 41: *Do people believe the AI is used in finance?*

Source: Survey results

11.3.11 *Would people with financial knowledge use the AI in the future?*

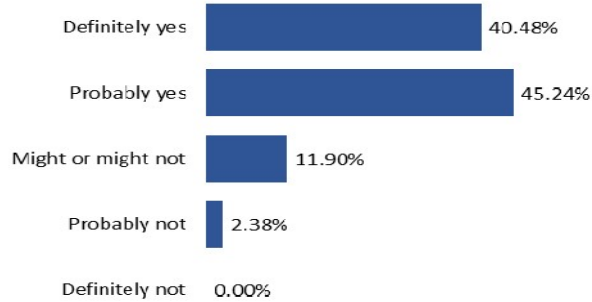


Figure 42: *Would people with financial knowledge use the AI in the future?*

Source: Survey results

11.3.12 Professionals know about the current AI usage

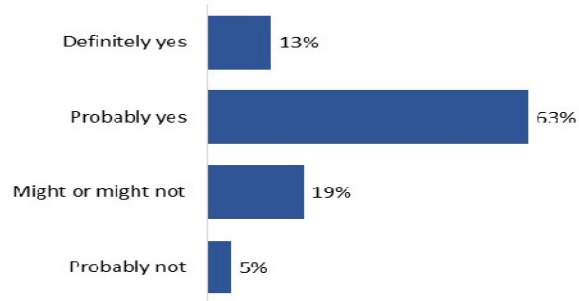


Figure 43: Professionals know about the current AI usage

Source: Survey results

11.3.13 Do professional know other usage than chatbots and robot-adviser?

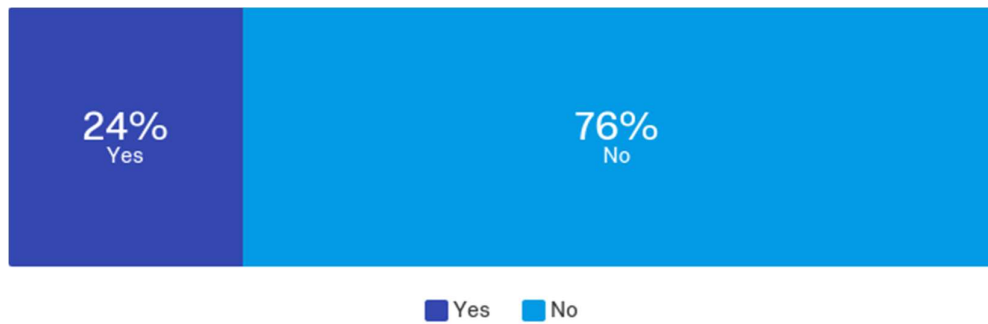


Figure 44: Do professional know other usage than chatbots and robot-adviser?

Source: Survey results

11.3.14 *Professionals would like to use more extensively the AI in the future*

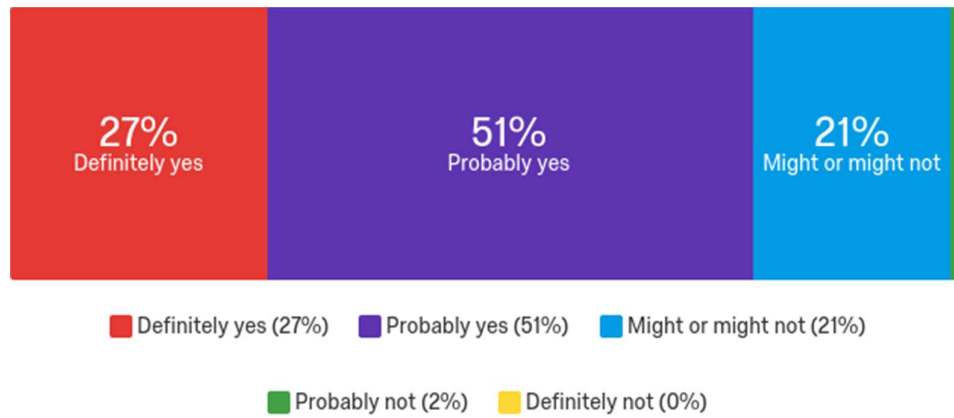


Figure 45: Professionals would like to use more extensively the AI in the future

Source: Survey results

11.4 The survey and its questions

Currently in second year of a double degree Master in Finance, I am doing my Master Thesis on the Artificial Intelligence with a focus on the Corporate Finance.

Inside a master thesis, you have to do your own research and bring something additional to the subject.

Hence, I am launching a survey. This one is decomposed in 6 blocks and will take approximately 10 minutes.

- A) Your background
- B) The Artificial Intelligence
- C) The Artificial Intelligence with a focus on Finance
- D) The Artificial Intelligence with a focus on Corporate Finance
- E) The Artificial Intelligence and the employment
- F) Additional Information

This survey is targeting the whole population as everyone is concerned by the Artificial Intelligence and its development. Nevertheless, some questions differ according to your experience and answers in a purpose of efficiency.

I will use the data by analyzing separately the mind of the professional and non-professional of the sector.

I am thanking you in advance for the completed form.

Corentin Wallon

*By answering this survey you allow myself to use the information given inside my Master Thesis.

A) Your background

A1 What is your gender?

- Male
 - Female
-

A2 How old are you ?

- under 18
 - 18 - 24
 - 25 - 34
 - 35 - 44
 - 45 - 54
 - 55 - 64
 - 65 - 74
 - 75 or older
-

A3 Which country do you come from ?

▼ Afghanistan ... Zimbabwe

A4 Which of the following jobs/industry most closely matches the one you are employed in?

- Banking
- Corporate Finance
- Insurance
- accountancy
- Auditing
- Real Estate
- Marketing
- Public administration/services
- Construction
- Educational services
- Health care or social services
- Medecine
- Manufacturing, transportation and warehousing
- IT & engineering
- Information
- Arts, entertainment or recreation
- Law and order
- Catering
- Farming
- Retired

- Student
 - Unemployed
 - Others
-

Page Break

B) The Artificial Intelligence

B1 Do you know what is Artificial Intelligence?

- Definitely yes
 - Probably yes
 - Probably not
 - Definitely not
-

Page Break

If Do you know what is Artificial Intelligence ? != Definitely yes

B2 Definition of AI according to John McCarthy and Wikipedia.

John McCarthy defines it as “The science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable.”

Wikipedia defines it as "a branch of computer science, whose object is to study the rules of intelligent human behaviours, creation of formal models of these behaviours, and consequently computer programs that simulate these behaviours. It can also be defined as a

branch of computer science dealing with solving problems, which are not effectively solved using algorithms."

Display This Question:

If Definition of AI according to John McCarthy and Wikipedia. John McCarthy defines it as "The scien... Is Displayed

B3 Did you accurately know what is Artificial Intelligence ?

- Definitely yes
 - Probably yes
 - Might or might not
 - Probably not
 - Definitely not
-

B4 How many times do you hear about Artificial Intelligence per week ?

- 0
 - 1 to 3
 - 4 to 6
 - 7 to 10
 - More than 10
-

B5 Is Artificial Intelligence used in your work place ?

- Yes
 - Maybe
 - No
-

B6 Do you personally use Artificial Intelligence ?

- Yes
 - No
-

Display This Question:

If Is Artificial Intelligence used in your work place ? = Yes

Display This Question:

If Do you personally use Artificial Intelligence? = Yes

B9 Could you briefly explain how it is helping you? (You can answer in French; the answer is not mandatory but really useful for me)

B10 Are you eager/willing to use Artificial Intelligence?

- Definitely yes
- Probably yes
- Might or might not
- Probably not
- Definitely not

Page Break

C) The Artificial Intelligence with a focus on Finance

C1 Do you think Artificial Intelligence is already broadly used in Finance?

- Definitely yes
 - Probably yes
 - Might or might not
 - Probably not
 - Definitely not
-

Display This Question:

If Do you think Artificial Intelligence is already broadly used in Finance? = Definitely yes

Or Do you think Artificial Intelligence is already broadly used in Finance? = Probably yes

C2 In which fields of the financial area is it used? (Multiple answer available))

- Corporate Finance
 - Commercial Banking
 - Investment Banking
 - Trading
 - Others _____
-

C3 Would you use more the Artificial Intelligence in Finance?

- Definitely yes
 - Probably yes
 - Might or might not
 - Probably not
 - Definitely not
-

C4 What would be the impact on the employment of the Artificial Intelligence in finance?

- Much more
 - Somewhat more
 - About the same
 - Somewhat less
 - Much less
-

C5 Are you eager/willing to use Artificial Intelligence in finance?

- Definitely yes
 - Probably yes
 - Might or might not
 - Probably not
 - Definitely not
-

Page Break

D) The Artificial Intelligence with a focus on Corporate Finance

D1 Do you know what is Corporate Finance?

- Definitely yes
 - Probably yes
 - Might or might not
 - Probably not
 - Definitely not
-

D2 Definition of Corporate Finance and explanation of the fields.

Corporate finance is the division of a company that deals with financial and investment decisions. Corporate finance is primarily concerned with maximizing shareholder value through long-term and short-term financial planning and the implementation of various strategies. Corporate finance activities range from capital investment decisions to investment banking.

D3 Do you think Artificial Intelligence is already used in Corporate Finance?

- Definitely yes
 - Probably yes
 - Might or might not
 - Probably not
 - Definitely not
-

Display This Question:

If Do you think Artificial Intelligence is already used in Corporate Finance? != Definitely not

Or Do you think Artificial Intelligence is already used in Corporate Finance? = Probably not

D4 In which part of Corporate Finance is it used? (Multiple answer available))

- Valuation
 - Business Modeling
 - Financial planning
 - Strategic decisions
 - Optimization of the company
 - Investment Banking
 - Secretary and administrative tasks
 - Others _____
-

Display This Question:

If Do you think Artificial Intelligence is already used in Corporate Finance? = Definitely yes

Or Do you think Artificial Intelligence is already used in Corporate Finance? = Probably yes

D5 For which reasons is Artificial Intelligence used in Corporate Finance? (Multiple answer available)

- To crunch data
 - To ease the jobs
 - To do administrative jobs
 - To do repetitive tasks
 - To create model
 - To advise
 - To reduce the costs
 - To analyze behaviour
 - To be more rational
 - To be faster
 - To optimize the strategies
 - Others _____
-

D6 Artificial Intelligence is already used in Corporate Finance with the Chat Box (automatic answer on the internet) and the Robot adviser (It analyses the information given and bring out an advice as the type of product the client is most likely interested in).

Do you know other usage of Artificial Intelligence in Corporate Finance?

- Yes
 - No
-

Display This Question:

*If Artificial Intelligence is already used in Corporate Finance with the Chat Box
(automatic answer... = Yes*

D7 Could you explain briefly the usage? (You can answer in French; the answer is not mandatory but really useful for me)

Page Break

D8 Would you use more the Artificial Intelligence in Corporate Finance?

- Definitely yes
- Probably yes
- Might or might not
- Probably not
- Definitely not

Display This Question:

If Would you use more the Artificial Intelligence in Corporate Finance? = Definitely yes

Or Would you use more the Artificial Intelligence in Corporate Finance? = Probably yes

*Or Would you use more the Artificial Intelligence in Corporate Finance? = Might or
might not*

D9 In which part of Corporate Finance would you use it? (Multiple answer available)

- Valuation
 - Business Modeling
 - Financial planning
 - Strategic decision
 - Optimization of the company
 - Investment banking
 - Secretary and administrative tasks
 - Others _____
-

Display This Question:

If Would you use more the Artificial Intelligence in Corporate Finance? = Definitely yes

Or Would you use more the Artificial Intelligence in Corporate Finance? = Probably yes

*Or Would you use more the Artificial Intelligence in Corporate Finance? = Might or
might not*

D10 For which reasons would you use Artificial Intelligence in Corporate Finance? (Multiple answer available)

- To crunch data
 - To ease the jobs
 - To do administrative jobs
 - To do repetitive tasks
 - To create model
 - To advise
 - To reduce the costs
 - To analyze behavior
 - To be more rational
 - To be faster
 - To answer e-mails
 - Others _____
-

Display This Question:

If Would you use more the Artificial Intelligence in Corporate Finance? = Definitely yes

Or Would you use more the Artificial Intelligence in Corporate Finance? = Probably yes

Or Would you use more the Artificial Intelligence in Corporate Finance? = Might or might not

D11 Would you see the Artificial Intelligence in Corporate Finance as ... (Multiple answer available)

- A tool helping to do a better/faster job
 - A machine doing the whole jobs
 - A supervisory tool
 - A simple program
 - You do not see it in Corporate Finance
 - Others _____
-

D12 Are you eager/willing to use Artificial Intelligence in Corporate Finance?

- Definitely yes
 - Probably yes
 - Might or might not
 - Probably not
 - Definitely not
-

Display This Question:

If Are you eager/willing to use Artificial Intelligence in Corporate finance? = Definitely yes

Or Are you eager/willing to use Artificial Intelligence in Corporate finance? = Probably yes

Or Are you eager/willing to use Artificial Intelligence in Corporate finance? = Might or might not

D13 How would you use the Artificial Intelligence in Corporate Finance? (You can answer in French)

Display This Question:

If Are you eager/willing to use Artificial Intelligence in Corporate finance? = Definitely yes

Or Are you eager/willing to use Artificial Intelligence in Corporate finance? = Probably yes

Or Are you eager/willing to use Artificial Intelligence in Corporate finance? = Might or might not

D14 Why would you use the Artificial Intelligence in Corporate Finance? (You can answer in French)

Display This Question:

If Are you eager/willing to use Artificial Intelligence in Corporate finance? = Definitely not

Or Are you eager/willing to use Artificial Intelligence in Corporate finance? = Probably not

Or Are you eager/willing to use Artificial Intelligence in Corporate finance? = Might or might not

D15 Why would you not use the Artificial Intelligence in Corporate Finance? (You can answer in French)

Page Break

D16 What would be the impact on the employment of the Artificial Intelligence in Corporate Finance?

- Much more jobs
- Somewhat more jobs
- About the same number of jobs
- Somewhat less jobs
- Much less jobs

D17 Which part of the Corporate Finance job would be replaced? (Multiple answer available)

- Repetitive tasks
 - Administrative tasks
 - Relational tasks
 - Client follow-up
 - Qualitative tasks
 - Analysis of the industry/market
 - Advisory tasks
 - Quantitative tasks
 - None
 - Others _____
-

D18

According to some reports, more jobs will be created than cut (=delete). However, those jobs won't be the same. People will need to be formed.

Do you agree with it in Corporate Finance?

- Yes
 - No
-

Display This Question:

If According to some reports, more jobs will be created than cut (=delete). However, those jobs won't... = Yes

Or According to some reports, more jobs will be created than cut (=delete). However, those jobs won't... = No

D19 Why? (Briefly; you can answer in French)

Page Break

E) The Artificial Intelligence and the employment

E1 Do you think a public transition plan towards computing jobs would be a good idea? (A public transition plan will allow people to be trained in computing in order to meet the new job opportunities)

- Definitely yes
- Probably yes
- Might or might not
- Probably not
- Definitely not

E2 Would you be ready to follow courses to be able to use the Artificial Intelligence?

- Yes
 - No
-

E3 Are you afraid to lose your job due to the Artificial Intelligence?

- Yes
 - Slightly
 - No
-

E4 Do you think the Artificial Intelligence will replace the human jobs? (Multiple answer available)

- Yes, in the long term
 - Yes, in the short term
 - No, it will be a tool for the human
 - Yes and No, it will only remove the repetitive tasks
-

Page Break

F) Additional Information (Optional)

F1 According to you, the survey was ...

- Extremely clear
 - Somewhat clear
 - Neither clear nor unclear
 - Somewhat unclear
 - Extremely unclear
-

F2 What is your e-mail address?

Executive Summary

Generally speaking, this master thesis discusses Artificial Intelligence inside the corporate finance with the current usage and its prospect in a near future. Even though the topic has worldwide impacts, there is a real lack of knowledge about its situational analysis and future. This thesis is bringing the gap through information retrieved from papers, reports and experts and an evolving survey using qualitative and quantitative analysis.

Above all, AI in corporate finance is clearly a hot topic which is impacting everyone for two reasons. Firstly, the corporate finance is something which touches everyone as most decisions inside organisations have financial consequences. Secondly, Artificial Intelligence impacts or will impact the life of everybody. People are using AI without even knowing it. Moreover, the exponential growth of AI researches are helping people and organizations from the agriculture to the finance with an expected market value counted in trillions of dollars.

Before going into the details, AI including past achievements and human differences is screened in order to have a clear vision of AI development and technologies currently available. It also demonstrates the reasons why AI will work in symbiosis with the humans in most jobs. This is obviously completed by the economic challenges. The governmental AI war between the China and the United States is enhancing the global growth mainly through the private sector funding. This growth is leading to huge private and public disparities according to the level of enablers previously leveraged inside organizations.

More importantly, this master thesis realizes a comparison of AI in corporate finance with the overall fields and the financial domain through a survey and the information retrieved from papers, reports and experts. Therefore, the progresses and expectations within the corporate finance are balanced and permit to stand out a fair mind about the research topic. It is thus proven that the current usages of AI within the corporate finance are not extensive compared to the finance and other fields. However, AI is expected to play a key role as a big part of the corporate finance job is repetitive. At a social point of view, people will have more responsibility by focusing on higher added-value missions even though jobs will be destroyed. Nevertheless, It should lead to shareholder value creation through higher productivity and effectiveness while reducing the costs and improving the stakeholders' satisfaction.