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LIBERA UNIVERSITÀ INTERNAZIONALE DEGLI STUDI SOCIALI

Master Degree in Innovation and Entrepreneurship

UNIVERSITY OF GOTHENBURG

SCHOOL OF BUSINESS, ECONOMICS AND LAW

Master Degree in Innovation and Industrial Management

Organizational implications of AI adoption

A multiple-case study on System integrators

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Graduate School

Academic Year: 2018/2019

Abstract

Digitalization is impacting and transforming businesses. Consequently, companies must take the opportunities coming from the diverse technologies available on the market and be ready to seize and manage them. One technology which is perceived to disrupt into businesses, claiming for adaptation, is Artificial Intelligence. This technology, being characterized by both technical and business knowledge need, is expected to increase the complexity of the decision to Make or Buy it, requiring for more collaborations, and to cause changes in the organizational design, requiring more cooperation and team working. Moreover, AI is expected to eliminate certain tasks but, at the same time create new jobs, revolutionizing the job market and the entire ecosystem. In this context, System integrator companies are playing a big role, being the first actors dealing with the technology and contributing to the AI diffusion. The research in the area as so far concentrated on the technicalities of the technology, so the purpose of this thesis is to focus on the organizational aspects taking the perspective of System integrators, to ultimately provide useful insights to companies willing to introduce AI to build AI solutions. The results of the thesis show that, as it frequently happens for new technologies, the AI impact on organizations is overestimated and the implications brought by the AI introduction are being faced incrementally and gradually by companies. Therefore, more evident implications of AI adoption will be observed only in the future years, in a more mature stage. However, the study highlighted some insight factors already observable, which can give a contribute to companies willing to introduce AI in the future. The main highlights of the research are that to effectively carry on their operations and implement they strategies, System integrators have to adapt the internal organizational setting by introducing appropriate changes in organizational structure, skills and culture, coordinating those activities with the readiness of markets and favouring type of settings which allows for collaboration.

Keywords: *Artificial Intelligence, Organizational implications, Make vs Buy decision, Internal organizational change, Changes to the ecosystem, System integrators, Sensors, Disruptive Technology*

Acknowledgments

After all the challenging personal and academic endeavors, this thesis came into its development. However, it was only thanks to perseveration and hunger for knowledge that all the obstacles encountered were overcome. Moreover, this thesis is not only a result of personal efforts but was achieved thanks to inspiring participants to which I would like to express my gratitude.

First of all, I would like to acknowledge FTK for introducing me to the topic and for all the support given. In particular, I would like to thank Dinesh Kumar, for being supportive, providing me with guidelines and advices, for being available at any time.

My appreciation goes also to all the participants of the interviews, for having taken the time to answer my questions. Without your precious insights and help this thesis would have never come to its completion.

Moreover, I would like to express my gratitude to my supervisor Ethan Gifford at University of Gothenburg, for giving me precious suggestions and having supported me throughout the whole journey. A genuine thank goes also to my supervisor at LUISS, Richard Tee, who accepted my work and had me as a candidate in this complex journey.

I would like to thank my loved ones to which I will be grateful forever. My parents and by brother, for being always by my side, for being my mentors and for all the love sent from far away. Without you I will never be the person I am proud to be today.

Last but not the least, I need to say thank you to all my friends, the ones from Rome, from my hometown and the foreign ones, for having made this journey memorable and full of laughs. Thank you for living together, even if in different countries.

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List of Abbreviations

AI: Artificial Intelligence

OEM: Original Equipment Manufacturer

MvB: Make vs Buy

MVP: Minimum Viable Product

TCE: Transaction cost Economics

TCO: Total Cost of Ownership

IPR: Intellectual Property Rights

1. Introduction

1.1Background

1.1.1 Artificial Intelligence disruption and its organizational implications

Industry 4.0 has been introduced as a popular term for the trend toward digitalization and the introduction of new technologies aimed to the industrial automation, such as 3D printing, Artificial Intelligence, IOT, Cloud computing. According to scholars, Industry 4.0 highlights a new Industrial Revolution where manufacturing operations are driven by smart digital technologies, data are collected and used actively through IoT solutions and machines are interconnected and able to communicate by means of cyber-physical systems[1]. Therefore, industry 4.0 will transform how things are made, how things are moved, how customers interact with companies.

Given the potential impact of all those technologies, companies must be ready to seize and manage the opportunities brought by Industry 4.0. They are trying to understand what necessary technological capabilities need to be acquired, and how to exploit the ones they already have available [2]. Even if a lot of companies adopted technological advances and experimented the related benefits, most of the research was mainly focusing only on the related technical dimensions, neglecting the organizational dimension of the introduced changes. Without properly considering and investigating the organizational and managerial implications of AI introduction and development, managers and companies risk to over-estimate the multiple digital technologies available, the related -technicalities and unpredictable potential, with a negative impact on the business decisions related to the adoption/rejection, management and development of new and currently available technologies.

Moreover, even when companies selected a given digital technology, still a lot of barriers must be overcome on a case to case base[3]. In fact, there is a lot of scepticism towards those technologies also because there are only few business cases available to prove that the investment is worth.

Among the technologies of Industry 4.0, Artificial Intelligence (AI) is expected to have a big impact on the way organizations perform, produce and deliver value. AI is a field which embodies theories and practical techniques to develop algorithms enabling machines, particularly computers, to perform

[1]Budman M., Khan A., (2017), Forces of changes: Industry 4.0, *2017 Deloitte Development LLC*
[2]Budman M, Khan A., 2017
[3] Seifert R. and Markoff R., (2018), Three key questions you will not escape for industry 4.0, *Research & Knowledge* (on-line review)

intelligent activities. Thanks to techniques such as Deep Learning and Machine Learning, AI is able to read and learn through data captured from the environment by means of specific technologies or devices such as data analytics or sensors[4].

When introducing a new technology, whether in a product/service or in a business process, there are implications not only on the technical side, but also on a managerial and organizational perspectives.

Given its features, AI is expected to bring diverse challenges and changes to the organizations which are going to introduce it and more in general to the all ecosystem, including society.

For example, organizations will need to cope with the effects on their organizational design, brought by the peculiarities of this technology. Indeed, AI will require organizations to move away from the traditional top-down structure and develop team-oriented settings[5]. In fact, the integration of AI requires an internal team of experts and engineers of AI's appliance working with frontline teams of the related business[6].

Another challenge which companies will need to face, is with regards to the choice related to the acquisition or the creation of the selected technology. In fact, given that the training of algorithms requires diverse skills and the selection of relevant data, it is more complex to adopt the make-versus-buy decision traditionally faced by companies when investing in new technologies[7]. This decision might become more challenging considering that companies need to evaluate the disruptive effects of the technology on their business and on the customer market before making any evaluation of opportunities and risks[8]. Hence, the adoption of the technology could require the redesign of product/processes, adoption of new business models, change of usual customers, etc. What is more, AI is an evolving technology and companies need to consider the rate of technological change when investing in it. If the technology become obsolete after few years, it is not worth to invest resources and time in it[9]. In fact, the decision of Make vs Buy is not only focused on the present capabilities but, also on the future potential ones.

[4]Boldrini N., (2019), Cos'è l'intelligenza artificiale, perché tutti ne parlano e quali sono gli ambiti applicativi, *AI4Business* (on-line review)
[5]Lindzon J., (2017), How AI is changing the way companies are organized, *Fast company* (on-line review)
[6]Lindzon J.,2017
[7] Ransbotham, S., Kiron, D., Gerbert, P., Reeves, M. (2017), Reshaping business with artificial intelligence: Closing the gap between ambition and action, *MIT Sloan Management Review*, *59*(1)
[8] Kutschera H., Hochrainer P., Schneider D., Thömmes P., (2017), The new make-or-buy question: Strategic decisions in a time of technology, product and commercial disruptions, *PwC Strategy&*
[9] Bartel A. P., Lach S., Sicherman N., (2014) Technological change and the make-or-buy decision, *The Journal of Law, Economics, and Organization*, 30(1), pp. 165–192

Furthermore, in addition to the traditional managerial challenges faced by companies when having a technology-driven change, AI entails specific challenges such the intuitive understanding of AI, the organization of AI, and the comprehension of the human-computer relationship[10].

Moreover, AI is expected to eliminate certain tasks, but at the same time, create new jobs. The skills required by employees will need to be improved and changed.[11] Individuals with the right skills and expertise are demanded by a lot of companies and not always easy to grasp[12]. This will not only influence the HR departments, required to put a greater focus on improving the key employee skills to integrate the new technology, but it will also impact the societal ecosystem, which will need to adapt to the several changes.

Another challenge that companies will meet regards with the creation of a skill gap inside the companies, which will force the organizations to provide training, and the society to arrange appropriate educational courses to fill it[13].

To conclude, AI adoption will involve several organizational implications which will not only relate to technical settings, but also to companies' strategic decisions, such the decision around the appropriate entry point for the technology, and organizational internal setting, such the redesign of the organizational structure. Moreover, those impacts will have in turn some effects to the whole societal ecosystem.

1.1.2 AI disrupting sensors: the role of System integrators

The global market of sensors has been growing more and more in the last years. It is expected to grow at a CAGR of 11,3% for 2022, reaching a market value of 241 billion dollars[14]. Sensors have a lot of different applications in different markets: electronics, industrial automation, transportation, security, building, infrastructure, etc. Sensor technology is growing in complexity and it relies on different specific technologies, which improve their functionalities.

One technology which is disrupting sensor devices is AI. This technology will massively increase the demand for sensors. AI is useful in sensor systems to solve problems that would have required human intelligence automatically[15]. But what is the relation which connects those two elements (AI and sensors)?

[10] Ibid
[11] Lindzon J., 2017
[12] Ransbotham S. et al., 2017
[13] Chitkara R., Rao A., Yaung D., (2017), Leveraging the upcoming disruptions from AI and IoT, *PWC report 2017*
[14] Allied Market Research, (2019), Global sensors market forecast 2022: IoT and wearables as drivers; *I-Scoop* (on-line review)
[15]Sanders D., (2013), Artificial intelligence tools can aid sensor systems, *Journal Control Engineering*, pp.44-48

The basic food for AI is data. It represents the bottom of the pyramid of the AI hierarchy needs[16]. Data is at the same time the most underutilized asset of companies and the most powerful engine of AI[17]. The collection of data can be done by using different tools such instrumentation, logging, user generated content and sensors. Sensors are applicable in diverse businesses and their use, and amount of data collected, is increasing. Those devices are capable of collecting a big amount of data and a lot of companies are not yet leveraging on them, since it does not represent their current business model and activities. With the introduction of AI there is room for a lot of challenging opportunities across different businesses. Both companies producing and using sensors have the potential to exploit these opportunities. For this reason, AI is particularly relevant in the sensor industry and it was interesting, according to the author, to study the AI adoption phenomena within companies using sensors as hardware devices.

However, applying data collected to AI is not really as easy and straight forward as it might seem to be at first glance. In fact data, to be used for the AI processes, once collected, must comply with certain features in terms of elaboration and organization, to effectively feed AI[18]. This may constitute one of the biggest challenges to be faced by companies which use sensors in delivering their value, since they need to learn how to use and elaborate data for AI, once introduced the technology.

Nonetheless, as said, the barriers preventing the adoption of AI by companies concern more the business aspect rather than the technical one[19]. According to a research done by Ransbotham S. et al [20], there is a big misunderstanding inside the companies about what are the resources needed to train AI. Only by fulfilling this gap, companies will be ready to leverage on the opportunities created by the collected data and face the right investments to make it happen.

In this scenario, it is challenging for companies to be able to combine the software part (AI), and the hardware one (sensors) and ultimately find the right application for their business. End users' companies are able to think at the outcome that they want from the final combined solution, but not how to achieve it. In this context, System integrator companies are playing a key role. System integrators are organizations that realize systems from a variety of diverse components, which are able to create solutions requiring hardware, software and networking expertise in several environments[21]. Those companies are contributing to the AI diffusion. Indeed, in the last years, System integrators have been key to enterprises and governments for the implementation of the right

[16]Rogati M., (2017), The AI hierarchy of needs, *Medium* (on-line review)
[17]Sundblad W., (2018), Data is the foundation for Artificial Intelligence and Machine Learning, *Forbes* (on-line review)
[18]Rogati M., 2017
[19]Ransbotham S. et al., 2017
[20] Ibid
[21] Prencipe A., Davies A., Hobday M., (Eds.), (2003), *The business of systems integration*, OUP Oxford

technology system and the individuation of their applications. The role of System integrators is, in fact, evolving as a consequence of the spread of new disruptive technologies such as Blockchain and AI[22].

Consequently, a lot of companies caught the opportunity of adopting AI technology for entering new businesses or to implement or upgrade functions of their existing products and businesses. Therefore, companies which were not recognized as System integrators before the application of AI, were pushed by the technological advance and evolved to become System integrator players.

1.2 Research purpose and question

AI technology is requiring companies to not only adjust their technical conditions, but also to redesign the organizational and strategic models. Organizations which introduced AI are changing their organization, processes and human resources' functions. Moreover, the traditional Make vs Buy decision of the technology is becoming more complex due to the requirements of AI skills and increasing collaboration needed.

In the context described, there are three main different players involved in the supply side of the AI industry **(Figure 1)**. Firstly, there are software makers, which develop AI algorithms. Secondly, there are companies which produce the hardware part, represented by sensors devices suppliers. Thirdly, there are System integrators, whose role is to integrate AI technology with sensor technology and AI algorithms to build customer specific solutions. System integrators are also called solution providers. All these three actors play important roles to support the design, the implementation and the diffusion of AI.

[22] Babu A., (2018), The evolving role of system integrators in the era of blockchain and artificial intelligence, *PCCW Solutions* (on-line review)

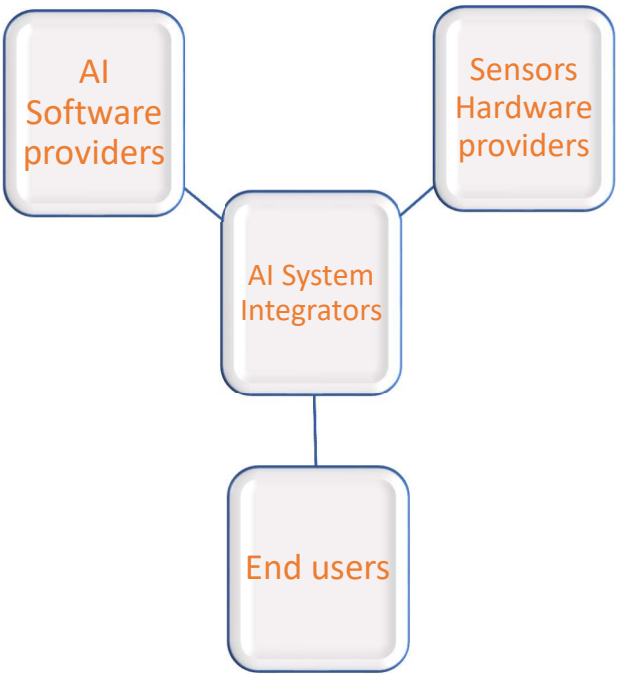

Figure 1: The supply side of AI industry, Compiled by the author

As mentioned in the background section **(1.1.2)**, a lot of companies which were not conceived as System Integrators, happened to turn into this role, in order to provide AI solutions which were designed for the traditional market in which they were operating, as well as, for markets that were out of their core activity. Those companies needed to face the aforementioned challenges and changes brought by the AI technology and needed to consequently adapt their organizations.

Based on those premises, the interest in further investigating how those companies were affected by the AI introduction, which decision they faced and how they evolved their organizations, led to the development of this research.

Therefore, the objective of this research is to investigate on the organizational implications of AI adoption by companies operating as System integrators. Given that the effects brought by the AI technologies are several, the author has decided to focus only on the key aspects shaping the phenomena. These aspects are:

1) the traditional Make vs Buy (MvB) decision of the technology
2) the internal organizational changes needed to align the organization with the new technology
3) the changes to the ecosystem brought by the AI solutions

In this study, the specific perspective analysed will be the System integrators one. This perspective was chosen for the interesting role they play, considering that those companies are key for the AI adoption and diffusion since they act as mediators between the technology technical and business

applications worlds. Those companies are the one entitled to identify the market opportunities for the new technology. Moreover, given that companies operating within this position need to have know-how and competencies of both AI technicalities and their business clients, their organizations will be even more challenged by these double-side capabilities.

The definition of System integrator is always referred as companies which can develop unique complex products through the integration of several complementary components into big product systems[23]. However, for the purpose of this research system providers are to be considered not only companies who are in this position as a core business, but also companies who had the opportunity to become such to address a solution for their own company or to leverage on a new market opportunity.

Even though the AI technology is not at its early stages, its applications in the business environment did not reach yet a maturity stage, therefore this research aims to explore the phenomena described rather than investigate on specific hypothesis.

Therefore, the research question, which is of an explorative type, is:

What are the organizational implications of AI adoption by System integrators?

To sum up, by providing multiple-case examples, the ultimate objective is to offer useful insights and a general understanding of the best practises of AI introduction and related organizational consequences, for companies willing to introduce AI in the future, as well as to provide insights for the entry point choice of the AI technology.

1.3 Research contribution

At the best of my knowledge there are no contributes that have considered to analyse the organizational implications in the specific context of the System integrators companies.

There are academic researches which investigates on the features and technical skills required for AI[24], but few researches have been carried on what are the organizational implications for AI solutions generation. Thus, this research has the opportunity to contribute filling this gap.

[23] Hobday M., (2000), The project-based organization: an ideal form for managing complex products and systems?, *Research Policy*, 29, pp. 871–893

[24] Luger, G. F. (2005), *Artificial intelligence: structures and strategies for complex problem solving*, Pearson education; Kilambi, S., Kilambi, J. (2002), *U.S. Patent Application No. 09/952,519;* Rzevski G., (1975), Artificial Intelligence in engineering: past, present and future, *WIT Transactions on Information and Communication Technologies,* 10

In addition, even though AI is not at its very early stages, there are still not a lot of use cases that companies are provided with[25]. Hence, this research contributes in providing an understanding of this technology in relation to the specific case of companies which apply AI to the specific hardware of sensors.

1.4Delimitations

Some limitations are worth to be mentioned in order to make the reader aware of the boundaries which were set to the research, due to limited time and resource context.

1) The first limitation is represented by the application of the study only to System integrators which use sensors as hardware. This choice was taken not only to narrow down the research focus, but also considering that the sensor market is growing, and more and more AI applications are designed on them, for their ability to capture large volume of data.

2) Secondly, the phenomenon studied could have been analysed under several perspectives, such as the one of the end-users of AI solutions as well as the different actors involved into the supply side. However, this research will be focused only on the perspective of System integrators, since they were the most interesting party to be analysed for their key integrating role, according to the author.

3) Moreover, even though there are several aspects which could have been studied under the umbrella of organizational implications, this research will evaluate only the decision to Make or Buy the technology and the Internal organizational changes and Changes to the ecosystem occurred. This boundary was set due to the limited time of the research conduction (six months) and with the aim of focusing on certain key aspects, rather than obtaining general information on several effects.

4) Lastly, it is worth to consider that this research has been designed and conducted with the support of three different actors, two thesis supervisors coming from different countries and a consulting company (FTK), which required slightly distinct outcomes and conditions. However, during the whole research project, the author tried to implement a work which could have been of interest to the all parties, even though they had different objectives.

[25] Seifert R. and Markoff R., 2018

1.5 Disposition

The structure of this research is defined as follows. In the first part the background of the research, its purpose and research question are presented, followed by the delimitations and disposition. Then, the second part is addressed to discuss the theoretical framework, which includes definitions and concepts of AI, and academic theories used in the study (Make vs Buy decision framework and Organizational change theories). In the third part, the methodology used to conduct the research is reported. Then, in the fourth and fifth part the empirical findings are respectively reported and discussed. Lastly, part six contains the conclusion.

2.Theoretical framework

This section illustrates the theoretical framework that contains key concepts to develop a general topic understanding and the academic theories used to explore the phenomena. The section is crucial to build up the guidelines for data collection and the reasoning of data analysis. In particular, in the first part, AI definitions, data relationship and key aspects shaping organizational implications for System integrators will be presented. Then, summarised theories with regards to Make vs Buy decision and Organizational change will follow. Lastly, a summary of the theoretical framework is reported.

2.1 Artificial Intelligence

2.1.1 History and definition

AI is leading the path to the next wave of digital revolution and companies need to be prepared to face that revolution[26]. Moreover, AI is expected to modify aspects of working life as well as human personal aspects, causing a shift similar to the one experienced with the introduction of personal computers in 1980s[27]. As for computer's introduction, AI accelerated innovation process and boosted the economy[28].

AI has been studied since the 50s and it is still in the spotlight for researchers due to its continuous developments and progresses. John McCarthy was the founder of the term Artificial Intelligence in one of his academic conferences in 1956. However, the roots of the topic can be deployed previously and can be accounted to Alan Turing, which published a paper concerning machines able to act intelligently and behave as humans, doing actions like playing chess[29]. From that point, a lot of

[26] Chui M., (2017), Artificial intelligence the next digital frontier?, *McKinsey and Company Global Institute*, *47*
[27] Chitkara R. et al., 2017
[28] Ibid
[29] Smith C., McGuire B., Huang T., Yang G., (2006), *The history of Artificial Intelligence*, University of Washington

progresses have been made both concerning mathematical models and hardware research[30]. However, the progress has been steadily since the '50s and the funding for AI research has been reduced in the last decades of 20th century[31].

Nevertheless, there is a combination of forces which is pushing the growth of AI in the very recent years. Those forces are represented by the fact that the boosting of computing power has become dramatically rapid and big amounts of data can be processed very fast. Moreover, this acceleration has led to a decrease of costs, which in turns is rising potential returns. Another important booster, is the growth of talents within this field, caused by the growing of university programs on the AI technology. Lastly, the cultural barriers, represented by the consumer acceptance of "smart features", are decreasing since consumers are approaching to them more and more[32].

It is important to provide an AI definition in order to understand what it is and what are its features, to ultimately be able to recognise the technology. Indeed, as the John McCarthy famous quote says *"As soon as it works, no one calls it AI anymore"*[33]. The world is surrounded by AI applications but, people do not realize that they have AI technology in their daily life. For this reason, AI is often perceived as a mythical future prediction rather than a reality[34]. Therefore, a definition and a description of the AI characteristics and functions, is provided in the following lines.

Nowadays, AI is an acronym used for several technologies which can be classified according to three actions: *sense, comprehend and act*[35]. *Sense* concerns the ability to perceive real time pictures and sounds in an active way. It can be observed in computer vision or audio processing. The activity of *comprehend*, instead, consists in the analysis and understanding of collected information. Whereas, *act* concerns systems acting in response to specific signals[36].

Under a technical point of view, a simply way to describe AI functioning, is under four different functional levels: *comprehension (*AI is able to correlate data and events and recognize images, videos, tables and report information); *reasoning* (the logic systems enabling AI to connect a vast array of information); *interaction* (the activities concerning AI and human interaction); *learning*, (the analysis and knowledge taken from data)[37]. As for the latter, it is worth to mention a technique used for it, known as Machine Learning. Machine learning is a process that gives training data to learning

[30]Boldrini N., 2019
[31]OECD, (2017), OECD Digital Economy Outlook 2017, OECD Publishing, Paris
[32]Evans H., Hu M., Kuchembuck R., Gervet E., (2017), Will you embrace AI fast enough?, *A.T. Kearney* (on-line review)
[33]Vitale A., (2018), Artificial Intelligence, Milan, Egea
[34]Urban T., (2015), The AI revolution: The road to Superintelligence, *Wait but why* (on-line review)
[35]Purdy M., Daugherty P., (2016), Why artificial intelligence is the future of growth, Copyright 2016 Accenture
[36]Ibid
[37]Ibid

algorithms[38]. Those algorithms, in turn, generate new algorithms based on the information obtained by the data.

In this view, AI can be defined as the discipline that includes theories and practices for the development of algorithms able to enhance machines to show intelligent activities[39]. In other words, AI is the ability of machines to work purposely when facing specific tasks and scenarios they are planned to perform and interact with[40].

Another dividing line, which is commonly related to AI definition, is the so-called distinction between "*Strong AI"* and "*Weak AI*", which is also known as "*General AI"* and *"Narrow AI"*. Strong AI defenders believe that once applied AI to a machine, this become able to think and be as conscious as humans. Whereas, supporters of Weak AI definition, argue that AI is only able to solve complex problems and it is not intelligent in the way humans are[41].

For the aim of this research, the focus will be put on Weak AI, since this definition refers to the technology as performer of only one task. The reason why the Strong AI was excluded, is that its business potential is long-term compared to the Narrow AI[42].

2.1.2 AI and Sensors: System integrators leveraging on data

With complex systems and products, such AI solutions, system integration is a fundamental competence to have[43]. System integration is intended as capability which creates competitive advantage for firms, since it generates new product development[44]. Therefore, System integrators that put in practice this capability can play a key role in the context of AI. Their major task is to integrate several technologies to hardware and knowledge[45]. According to Davies et al. *[46]*., System integrators are *a prime contractor organization responsible for the overall system design and integrating product and service components supplied by a variety of external suppliers into a functioning system.* Similarly, Prencipe et al.[47] define System integrators as those organizations which design systems

[38]Internet Society, (2017), Artificial Intelligence and Machine Learning: Policy Paper, *Internet Society* (on-line review)
[39]Boldrini N., 2019
[40]Ministry of Economic Affairs and Employment of Finland, (2017), *Finland's Age of Artificial Intelligence*, Helsinki, p.15.
[41]Cimatti, A. , Pistore M., Roveri M., Travers P., (2003), Weak, strong, and strong cyclic planning via symbolic model checking, *Artificial Intelligence* 147(1–2), pp 35-84.
[42]Chui M., 2017
[43]Prencipe A. et al., 2003
[44]Hobday M., Davies A., Prencipe A., (2005), Systems integration: a core capability of the modern corporation, *Industrial and corporate change*, *14*(6), pp.1109-1143
[45]Hobday et al., 2005
[46] Davies A., Brady T., Hobday, M., (2007), Organizing for solutions: Systems seller vs. systems integrator. *Industrial marketing management*, *36*(2), pp. 183-193
[47] Prencipe et al., 2003

with the use of a variety of components, which combined with hardware and software, create solutions.

For the purpose of this research, the role of the System integrators, is to combine AI software with Sensor device hardware. For this reason, it is important to clarify the way those two components are connected and can be combined.

The link between AI and sensors is data. Indeed, there is an important interdependence between AI and data[48]. The algorithms of AI are not born intelligence and they must be trained by data. Hence, the access of data provided digitally and in an appropriate form, is key for the AI application[49]. This applies for all the types of data, such as the data collected through sensors about the status of machines and environments as well as data created by human hands[50].

This aspect can be faced by adopting the Maslow's hierarchy of needs. In fact, inspired to this theory, a pyramid of AI needs has been designed **(Figure 2**)[51]. Data collection is placed at the bottom of the pyramid. Companies must build the right infrastructure in order to implement data science algorithms. Once data are made accessible, they can be explored and transformed. This requires data cleaning, which is a process that assures reliability of data and that nothing is missed. Then, companies can build what is known as *analytics* and define the various elements to trace the data (intermediate part of the pyramid). This process helps in defining the features that will later be incorporated into the machine learning models. Once companies know what they need to learn or predict, they can start to generate the training data. The last step is to test the framework designed and ultimately deploy AI algorithms. In this way the top of the pyramid is reached.

[48] Ibid
[49] Vinnova, 2018
[50] Ibid
[51] Rogati M., 2017

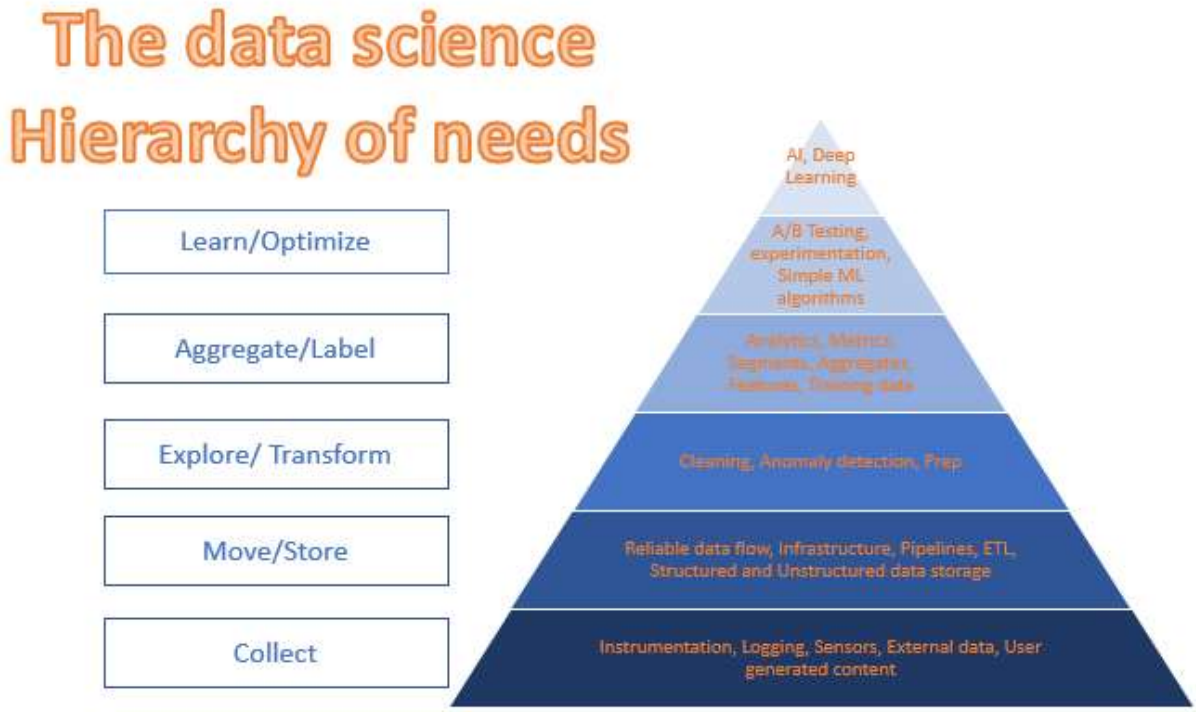

Figure 2: The data science Hierarchy of needs, Based on Rogati M., 2019

The AI models are powered not only with data coming from the collecting devices, but also with other sources of data that can be used in the solution[52]. Moreover, the data used in the model can be structured but, also unstructured. However, before being effective for AI, unstructured data must follow the cleaning procedure previously mentioned.

Nonetheless, most of the data produced in the society and in social processes are not presented in a standardized way and this does not facilitate their combination and procession. It is important to standardize them in a way that they are uniform in terms of content and format. This ultimately permit AI to create value from them[53].

In order to be successful, companies need to prepare programs for the digital transformation such as setting up the appropriate data ecosystem, define or acquire appropriate AI tools and identify use cases[54]. In addition, big changes must be done within the organization and in running of operations that are not currently digital in order to introduce AI solutions[55]. Many companies do not still have

[52] Chiang C., (2018), In the machine learning era, unstructured data management is more important than ever, *Igneous Blog* (on-line review)
[53] Vinnova, 2018
[54] Chui M., 2017
[55] Vinnova, 2018

analytics experts and cannot access their own data easily[56]. Moreover, often companies are unaware of the ownership of their data and ignore that they may not be able to access them[57]. It is also worth to highlight that with the expansion of data flows, companies need to understand the way to manage, analyse and determine useful insights from them[58].

The skills needed to apply adjustments to data, in an adequate and resource-efficient way, are based on a competence combination of AI and data scientist[59]. Organisations that have both appropriate skills and data combination have shown much more benefits compared to those who lack one of them[60]. Thus, given that data and skills both play a fundamental role, it is fundamental to have a data science team ready to analyse data. This is a key aspect for companies aiming to exploit new opportunities and strengthen or defend their competitive advantage, given the rapidity of both the technological change and the knowledge management processes enabled by the availability of learning techniques and tools.

Therefore, System integrators need to develop or acquire the aforementioned skills and data architecture in order to succeed and increase their competitive advantage.

2.1.3Opportunities and barriers

User companies of AI solutions are benefitting from AI in the way they organise and generate insights for new ideas as well as handle their customers relationship. In particular, a study carried by Stancombe C. et al[61], highlights and reports cases of the fact that AI is increasing sales, improving operations by cutting costs, raising the efficiency of customer service. Therefore, System integrators must look at those effects and develop accordingly the solutions for the several use cases.

Moreover, technological innovation enables the establishment of markets that did not exist before. For instance, the disruption of Internet created the market for e-commerce[62]. In the same way, the introduction of AI technology will lead to the creation of new business opportunities. Even in this case, System integrators are responsible for the individuation of possible opportunities and creation of new markets. In fact, as said in the introduction **(1.1.2)**, a lot of companies turned into System integrators caught by the opportunity of extending their market or improving their offering.

[56] Ransbotham S. et al., 2017
[57] Ibid
[58] Chitkara R. et al., 2017
[59] Vinnova, 2018
[60] Stancombe C., Thieullent A., KVJ S., Chandna A., Tolido R., Buvat J., Khadikar A., (2017), Turning AI into concrete value: the successful implementers' toolkit, *2017 Capgemini Consulting*
[61] Ibid
[62] Chitkara R. et al., 2017

In this view, AI is seen as an opportunity by executives considering that it will help the organization in cutting costs, obtaining a sustainable competitive advantage and creating new business opportunities[63].

Having observed that AI opens up for many and challenging opportunities, an interesting question is why are companies lagging in adopting it? The answer may be attributed to several factors. One factor is represented by the fact that a lot of markets are not ready for the introduction of AI solutions[64]. Even if most companies' executives perceive the disruption as an opportunity, there are also some risks that might arise from unpredictable disrupting phenomena. One of them has been identified as the increase of competition among companies[65]. In fact, scholars have underlined five key changes that will shape a new competitive landscape: the generation of higher revenues, an improved safety, a reduced loss due to accidents, a decrease of the operating costs and an improved customer experience[66]. Therefore, even though all the companies will be benefitted by the same effects, the competitive landscape will completely change. Consequentially, companies might be sceptical to adopt AI solutions.

Another factor which is slowing the taking over on the technology is represented by the several barriers to the adoption of AI, which have been identified by scholars. The top three barriers for pioneer companies are the development of the right AI talent, the competing investment priorities and the cultural resistance to AI approaches[67]. However, the barriers differ according to state of technology adoption within the organization. Indeed, there is a relationship among the aforementioned barriers and the rate of adoption[68]. Those barriers are obstacles for the System integrators seen as they represent a resistance to the AI solutions adoption.

2.1.4 AI organizational implications: key aspects

As already mentioned in the introduction **(1.1.1**.), the spread of AI applications is taking up to several implications. The author decided to classify key aspects shaping the implications under three different labels **(Figure 3),** which are the Make vs Buy decision, Internal organizational changes and Changes to the ecosystem.

[63] Ransbotham S. et al, 2017
[64] Ibid
[65] Ibid
[66] Chitkara R. et al.,2017
[67] Ransbotham S. Et al,2017
[68] Ibid

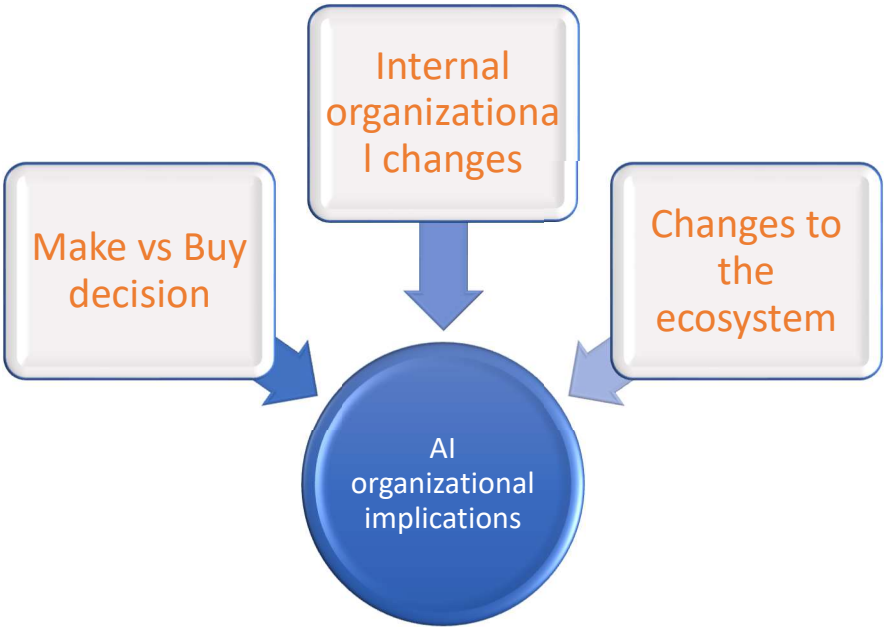

Figure 3: AI Organizational Implications, Compiled by the author

Make vs buy decision

When a technology needs to be introduced inside a business, there are two are paths that a company can follow: acquiring the technology by another entity or developing it internally. The decision regarding which path to follow, gets more complicated when it comes to AI. Indeed, generating value from AI is more complex when deciding to develop or buy the technology for the business processes[69].

The decision to make vs buy is influenced by the need to train AI with the right algorithms. This process requires a lot of diverse skills such as the ability to build algorithms, the ability to collect and then integrate data in the solutions and the ability to train the algorithms[70]. People with different disciplines are needed.

The first thing companies aim to do, when dealing with the first projects around AI is to develop the right experience for building solutions[71]. There are different ways to acquire the right competences. When a company rely on external parties, it can benefit from the quick access to specialised expertise. However, this path does not increase the overall organization competences and experience[72]. Furthermore, given AI business-technical peculiar double capabilities need, even when companies

[69] Ransbotham S. et al., 2017
[70] Ibid
[71] Vitale A., 2018
[72] Ibid

decide to buy the technology from an external party, still workers that know how to structure the problem and have the domain business knowledge, need to co-work with the external party for the development of the AI algorithms[73]. Therefore, companies must take in mind that collaboration is needed. On the other hand, a company can develop competences internally and absorb all the capabilities in the organization, even though it will require long time. Moreover, in this case companies must assess in advance if the right talent needed is available in the job market[74]. This last may constitute an issue considering that, as already mentioned **(1.1.1)**, there is a scarcity of individuals with the right skills and expertise[75].

Indeed, an aspect that influence the decision to make or buy the technology, is related to the scarcity of AI expertise. Most of the talents work for universities research centres, even though there are also some dedicated teams in big companies[76]. In fact, according to a study carried by Tencent[77], people with AI expertise are around 300 thousand and the request is over millions.

In addition, another thing that companies need to additionally consider is the speed at which they could be able to access the frontier research (state-of-the art research) and take it to production[78]. It is important to support innovations in this field, whatever is the mode in which a company decides to do it. Therefore, companies must consider if investing internally would make them a quicker access to the latest AI findings or whether to outsource the production, being able to have the latest technology in their structures.

Some previous researches made on empirical data, already report how companies are dealing with the Make vs Buy choice. From a research carried by Ransbotham S. et al., it has been outlined that pioneers of the market prefer to develop technologies and the related skills internally, while organizations that are less experienced tend to outsource technology and the skills needed[79]. Moreover, a research carried by Chui M.[80], reports big technology companies (which is the category identified as leading adopter of AI) tend to "make" the technology rather than "buy" it.

Internal organizational changes

[73] Ransbotham S. et al., 2017
[74] Vitale A., 2018
[75] Ransbotham S. et al.,2017
[76] Vitale A., 2018
[77] Tencent, (2017), *Global AI talent white paper*, 2017. In Vitale A., (2018), *Artificial Intelligence*, Milan, Egea
[78] Vitale A., 2018
[79] Ransbotham S. et al, 2017
[80] Chui M., 2017

The process of AI integration within the organizations is increasing the collaborations and the teamwork, reshaping the traditional top-down hierarchal structures[81]. According to the CEO of Bench, in order to integrate AI, it is fundamental that people with technical AI knowledge mix up in teams with people that have the product knowledge[82]. Indeed, companies are shaping their organizations in order to be more team-centric and be ready to adapt to the technological disruption[83].

New competences are required by companies since AI demands both specific technical and soft skills. For what concerns technical skills, there are three new roles which are now required in companies: Data scientists, Machine learning Engineers and Data Engineers[84]. Data scientists are encharged of make analysis through advanced tools and find better algorithms applicable to data, to ultimately get an overview of the situation and make better decision. Machine learning engineers have statistic and programming skills to produce algorithms to be integrated with systems. Lastly, Data engineers develop infrastructures to deal with big amount of data and are specialized in databases. Soft skills required, instead, concern the communication and the sharing capability of AI results. Those type of skills are even more essential when a solution is designed for new services or projects. Indeed, people with a deep knowledge of the topic around which the solution is designed (domain competences), need to communicate with people with technical expertise[85]. Here stands the importance of cross-functional teams[86], where people with different domains collaborate to reach a common goal.

In order to gather the talented human resources, a lot of companies are doing what is known as "acqui-hiring"[87]. Indeed, from a study carried by Chui M.[88], it emerged that big tech giants, such as Amazon, Google and Facebook, are acquiring AI start-ups, not only for their technology but also, mainly to acquire their talented employees[89]. Moreover, a lot of companies are expanding abroad to seek for talents. However, as mentioned before, even though universities are developing talents, there is still a scarcity of people that have the right capabilities to build AI[90].

For what concerns managerial implications, there are additional challenges to the traditionally faced by companies when having a technological transformation. First, executives need to gather a basic understanding of how AI works. This is critical since managers need to generate an intuitive

[81] Lindzon J., 2017
[82] Ibid
[83] Ibid
[84] Vitale A., 2018
[85] Ibid
[86] Cross-functional teams: teams made by people from different functional areas within a company. Edward F., (2003) *Investigation of Factors Contributing to the Success of Cross-Functional Teams,* McDonough III
[87] Vitale A., 2018
[88] Chui M., 2017
[89] Ibid
[90] Stancombe C. et al, 2017

understanding of AI in order to see the benefits for the business. Secondly, as previously mentioned, AI requires a change in the organizational structure. Thus, managers need to tackle with the organizational change triggered by the phenomena. Lastly, in this evolving scenario, managers need to re-think the competitive landscape and design a strategy for AI[91].

Changes to the ecosystem

Before going through those implications, it is important to make a clarification on what the author refers to when mentioning the ecosystem. A business ecosystem is referred as "*communities of economic actors whose individual business activities share in some large measure the fate of a whole community"*[92]. In other words, the business ecosystem is made up of diverse participants which can be firms or other organizations, which are interconnected having an effect towards each other[93]. Therefore, for the purpose of this thesis, the ecosystem defines all the actors which affects and are affected by the AI revolution, including the society itself.

Once AI solutions are brought to the market by System integrators, there are several implications faced by the companies in the ecosystem which adopt them. AI introduction will impact a vast array of industries, which are already taking steps towards it. In the same way, AI is expected to accelerate its growth thanks to its scalability and power, which will further increase the adoption pace by companies[94]. Consequentially, businesses adopting the final solutions will experience massive changes internally soon. For instance, as for the organization side, companies expect AI to have critical impacts on several departments such information technology, operations, manufacturing, supply chain management and customer- facing-activities[95].

One aspect affected by AI solutions introduction, is the number and nature of jobs[96]. Some jobs will be replaced by smart machines and the related skills required will change. Indeed, AI will formulate a virtual workforce that will automatically perform complex tasks, solve problems across industries, capable of self-learning[97]. The effect of this change will be different according to the industry. In particular, for example, a study carried from Frey and Osborne[98] established that AI will automate

[91]Ransbotham S. et al,2017
[92]Moore J. F., (2006), *Business ecosystems and the view from the firm*, The antitrust bulletin, 51(1)
[93]Peltoniemi M., (2006), *Preliminary theoretical framework for the study of business ecosystems*, Emergence: Complexity & Organization, 8 (1), pp.10-19
[94] Chitkara R. et al., 2017
[95] Ransbotham S. et al, 2017
[96] Ibid
[97] Purdy M., Daugherty P., 2016
[98]Frey C., Osborne M., (2013), The future of employment: how susceptible are jobs to computerisation?, *Technological forecasting and social change*, 114, pp. 254-280

70% of jobs in the energy sector and 65% in the consumer staples sectors. Given this massive transformation of labour force, AI will reduce and, in some cases, eliminate workers.

On the other hand, AI will create new jobs. To give an example coming from the insurance sector, a lot of things which cannot be insured, such as brand or reputational risk, will become insurable thanks to AI. This will be possible as a result of new methods to assess risk, that will consequently create new jobs, requiring more insurers [99].

In addition, skills required will change and this will create a skill gap that will inevitably entail an adaptation of the existing workers range of skills and initiate a flow of new workers to be hired[100]. In particular, skills will shift from low-value activities to high-value ones[101]. Another, high- demanded skill will be the adaptation capability, given that the pace of task changing will increase.

Given all those considerations, when it comes to explore the consequences provoked by the AI adoption, it is interesting to take a focus on the implications of the three aspects above highlighted: the way companies are dealing with the traditional make-vs-buy decision, the internal organizational changes and changes implied for the whole ecosystem. Therefore, as mentioned in the paragraph **(1.2),** for the purpose of this research, both those three implications will be investigated.

2.1.5 AI Expert insights

In order to get additional insights on the research topic, at the beginning of the research, an interview to an expert of the field, was carried. Since the expert gave useful information for the research conduction previous to the data collection phase (ex: for the identification of the main themes of the interview guide), information obtained during the interview have been placed as a part of the theoretical background rather than in the empirical findings.

The expert interviewed for this research is an employer of IBM (International Business Machines Corporation) which is an international company among the leaders in the informatic sector. The company offers tailored digital solutions for cognitive technology, data analysis, IT security etc. Among its impressive inventions, IBM developed a question answering computing system, based on the AI technology and founded a group with the aim of creating several businesses around it. For this reason, this company is an expert of AI software and its application fields. In particular, the respondent of this interview, Frode Langmoen, is the technological executive for the Nordic country area and it is an expert of AI technology, being working in the sector from several years.

[99] Ransbotham S. et al., 2017
[100] Chitkara R. et al., 2017
[101] Ibid

The objective of this interview was to acquire a better understanding of the AI integration process, as well as getting insights on how AI is changing System integrators and its environments.

The first aspect that was clarified concerns the relationship between AI and data. When referring to the process of cleaning and structuring data, the respondent said the company's motto is *"No AI without IA (Intelligence Architecture)"*. He explained that the information architecture, which can be built trough different tools, is essential to ultimately get useful insights from data. The most difficult challenges faced by companies during this process, is with regards to: 1) the lack of all the data necessary to build up a good AI model and 2) the required combination of structured and unstructured data.

For what concerns the latter, the problem is caused by the unstructured data storage. Often companies already have a database for structured data, whereas it gets more complicated with unstructured data (pictures, social media etc.) which are usually 80% of the data available by companies. Hence, the combining process of unstructured and structured data could become very complex. The expert also mentioned that when implementing AI projects, 80% of data is taken inside the companies, representing the most important input source.

The knowledge needed to design and make this process run, requires both skills in data scientist area and in the industry area for which the AI solutions is built for. The technical skills required are applicable to all the industries, whereas industry specific knowledge varies. Therefore, it is really important that people with this expertise collaborate together.

The expert also clarified that when it comes to apply AI to sensors, there are two types of actors involved: sensors providers producing the hardware and data scientists, which are dealing with data. A lot of companies which excel in capturing data and in the IoT processes, are not able to analyse data and often unaware of their potential. In this scenario, System integrators play a key role.

In order to understand if companies tend more to make or buy the AI technology, it was asked to the expert if the companies using sensors usually request, with a higher frequency, customized or integrated solutions. The respondent said that often it is a matter of size: big companies tailor the solutions to their sensors, but smaller companies cannot afford it, and then request the standardized ones.

Moreover, the expert provided some information on how companies that match AI and sensors devices use to organize their work during the integration phase. When integrating AI into the product/process of companies, collaboration is essential since people with expertise in business

domain knowledge need to cooperate with people providing technical skills. Thus, it is often needed to implement new specific cross-functional teams to achieve that.

The way of organizing the work system to develop the solution varies according to the firm-specific factors. As far as the organizational structure is concerned, the expert said that from its experience, some companies needed to set up new units or departments, for instance in the case of working with external parties. However, a lot of companies, especially big ones, started AI into their innovation offices, without setting any new department. Examples of this, are big companies such Volvo, AstraZeneca and ABB, which started AI in the innovation office and then spread it into different areas. Moreover, the expert gave insights about the way small Swedish companies, which have limited resources and do not have an innovation office, deal with AI integration. Nowadays, there are some start-ups which are disrupting the market by offering the technology for affordable prices leveraging on different AI models already tailored for specific industries. Small companies often opt for those ones.

With the aim of collecting information about the changes in organizational roles, it was asked the respondent's opinion regarding the way AI solutions are affecting the workers and their skills. The expert said that AI acts just as a tool to support workers which lack some skills. Even though AI will eliminate some jobs, it will also create new ones. However, this phenomenon is more a consequence of digitalization and can be interpreted as a normal evolution related to changes in society.

For what concerns the skills of the users of AI solutions, after the AI integration, in some cases new workers are hired, but most of the time they are only re-trained, since when it comes to the interpretation of the output of AI, the same previous knowledge is required.

The expert said that there is a skills gap inside companies caused by the AI diffusion and in particular, data scientist is the biggest group required. There is a high demand for them, but compared the offer is not so big. Sometimes it has been a problem for companies to find the right talent however, with internationalization it is easier to get skilled people all around the world.

2.2Make vs Buy decision

When a company needs to introduce a new technology inside the organization, it must assume a strategic decision and consider if to develop the technology (make) or if to outsource it from another company (buy). As said previously **(2.1.4)**, this choice is particularly complex when it comes to AI. Moreover, the decision to make or buy is inextricably linked to system integration capabilities[102].

[102] Hobday M. et al., 2005

Therefore, theories concerning the Make vs Buy decision to support this research are reported in the next sections.

2.2.1MvB decision and innovative technologies

The decision to "Make vs Buy" concerns with choice faced by companies when there is the need to design a new process or component for the product offering[103]. The decision to whether outsourcing or developing internally has been explored by several academic researches which started with the pioneer study by Coase[104]. In particular, theories concerning transaction costs have been explaining the issue of incomplete contracts and specificity of the assets when coming to the vertical integration or outsource decisions[105], whereas theories regarding property rights have been explaining the relation between the incentives of make or buy and the related investments[106].

The transaction cost theory (TCE), proposed by O.E. Williamson[107] focuses on the administration and efficiency objective of transactions. When it comes to analyse transactions, it is important to consider uncertainty to execute the transaction and the specificity of the assets object to it[108]. The logic behind Williamson argument, is that individuals are subject to asymmetry of information and opportunism, which makes more difficult to evaluate supplier's transaction by means of market mechanisms (hold-up problem) [109]. Thus, in presence of these conditions, the adoption of market mechanisms involve a cost increase inducing companies to adopt in-house solutions and vertical integration strategies

On the other hand, the theory of property rights with regards to the in-house (Make) vs outsourcing decision (Buy), states that when it is complex and costly to determine properly the rights over the other party assets, it is better to opt for ownership (Buy)[110].

[103]Platts, K. W., Probert D.R., Canez L., (2002), Make vs. buy decisions: A process incorporating multi-attribute decision-making, *International Journal of Production Economics*, 77(3), pp. 247-257
[104]Coase R., (1937), The Nature of the firm, *Economica*, New Series, 4(16), pp. 386-405
[105]Williamson O., (1971), The vertical integration of production: market failure considerations, *The American Economic Review,* 61(2), pp. 112–123
[106]Grossman S. J., Oliver D. H., (1986), The costs and benefits of ownership: a theory of vertical and lateral integration, *Journal of Political Economy*, 94(4), pp. 691–719
[107]Williamson O., 1971
[108]Walker, G., Weber D., (1984), A transaction cost approach to make-or-buy decisions, *Administrative science quarterly*, 29(3), pp. 373-391
[109]Williamson O., 1971
[110] Grossman S. J., Oliver D. H.,1986

Since the development of those theories, a lot of other models have been designed to answer the Make vs Buy decision with a focus on the economic level[111]. However, as Ford and Porter[112] argue, a lot of other issues apart from the monetary cost aspects, must be taken into account in the equation decision. Strategic issues must be addressed and considered as well.

With the ultimate aim to understand the make vs buy decision motivations, it is important to understand the innovation strategies induced by external or internal sources. In order to develop innovations, firms have several paths that could be followed. When a firm decides to develop the technology, and therefore invest in R&D, it is following the Make path. By contrast, the Buy path is pursuit when the technology is acquired from a second party. Moreover, a third path (Ally path), more cooperative, consists in collaborating with external parties to both obtain and develop the technology[113].

One important factor which influences the Make or Buy decision, is the degree of appropriability of innovation, which is the ability of a company to have appropriate gains from the innovation[114]. This ability is shaped by the market structure, intellectual property regimes and the nature of technology[115]. In situations of difficult imitation and limited leakage (of control on the technology), companies will preferably outsource; whereas in opposite situations, in-house production will be more convenient[116].

Moreover, the present and potential technological capabilities of the firm must be also considered[117]. In particular, a crucial element which companies must look at, is the pace at which the new technologies evolve. In other words, the rate of technological change influences the Make vs Buy decision. Indeed, the threat of obsolescence drives companies to avoid making the new production technologies and take a step back to the decision of in-house production[118]. Furthermore, the technology life cycle influences the availability of the sourced technology[119]. Hence, companies are willing to invest in a certain technology only when they have proof of its intensively use compared

[111]Levy H., Sarnat M., (1976), The make-or-buy decision, *Journal of General Management* 4(1), pp. 46-50; Balakrishnan S., (1994), The dynamics of make-or-buy decisions, *European Journal of Operational Research*, 74(3), pp. 552-571
[112]Ford W. H., Porter H. F., (1915), Deciding whether to make or to buy, *The library of factory management and suppliers*, Vol. III, pp. 45-52, Chapter 5
[113]Veugelers R., Cassiman B., (1999), Make and buy in innovation strategies: evidence from Belgian manufacturing firms, *Research Policy*, 28(1), pp. 63–80
[114] Love H. J., S. Roper, (2001), Outsourcing in the innovation process. Locational and strategic determinants, *Regional Science*, 80(3), pp.317-336
[115] Teece D.J, (1986), Profiting from technological innovation: implications for integration, collaboration, licensing and public policy, *Research Policy,* 15, pp. 285-305
[116] Love H. J., S. Roper, 2001
[117] Platts, K. W. et al, 2002
[118]Bartel A. P. et al, 2014
[119] Radnor M., (1991) Technology acquisition strategies and processes: a reconsideration of the make versus buy' decision, *International Journal of Technology Management*, pp. 113-135

to the sunk costs required to develop a given technology. Indeed, the company support a sunk cost in the training of the workers and the installation of the new equipment, when there is a new technology. Otherwise, they will outsource the latest technology which is available from suppliers[120].

Another aspect to consider is the technological intensity, which is referred to the knowledge level within the company's products, which is often measured as the ratio between the R&D expenditure and the revenues of the company[121]. In a scenario in which the supplying industry is more technology intensive compared to the producing industry, investing in the technology is less likely. Vertical integration is instead more likely when it comes to the opposite direction (producing industry is more technology intensive than the supplying one)[122] .

What is more, the Make vs Buy decision has become more complex in the current business environment since there are frequent disruptions in the market that enhance competitors to adopt the latest technologies, to redesign product/process and to adopt innovative business models. Hence, companies need to deal with the additional challenge of disruption, which make insufficient the traditional methods used to consider the decision[123]. This decision can be seen as an important opportunity to explore the disruptions that a company might face in the following years. As opposite to the traditional methods of the Make vs Buy models, the evaluation of the opportunities and risks of disruptions anticipates the cost evaluation of the decision[124]. It results that when companies have the ability to exploit the disruption, integration is favoured in order to ultimately develop core capabilities. By contrast, in case disruption drives to high risks, companies will preferably make partnerships or buy the technology.

2.2.2 A framework for the determinants of the MvB decisions

As mentioned, the pillars of the Make vs Buy decision are the theory of transaction costs (TCE) and the intellectual property theory (IPR). However, even though the TCE has been useful to motivate the logic behind the decision, when applied to innovative technologies (such AI), it is important to consider further strategic reasons and competence/resource-based approaches[125] in order to make the decision-making framework more associated to the real business world.

[120] Bartel A. P. et al, 2014
[121] Zawislak P. A., Fracasso E.M., Tello-Gamarra J., (2018), Technological intensity and innovation capability in industrial firms, *Innovation & Management Review*, 15 (2), pp.189-207
[122] Acemoglu D., Griffith R., Aghion P., Zilibotti F., (2010), Vertical integration and technology: theory and evidence, Journal of the European Economic Association, MIT Press, 8(5), pp. 989-1033
[123] Kutschera H.et al, 2017
[124] Ibid
[125] Pascucci, S., Royer A., Bijman J., (2011), Should I make or should i buy? innovation strategies and governance structures in the italian food sector, Inte*rnational Journal on Food System Dynamics,* 2(2), pp 1-14

Given all the considerations previously discussed and the need for a practical and simplified approach, a framework[126] which embodies all those aspects in an integrate interpretative model, has been chosen to analyse the phenomenon under analysis of this study. This more comprehensive framework is made up of three different key elements: Business strategy, Product supply chain risks and Economic factors. These elements are discussed in the following.

Business strategy

The elements that must be taken into consideration under a business strategy perspective are the attractiveness of the process/product, the strategic importance of the product and the industry dynamics.

Companies need to consider the strategic importance of the product and process technologies required for the production. Moreover, they have also to consider how the competitive environment might evolve in the future. As a rule of thumb, inspired at the Prahalad and Hamel theoretical framework[127], when the products or processes to be introduced are critical and considered core for the company, since it creates differentiation and creates synergies across the businesses, it is better to opt for in-house capabilities. This last is also preferred when there is the need to develop internal technology knowledge in order to keep control of technology development. Following the logic of the TCE theory[128], the make option is a better choice in the case in which it is not possible to have enough control on the technology supply market.

By contrast, outsourcing is more convenient when the new business process/product is not attractive for the company, since it implies a lot of obstacles such as the need to find appropriate competencies on the labour market, or the need to adapt to specific regulatory environments or because it does not represent a critical or core element for the firm's competitive advantage. Furthermore, when the supply market is open to build constructive partnerships, which are capable of developing innovations, companies will avoid in-house production.

Product supply chain Risks

The type of risk which fall within this category is related to issues on the hold-up risk, supply and transportation risks and intellectual property protection. Moreover, this category includes the risks faced when it comes to the identification and selection of the suppliers and the design of the terms and conditions of the collaboration.

[126]Shorten D., Pfitzmann M., Arvind K., (2006), Make versus buy: a decision framework, *Booz Allen Hamilton*
[127] Prahalad C.K., Hamel G., (1990), The core competence of the corporation, *Harvard Business Review*, pp.79-91, 68(3)
[128] Williamson O., 1971

The in-house production is preferred when there is a lack of possibility to outsource and the supply market is characterised by high risk. Furthermore, it is better to integrate the production when quality, predictability and reliability of the suppliers are critical to the business success. Lastly, coherently with the theory of intellectual property rights[129], this path is taken when there is the need to protect sensitive intellectual property which is fundamental to the business.

Instead, outsourcing is favoured when contracts and partnerships are strong enough to solve the hold-up risks and there are several supplying sources. As opposite to the Make choice, the Buy choice is convenient when the potential risk to uncouple the supply chain is not dangerous or frequent and no critical intellectual property is embedded in the product/function.

Economic factors

Economic factors concern all the aspects which impact directly and indirectly on the economic and operating performance advantages, on the financial returns (impact on capital expenditure, return on invested capital, return on assets, etc.) and lastly on the level of skills and expertise required.

Coherently with the framework of the TCE theory, a company will internalize the product/function when this choice is significantly advantageous in terms of internal costs reduction and quality improvements. In addition, the investment will be made when it pays off in terms of returns and in case the capabilities and skills of the company are strong enough to support the investment

As opposite to integrating, outsourcing will be the best option in the scenario where savings and quality are raised by buying on the supply market or collaborating with suppliers. Again, if the cost of the investment does not outweigh the potential profits and skills to support it are difficult to gather, the company will decide to outsource the product/function.

A figure of the integrated model presented is reported below **(Figure 4)** which summarize its contents.

[129] Grossman S. J., Oliver D. H.,1986

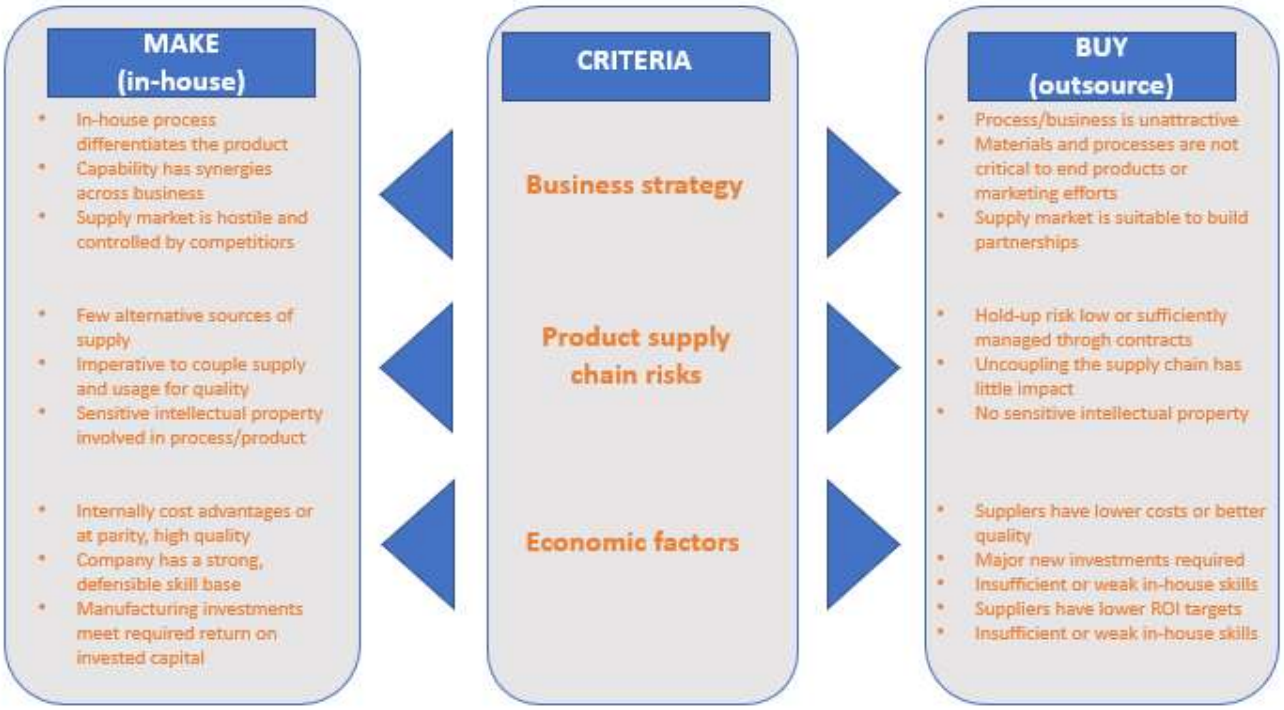

Figure 4: MvB decision framework, Based on Shorten D. et al., 2006

2.3 Organizational change

In this current volatile environment, one of the biggest issues faced by companies is how to manage the change[130]. Organizational change is about the practices adopted when an organization move from the actual to a desired future state that will improve organization effectiveness[131].

Companies need to adapt themselves to coming events in order to maintain their competitiveness and effectiveness. An organization needs to balance external pressures coming from the environment, as well as, internal pressures, coming from the internal context. It is important that an organization applies proper solutions in response to changes and balance those pressures[132]. The organization effort change will be a failure if there is mismatch of the strategic orientation and the conditions of the external environment[133].

There are different forces that act on the environment and shape an organizational change. Those forces can be classified in external and internal forces. The *internal forces* are those that can be

[130] Lorenzi N. M., Riley R.T., (2003), Organizational issues=change, *International Journal of Medical Informatics*, 69(2-3), pp. 197-203
[131] Jones G. R., (2013) *Organizational Theory, Design, and Change*, Pearson, Chapter 3, pp. 274- 391
[132] Ibid
[133] Acemoglu D. et al., 2010

identified through alarm signals for the need of an organizational change[134], such as organization's growth, power and political factors, human resources, merging and acquisitions of organizations, crisis and economical restrictions[135]. On the other hand, *external forces* are defined as those that entail changes in relation to variations in the environment where the organization is operating[136]. Within this category there are several forces which have been identified: market forces, obtaining resources, demographical features, globalization and technological changes. In particular, technological changes, concerns the adoption of a new technology with the aim of increasing the organization's productivity within the market it operates[137]. This last, is the force shaping the change studied in this research.

As a matter of fact, innovation and technological change entail improvements and changes in the technical and organizational framework of companies[138]. Indeed, as previously mentioned **(2.1.4)**, AI is expected to enhance a process of change within the companies with regards to organizational structure, worker's tasks and skills required. For this reason, the theoretical approach related to organizational change is discussed in the following paragraphs.

2.3.1 Types of change

In order to put into practice process changes, there are different types of initiatives that managers can select to ultimately reach their objectives. All those types of change can be named under the labels of evolutionary and revolutionary change being based on both the rapidity of their action and the breadth of their impact.

The *Evolutionary* type of change happens in a gradual way and it is focused on a specific target[139]. The aim of this change type is not to suddenly modify the culture or structure of the organization, but it is focused on a continuous adaptation with the introduction of small changes. This type of strategy accommodates the change and avoid shocks[140] and it is conceptualized to be a gradual change. Indeed, the speed and the nature of change is adjusted to the external and internal constraints to which the organization in restricted[141]. Organizations use three different instruments to achieve Evolutionary change: empowered and flexible work groups, sociotechnical system theory and Total Quality

[134] Aldrich H., 1999
[135] Esparcia S., Argente. E., 2012
[136] Aldrich H., (1999), *Organizations evolving*. London, Sage Publications Ltd.
[137] Esparcia S., Argente E., (2012), Forces that drive organizational change in an adaptive virtual organization, in *Sixth International Conference on Complex, Intelligent, and Software Intensive Systems*. IEEE. 4-6 July, Palermo (Italy)
[138] Bessant T. J., Pavitt K., (2005), *Managing innovation integrating technological, market and organizational change*, Chichester, John Wiley and Sons Ltd, pp. 169-205
[139] Jones G. R., 2013
[140] Lindblom C. E., (1959), The science of muddling through, *Public Administration Review*, pp. 79–88
[141] Jarvenpaa, S. L., Stoddard, D. B., (1998), Business process redesign: Radical and evolutionary change. *Journal of Business Research*, 41(1), pp.15-27

Management[142]. Flexible work teams are formed by employees that are able to perform more than one task[143]. Sociotechnical system theory concerns different theories on how to raise the organizational effectiveness by redesigning roles, tasks and relationships[144]. Instead, Total Quality Management is a process during which the organization tries to increase the quality of its goods and services[145].

As opposed to evolutionary change, *Revolutionary* change is very rapid and has a general focus. It aims at finding new modes to be effective in a fast way[146]. The outcome is a radical shift of the way in which things are done[147]. Revolutionary change implies a radical transformation of culture, stucture and business practices of the organization. This change is conceptualized to be a radical change intermediated by long periods of incremental changes[148]. The advantage of revolutionary change is that it is carried on in a small span time[149], while the disadvantage is that it increases risk[150]. The main instruments used to implement this type of change are innovation, reengineering and restructuring (which are described in the following).

2.3.2 Restructuring and reengineering

When an organization adopt a new technology to deliver better value, it is often necessary to change the structure of the organization and the way tasks are bundled in roles. This may be required since with the introduction of an innovative technology, such as AI, the previous organization became obsolete[151], being inconsistent with the processes and routines necessary to fully exploit the new investment. The changes accomplished by the organizations fall under the terms of reengineering and restructuring.

The term **reengineering** was for the first time coined by Hammer and Champy[152], who defined it as *"the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and*

[142] Jones G.R., 2013
[143] Ibid
[144]Taylor J. C., (1975), The human side of work: the socio-technical approach to work design, *Personnel Review,* 4(3), pp. 17–22
[145] Hackman J. R., Wageman R., (1995), Total quality management: Empirical, conceptual, and practical issues, *Administrative Science Quarterly*, 40(2), pp. 309-342
[146] Jones G. R.,2013
[147] Ibid
[148] Jarvenpaa, S. L., Stoddard, D. B., 1998
[149]Stoddard D., Jarvenpaa S. L., (1995), Business process redesign: Tactics for Managing Radical Change, *Journal of Management Information Systems*, 12(1), pp. 81-107
[150]Nadler D. A., Shaw R.B., Walton E.A., (1995), Discontinuous change: leading organizational transformation, Jossey-Bass Publishers, San Francisco CA
[151]Jones G.R., 2013
[152]Hammer M., Champy J. (2009), *Reengineering the Corporation: Manifesto for Business Revolution,* A. Zondervan

speed". Generally speaking, reengineering is the process under which companies try to redesign the way they operate in order to increase their efficiency[153].

It involves a redesign of the functions and roles, which is caused by a change in tasks. The reengineering process requires to have a radical redesign of organizational processes in a cross-functional way[154]. The key concepts of this process are a radical change, a process of goal orientation, the use of information technology and ultimately restructuring[155]. In other words, the organization's procedures are studied following the new business objectives, the non-needed processes are eliminated, and the operations are redesigned with the help of the information technology[156]. For these reasons, reengineering is often seen as an approach used when there is a radical change inside the organization[157].

For what concerns **restructuring**, it is intended as the process during which the authority relationships and the organizational structure and culture is redesigned to ultimately reach a higher level of organizational effectiveness[158]. In particular, it has been defined as "*a set of discrete decisive measures taken in order to increase the competitiveness of the enterprise and thereby to enhance its value"*[159].

The structure of the organization can significantly change since restructuring can include actions like flattering the hierarchic levels, redesign the divisional boundaries, modify the span of control and reduce the number of employees[160]. Hence, when managers decide to start a process of restructuring, some of the reasons that guide their choice are the aim of reducing costs, improve the productivity and create more value for the shareholders[161].

2.3.3 Organizations for innovation

Organizational changes are often caused by the introduction of new processes, products and technologies, which are introduced to stimulate and support innovation processes. Therefore, those

[153]Philip M., (2015), Business Process reengineering as a tool in total quality management makes engineering business sense: A new perspective and model, *International Journal of Engineering and Advanced Research Technology,* 1(6), pp 42-46

[154]Hammer M., Champy J., 2009

[155]Vidgen R., Rose J., Wood B., Wood-Harpe T., (1994), Business process reengineering: the need for a methodology to revision the organization, *Proceedings of the IFIP TC8 Open Conf. on Business Re-engineering*, Queensland Gold Cost, Australia, 8-11 May, pp. 603-612

[156]Philip M., 2015

[157]Jarvenpaa, S. L.,Stoddard, D. B., 1998

[158] Jones G.R., 2013

[159]Atiyas I., Dutz M., Frischtak C., (1992), *Fundamental issues and policy approaches in industrial restructuring*, The World Bank Industry and Energy Department Operations Policy Staff, Industry Series Paper No. 56

[160] Vyas K. K., (1997), Corporate restructuring and value creation, University of Groningen, Chapter 4

[161] Ibid

organizations which are oriented to innovation, can embody specific design elements which facilitate the processes to accommodate the change. Indeed, scholars have highlighted that the characteristic of an innovative organization can be distinguished by the ones of a non- innovative organization[162].

In particular, one of those design elements which influence innovation, is the structure, which can exercise a significant influence on the company's innovation propensity, on the effectiveness of the innovative projects and on the rapidity of the innovation process[163]. In this view, scholars classify structures in mechanic and organic ones. While the former is more appropriate for static technology contexts and foreseeable market trends, the latter is considered more appropriate for innovative and creative contexts, as well as, to act in competitive and dynamic environment[164]. The main reason of this feature is that organic structure allows for more decisional freedom in the decision-making process, are less formalized and are characterized by a lower level of behavioural standards, being a flatter type of structures.

Another element which has an influence on innovation, is organizational culture. An innovative culture has been defined as *"the firm's orientation towards experimenting with new alternatives or approaches by exploring new resources, breaking through existing norms, and creating new products to improve its performance"*[165]. Indeed, culture positively impacts innovation, encouraging creativity and motivating individuals to the entrepreneurial spirit[166.] Several studies have examined the traits of culture which boost innovation. According to Rothwell & Wissema[167], elements of culture pushing for innovation are the willingness to take entrepreneurial risk, long-term planning, and the acceptance of change. Moreover, Barnett [168]believes that the more individuals can express their idea, the more are the opportunities to explore it.

Therefore, companies willing to innovate should try to shift their culture towards this type. However, it is difficult to change organizational culture since this last is generated and/or influenced by the interaction of several factors such as the characteristics of organizational members, organizational ethics, the property rights system, and organizational structure[169]

[162] Dombrowski C., Kim J. Y., Desouza K. C., Braganza A., Papagari S., Baloh P., Jha S., (2007), Elements of innovative cultures. *Knowledge and Process Management*, *14*(3), 190-202

[163]Schilling M. A, Izzo F., (2013), *Gestione dell'innovazione*, Milan, McGraw-Hill, Chapter 10

[164]Dougherty D., (2001), Reimagining the differentiation and integration of work for sustained product innovation, *Organization Science*,12(5), pp. 612-631

[165] Dombrowski, C. et al.,2007 (p. 1029)

[166]Pantelis C. K., Kyriaki I. K. Panagiotis E.P., (2018), Cultural change and innovation performance, *Journal of Business Research*, Volume 88(C), pp. 306-313

[167] Rothwell R., Wissema, H., (1986), Technology, culture, and public policy, *Technovation*, 4(2), pp. 91–115

[168] Barnett, H. G., (1953), *Innovation: The basis of cultural change*. New York: McGraw Hill.

[169] Jones G. R., 2013

Therefore, when a cultural change is planned, an organization needs to redesign all those factors and motivate individuals that are part of the organization. This is realized in a process that requires relevant time, commitment and effort[170].

2.4 Summary of theoretical framework

With the ultimate aim of facilitating the reading process of the following parts and, in particular, to guide the reader towards the empirical findings, analysis and conclusions, a summary of the theoretical framework is provided. Therefore, a brief description of what has been discussed and how will be applied in the following chapters, is given below.

The theoretical framework has outlined and discussed the AI technology definition and functioning, the key aspects of its adoption and has identified several theories in the area of the decision to Make or Buy a technology, as well as, organizational changes theories, to ultimately be able to answer the research question on what are the organizational implications of AI adoption by System integrators. From the discussion of the implications on the key aspects stated above, it was possible to outline that some key consequences of AI adoption are: the increase of complexity of the decision to produce in-house or outsource the technology; internal organizational changes due to changes in structure, roles and competences required; changes in the ecosystem due to modifications of jobs, processes and creation of a skill gap brought by the AI solutions. The first aspect outlined is analysed with the help of the academic framework concerning the traditional decision to make or buy, including specific theories related to the acquisition of disruptive technologies. Then, theories of organisational changes are used to investigate the implications of the internal changes brought by AI technology. In particular, theories regarding the type of change are used to understand the radicalness of the internal change and to define evolutionary or revolutionary changes. Following, the concept of *restructuring,* is used to investigate variations in the structure, whereas the concept of *reengineering*, is applied to explore modifications of roles and processes. Finally, characteristics of innovative organizational forms are used to analyse the changes to the structure and the culture occurred. From the knowledge acquired by the theories above, it is possible to compare empirical findings and ultimately answer the research question.

[170] Ibid

3. Methodology

This chapter aims at explaining the methods used to conduct the research, the reasoning behind their choice and discussing the advantages and disadvantages of the selected strategies. Firstly, the choice of the research strategy is presented. Secondly, the research design is explained. Thirdly, the method used for the data collection process and analysis are examined. Lastly, a discussion on the quality of the research is presented.

3. 1 Research strategy

The general objective of this research is to understand the critical elements caused by the AI disruption in the organization of System integrators companies, whose role is to integrate AI technology with sensor devices. Thus, the study aims at getting an understanding of the effects of AI adoption with a particular focus on those specific companies which provide the integrated solutions requiring technical tools and skills to make the phenomenon happen.

A research strategy design provides information about the general guidelines which will be followed to conduct the research in the business context[171], therefore, in order to select the appropriate research strategy for this study, on the base of the research question selected, some considerations on the link between theory and research were taken into account.

The decision concerning the adoption of an inductive or a deductive approach has been the first step undertaken in order to define the research strategy.
An inductive approach, which implies the generation of theory consequent to the observations of the phenomenon studied[172], was considered as the most appropriate, given that the research is exploratory, and that the technology studied is at its early stages in the selected specific context of System integrators companies. Indeed, the aim of the research is more of a general kind and it appeals to provide descriptive evidences by observing the phenomena, rather than testing an accepted theory in the field. Moreover, it would have been difficult to apply the deductive approach, taking into account that not a lot of research is present on the topic, given that the phenomenon is at its early stages.

The next choice to be taken in order to develop an appropriate research strategy, concerned the adoption of quantitative or a qualitative approach. Considering that the aim of the study is to

[171] Bryman A., Bell E., (2011), *Business research methods*, New York, Oxford University Press
[172] Bryman A., Bell E., 2011

investigate on the three aspects of AI adoption (the reasoning behind the Make vs Buy decision of AI technology, internal organizational changes and changes to the ecosystem brought by the AI adoption) to ultimately provide some descriptive findings about a phenomena that is at its early stages, it followed that a qualitative approach was considered the most suitable method to be applied. In fact, qualitative approaches are suitable for studies aiming at generating findings, which utilize inductive approaches[173]. By contrast, a quantitative approach could have been more appropriate in the case of the use of a deductive approach, which emphasised the testing of theories at the base of some hypothesis[174].

Moreover, according to Friedland and Alford[175], qualitative approaches are appropriate when exploring the organizational level. Therefore, considering that the research focus is on the organizational implications of AI and this imply a study of organizational levels, qualitative approach suits for the research topic.

In addition, qualitative studies enable the researcher to the collection and integration of different sources, to ultimately include the study of the real-world and its participants [176]. This is particularly relevant for this research considering that different type of sources such as the information collected by the System integrators and the AI expert, and business and academic theories around the topic, have been considered.

Nonetheless, before taking the decision to follow a certain type of strategy, the author needed to consider also the criticisms implied by its use. For instance, qualitative research is not easy to replicate, and results cannot be generalized[177]. However, this last was not considered as an issue, taking into account that the scope of this research is to gain insights, rather than developing a general theory. Therefore, generalization falls out of the scope of this research. Moreover, it is argued that qualitative research can be too subjective[178]. Notwithstanding, the researcher tried to minimize this critical aspect, by relying only on the evidences collected and hence reducing at minimum the space for bias.

[173] Ibid
[174] Ibid
[175] Friedland R., Alford R., (1991), Bringing society back in: symbols, practices, and institutional contradictions. In W.W. Powell, P.J. Di Maggio (eds.), *The New Institutionalism in organizational analysis*. Chicago: University of Chicago Press, 232-263
[176] Yin R. K., (2011), *Qualitative research from start to finish*, London: The Guilford Press
[177] Ibid
[178] Ibid

3.2 Research Design

As far as the theory is concerned, taking into account the considerations made previously, the research design selected for this study is the multiple case study. This design is often used in business research when a qualitative research strategy is applied[179].

The multiple case study can be considered as a lengthening of a single case study, where there is not only one source for empirical findings but several ones[180]. According to Yin[181], it is *"an empirical enquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident".* In fact, since the phenomena studied in this research is at its early stages and the effect of AI are not already evident, this method was evaluated as the most suitable for the research.

In addition, a comparative design such as the multiple case study, is appropriate given that more than one source of evidences has been analysed to ultimately compare and find similar patterns across the cases. Indeed, a comparative design is suitable to outline similarities and differences across cases[182].

Furthermore, since the focus of the research is not to develop a general theory but, instead, collecting insights from the cases, it is possible to state that a multiple-case study is more appropriate than a cross-sectional design[183]. In fact, this method is suitable, considering that the aim of the research is to explore the different organizational implications that the AI disruption is currently provoking by gaining insights from System integrators cases, rather than focusing on the general context in which they are operating. Hence, the ultimate aim of the research is to get an understanding of the effects experienced by the case companies to provide insights to the companies willing to introduce AI in the future.

The multiple case study includes five System integrators, where some companies constitute small size cases and other big size cases. The criteria used for the selection of those companies are presented with more detail in the following paragraph **(3.3.1).**

[179] Ibid
[180] Yin R. K., 2011
[181] Yin R. K., (2009), *Case study research: design and methods*. London, SAGE Publications Ltd.
[182] Bryman A., Bell E., 2011
[183] Ibid

3.3Research methods

3.3.1Data collection

Secondary data

The first step undertaken was a narrative review with regards to the main topic of the study, in order to get more knowledge on the subject, before carrying on the primary data collection phase.

The aim of narrative review is gaining knowledge about a topic rather than accumulate it and it is used to gain an initial impression of the topic to which the research will focus on[184]. This method was considered as the most appropriate not only because is often used for qualitative and inductive approaches, but also since interpretative researches such this one, require greater flexibility to modify the research boundaries during the study of the topics[185]. Indeed, an initial screening of websites, reports and reviews was done in the first steps of the research in order to understand where to put the focus of the research and increase the author's knowledge around the topic. As it often happens during narrative reviews, the researcher discovered important issues to the topic not previously anticipated, which lead her to an anticipated understanding of it[186].

Moreover, the aforementioned review has been additionally useful to assess the gap of previous research and understand the potential contribution of the study.

Once this process has been completed and after having carried the first interview with one expert of AI technology, which gave useful insights on the topic, the complete and understandable research question has been designed, based on the information acquired.

Then, a review of the collected materials regarding the focused research and the academic frameworks to be used, started. The collection has involved academic papers, on-line reviews and books. To speed and ease the process of relevant literature findings, several among the most important academic and scientific databases, such Scopus, Web of Science and Google Scholar have been used. Moreover, material accessible through on-line library of the University of Gothenburg and LUISS University has been consulted. Given that conventional search engines and websites contain a huge amount of information which are not always reliable, the inputs of the research were analysed critically to avoid unreliable results. The criteria used for the selection of an article/book have been based mainly based preferably on the presence of peer-reviewed source (when possible), the number of citations and the most recent year of publish. Those criteria were defined to assess reliable and recent sources,

[184] Ibid
[185] Ibid
[186] Noblit G. W., Hare R. D., (1988), *Meta-Ethnography: Synthesizing Qualitative Studies*, Newbury Park, CA: Sage

fundamental for the study of an evolving technology such AI. However, given the novelty of the AI technology in terms of evolution of the related applications as well as the exploratory nature of this study, the latter relied also on consultant companies reports and on-line reviews. These last were carefully selected by the author to verify their reliability and obtain an appropriate information set.

Even though, narrative reviews are less explicit with regards to exclusion and inclusion criteria of research studies[187], a variety of keywords, which are reported below, have been used to facilitate the finding of pertinent information. The keywords used have been: *Artificial Intelligence, AI, Disruptive technology, Technology change, Innovation, Make vs Buy decision, Organizational change*. Moreover, since the knowledge of the topic studied became deeper while conducting the reviewing processes, new keywords were added at a later stage.

In addition to the databases, other sources were selected using the so-called snowball effect, which enabled to find other important articles/books by looking at the cited sources of the material used.

Overall, the secondary data have additionally been useful for the researcher to compare and contrast the information in the data analysis phase.

Primary data

In order to collect the primary data, semi-structured interview's method was used. According to Fylan[188], semi-structured interviews are good to find out "why" rather than "how many" or "how much", thus they fit for the purpose of this research since this study is explorative and does not aim at giving specific definitions. This methodology allows to focus on specific topics and at the same time having a certain degree of flexibility which enables to integrate additional insights[189]. However, there is no fixed responses range compared to structured interviews[190]. In fact, semi-structured interviews allowed to explore the most important topics, determined during literature review, but at the same time left space for coming up insights during the interviews. It was possible to keep the focus on the three aspects addressed from the beginning, as well as to get additional ones. Moreover, this structured method contributed to ease the process of data analysis, considering that questions were set to gather specific information, which were later used to furtherly develop themes. In addition,

[187]Bryman A., Bell E., 2011
[188]Fylan, F., (2005), Semi-structured interviewing, in Miles J., Gilbert P. (Eds.), *A Handbook of research methods for clinical and health psychology*, New York, USA, Oxford University Press.
[189]Bryman A., Bell E., 2011
[190]Ayres L., (2012), Semi-structured interview, *The SAGE Encyclopedia of qualitative research methods,* Vol. 1, Thousand Oaks, CA: SAGE Publications Ltd

semi-structured interviews enabled the cross-case comparability. In fact, some structure is needed in order to ensure comparability among cases[191].

Given that two actor types were interviewed, two different interview guides were designed according to their role within the interviewing process. One interview guide **(Appendix 1)** was realised for the expert with the ultimate aim to get insights, a better understanding of the AI and sensors technology system and information regarding the ecosystem, which supported the theoretical background. The second interview guide **(Appendix 2)** was designed for the System integrators on the base of the willing information to gather, which are respectively information on the company's AI products functioning, make vs buy decision reasoning, internal organizational changes and changes to the ecosystem occurred. As expected, none of the interviews was exactly the same, given that different follow-up questions were added during each interview.

In order to assess a better data quality, the interview guide passed through a trial process. In fact, during the first interview, there has been the possibility to ask feedback to the initial respondents and eventually modify the questions or change their order.

Moreover, an introductory text and a final text **(Appendix 3)** were added to the interview guide to be used respectively at the beginning and at the end of the interview process. The former text was used by the researcher to provide the research aim and to clarify the structure of the interview. Instead, the latter was used to greet the respondent for their time, ask them to give feedbacks of the interview's transcript to be sent in the future and lastly to request their availability for potential follow-up interviews in case it could have been necessary.

The interviews were recorded and, once each interview was completed, a summary transcript of it was created. The reasoning behind that choice was to better organize the information and analyse them. Transcribing is very time consuming[192], however it is the best method to assure objectivity within the data collection process. Hence, in order to balance this trade-off, the researcher decided to compile a summary containing the interview content, rather than making a word by word transcript. The summary transcript of the interview was sent to the respondent, to evaluate information accuracy and assure further reliability. Moreover, straight after the end of the interviews, some notes concerning interviewee's feelings and additional relevant information, which could be later useful, were taken.

[191] Bryman A., Bell E., 2011
[192] Ibid

The method used for the interview was set according to respondent's availability. Nevertheless, the interviews were preferably done in face-to-face meetings. The face-to-face interview method was chosen as first choice since, in qualitative research, it provides the highest data quality[193]. When the interviews were conducted face-to-face, the place of the interview was the company office and the specific place within it, where the interview was set, was chosen by the respondent. In fact, it is important to choose a proper environment in which the respondent feel comfortable. Indeed, the environment in which the interview is conducted should be quiet and private, since this surrounding helps the respondent in expressing his ideas and thinking about the answers to give[194].

However, some of the interviews were carried on Skype (with no video) or by phone. Even thought, these methods do not allow to observe respondent's body language and decrease the data quality, it permits to save time and resources [195]. Moreover, another advantage of Skype or telephone interviews over face-to-face ones, is represented by an increase of answers evidence, considering that the respondent cannot see the interviewer characteristics (age, ethnicity, etc.) and avoid be affected by that, when giving answers[196].

Sampling

The sample chosen for this research is purposive. The best strategy for sampling depends on the context and nature of the research[197]. Even thought, non-probability method does not allow for generalizability of the finding, the aim of the research is focused in exploring the effects of AI introduction in the selected company types, rather than provide a general theory for the impact of AI within organizations. Therefore, purposive is still the most advantageous for this study. Moreover, purposive is not a convenience sampling which is only based on accessibility of researcher's contacts, but it is focused on gathering information from specific actors which can help in reaching the specific objective of the research.

Even though purposive sampling is likely to be biased[198], it was still considered the most suitable for this research since it enabled to select respondents on the base of the specific information required to answer the research question identified.

[193] Ibid
[194] Ibid
[195] Ibid
[196] Ibid
[197] Palys T. P., (2008), Purposive sampling. In L. M. Given (Ed.) *The Sage Encyclopedia of Qualitative Research Methods*, Vol.2, Sage: Los Angeles, pp. 697-8.
[198] Ilker E., Musa S.A., Alkassim R.S., (2016), Comparison of convenience sampling and purposive sampling, *American Journal of Theoretical and Applied Statistics*, 5 (1), pp. 1-4

In order to find the sample companies to interview, the research was supported by First to Know Scandinavia (FTK), a Swedish consulting company, which helped in identifying and getting contacts of the different respondent involved into the context and affected by AI disruption. Moreover, they provided also the contact of an expert of the field, whose interview is reported in the theoretical framework **(2.1.5),** that was, as previously mentioned, consulted at the beginning of the research to get an overview of AI technicalities and implications. However, some of the respondents were identified through some personal contacts of the author.

The System integrator companies to be interviewed were selected within different industries. Therefore, companies were not designing the AI solution for the same type of market. Nonetheless, this did not constitute an issue, given that research aim was not to provide evidences of a specific context.

The criteria for their selection was the company's use of both AI and sensor technology. A general criterion for all the respondent's selection has been a minimal knowledge of AI, which was needed to collect information about the sensors-data-AI functioning. Another criterion applied to select companies has been to have already completed at least one AI solution project, following the intention of studying more evident organizational changes and established Make vs Buy strategies. In this way, the phenomenon studied could be observed in a better way, having clear evidence of it. Indeed, one of the interviews collected has not been included in the study seen as its projects were on a very early research stage. Only one exception was made for the case of Nord-Lock, considering that even though its AI solutions were not already on the market, the strategy of the company towards them was clear enough and the respondents could provide a picture of the related future changes. Hence, the ultimate aim of observing clear evidences was still respected.

The first approach used to contact companies has been through email (**Appendix 4).** An introduction of the research topic was included in the e-mail in order to acknowledge the potential interviewee about the study field and to verify if the selected companies were meeting the right requirements to participate in the research. Moreover, it was asked to the parties if they preferred to receive the interview guide before the interview process. The reasoning behind this technique relies in the possibility to increase the research dependability and in turn, improve the research quality[199].

[199] Bryman A., Bell E., 2011

To conclude, the details of the interviews conducted, and respondent's profiles are reported in the table below **(Table 1).**

Respondent	Name	Position	Company	Interaction	Date	Duration
Expert	Frode Langmoen	Technology executive	IBM	Face-to-face	15-03-2019	38 min
A	Stefan Lindgren	Chief Technology Officer	TalkPool	Face-to-face	25-03-2019	29 min
B	Veronika Cottlehuber	Head of Digital Service Center	Siemens	Telephone call	3-04-2019	39 min
C	Anonymous	Director of product management and marketing	Anonymous	Face-to-face	4-04-2019	33 min
D	Pierre Kellner	Business developer of Smart Products and services	Nord-Lock	Skype call	9-04-2019	53 min
E	Carlos Garcia Timon	Managers of sales and business solutions in the IT area	SKF	Face-to-face	15-04-2019	45 min

Table 1: Table of respondents from case companies

3.3.2 Data analysis

As far as the theory is concerned, the selected method for the analysis of the data collected in this study is thematic analysis, which is one of the most used approaches in qualitative research[200]. Thematic analysis, differently from other approaches such as grounded theory, does not have specific connections with theoretical views[201]. The reason why this method was selected concerns its ability to detect major trends in findings, which help in the identification of themes generated on the base of the frequency of certain words in the input data[202]. Indeed, thematic analysis method was considered the most appropriate for its flexible application, suitable for a research of an explorative kind.

[200] Ibid
[201] Maguire M., Delahunt, B., (2017), Doing a thematic analysis: A practical, step-by-step guide for learning and teaching scholars, *AISHE-J: The All Ireland Journal of Teaching and Learning in Higher Education*, 9(3), pp.3351- 33514
[202] Bryman A., Bell E., 2011

According to Yin[203], the analysis of the data can be segmented analytically in a five-phase cycle. After the compilation process, which corresponds to the first phase, data were fragmented and assembled on the base of different thematic codes arisen during the interviews. The mentioned steps represent the second and third Yin's phase. Themes analysed were *AI definition and functioning, Make vs Buy decision, Internal organizational changes, Changes to the ecosystem*. The themes were identified on the base of the information collected during the interviews and reflected the themes identified in the interview guide **(Appendix 2)**. Then, the interpreting phase followed, during which primary and secondary data have been assembled to improve interpretation. For the interpretation phase, the same theme labels were identified. However, an additional classification has been done, by further coding two themes. The theme *Internal organizational changes* has been classified into four categories: Changes to the structure, Changes to the culture, Changes of skills and roles, and Additional internal organizational implications **(Figure 5).** Whereas, the theme *Changes to the ecosystem* has been divided into two categories: Changes of jobs and Skill gap **(Figure 6).**

During the data analysis process, the literature review has been of a great importance since it gave the key concepts to identify the reasoning behind the Make vs Buy decision and organizational elements disrupted by AI, to ultimately read the data in a correct way. In fact, as previously mentioned, the guidelines for the interview were designed based on the literature review. Ultimately, conclusions were drawn on the base of the themes identified, which enabled to answer the research question by splitting conclusions of each theme identified in the analysis (*Make vs Buy decision, Internal organizational changes, Changes to the ecosystem*). This constitutes the last phase of the Yin's cycle.

3.4Research quality

When evaluating the quality of a business and management research, usually three different dimensions, namely reliability, replicability and validity, are evaluated[204]. Those dimensions respectively concern with the use of consistent measures, the possibility to replicate the study and the righteousness of the conclusions drawn[205]. However, those dimensions are discussed to not be applied with the same relevance when carrying a qualitative research. Indeed, specific criteria, namely trustworthiness and authenticity, have been proposed for the assessment of a qualitative study, in alternative to validity and reliability[206]. This study will follow the second definition and evaluate the

[203] Yin, 2011
[204] Bryman A, Bell E., 2011
[205] Ibid
[206] Guba E. G., Lincoln Y. S., (1994), Competing paradigms in qualitative research, in N. K. Denzin and Y. S. Lincoln (eds), *Handbook of Qualitative Research*. Thousand Oaks, CA: Sage

research trough trustworthiness and authenticity, since they enable the researcher to reveal more than one social truth, compared to traditional dimensions[207].

Trustworthiness

Trustworthiness is divided into four sub-criteria: credibility, transferability, dependability and confirmability. *Credibility*, which is as a substitute to internal validity, ensures that the research has been carried according to good practise criteria and that it is credible. In order to fulfil this criterion, once the transcripts were created, they were sent to the respondents to check if the interpretation of the interviews, was correct. *Transferability* concerns the extent to which findings are useful to understand the phenomenon studied in a different context and it is opposed to external validity[208]. For the satisfaction of this criterion, all the information with regards to the case selection and the context were provided. However, even though the replicability of this study may be consistent only by including some similarities of the cases selected, it does not constitute an issue considering that generalizability was outside of the narrow scope of this research. *Dependability* aims at establishing the reliability of the findings. According to Guba and Lincoln[209], the researcher needs to apply an auditing approach to fulfil this criterion, ensuring that complete records of all the phases of the research process have been kept. For what concerns this criterion, a detailed description of the methods used to collect and analyse empirical data were provided and the transcripts of the recorded interviews were processed, with the ultimate aim of showing the auditing approach "steps". Even thought, complete objectivity cannot be achieved in qualitative research, c*onfirmability* is about ensuring that the researcher has acted in good faith, trying to leave away personal values from the interpretation of data[210]. In order to avoid bias in the collection and analysis of data, transcripts were created and a double-check of interviews with the respondents was done.

Authenticity

When assessing authenticity, the researcher's aim is to show that his/her conduct during the research was plausible and the research had an impact on respondent's views. It can be assessed trough five different criteria: Fairness, Ontological authenticity, Educative authenticity, Catalytic authenticity and Tactical authenticity[211]. *Fairness* is about ensuring that the research represents the viewpoint of all the members within the social setting. Instead, *Ontological authenticity* refers to ability of the

[207] Ibid
[208] Xerri D, (2018), Two methodological challenges for teacher-researchers: reflexivity and trustworthiness, *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, 91(1), pp.37-41
[209] Guba E. G., Lincoln Y. S., 1994
[210] Bryman A., Bell E., 2011
[211] Ibid

researcher in supporting members in the understanding of their social setting. In order to satisfy this criterion, an introductory description of AI technology and the problem analysed was explained at the beginning of each interview. *Educative authenticity* regards the ability of the researcher to demonstrate members appreciation of other's people viewpoints. To fulfil this criterion, it was sometimes provided the opinion of respondents, obtained through previous interviews, to other respondents, in order to spread other members point of view. *Catalytic authenticity* describes the extent to which the study aroused some actions in the participants. Lastly, *Tactical authenticity* concerns the extent to which the research has stimulated participants to take action.

4. Empirical findings

In this section empirical findings gathered during the interviewing process are presented. The findings obtained by the interviewed sample are reported following a company order and divided into four categories, which are respectively AI definition and functioning, make vs buy decision, Internal organizational changes and Changes to the ecosystem. Moreover, all the empirical findings are preceded by a small company description.

4.1TalkPool

4.1.1Company description

TalkPool AG was founded in 2000 and has its own headquarter in Switzerland. The overall group has a staff of more than 300 workers established in 200 countries[212]. Even though externally TalkPool is seen as a unique company, it is made up of several daughter countries across the world. Moreover, it uses a partnership model, which enabled to expand its market by making joint ventures or franchising. Indeed, its revenues are generated in Europe, Middle East Africa and South America[213]. TalkPool is specialized in Telecom Networks but more recently, it started to offer also IoT ecosystems in the smart building sector, with the opportunity to exploit AI technology. Therefore, TalkPool represents one example of company who turned into the System integrator role with the opportunity to enter a new market. The IoT and digitalization activities are core to TalkPool AB, the daughter company situated in Sweden. This daughter company is small in size, counting 15 employees[214]. Its specialised IoT- Network is present in several IoT verticals such smart cities, smart building and smart industries. Overall, TalkPool is a supplier and technology independent company.

[212] TalkPool, (2019), About us (on-line website)
[213]Stefan Lindgren, TalkPool CTO, Personal Interview
[214]Stefan Lindgren, TalkPool CTO, Personal Interview

4.1.2AI definition and functioning

TalkPool produce sensors with a vast array of use cases. During the interview the focus was posed on the sensors used within the smart building vertical, which involves savings and damage prevention. In particular, those sensors are capable of measuring air and temperatures indoor quality. Thus, they enable to control the heating, the cooling and the ventilation of inside and outside buildings, to ultimately adjust them on the base of the load of people inside buildings, or by optimizing the building settings. This is possible by matching sensors and the analytics (AI), which individuate patterns to detect damages. Indeed, data collected by the sensors are used to feed the AI algorithms which are run in the cloud.

When asked the respondent A to provide a definition of AI according to its business, he replied that it is a process which involves three steps. First, sensors collect data. Secondly, data are sent to a server in the cloud, which combines them with data coming from different sources. Structured and unstructured data are mixed. For instance, data about building temperature are merged with the ones about weather forecasts and sun radiation. Thirdly, data combined are used to run the algorithm in the cloud which gives as output the usual warm temperature, the typical radiation etc. Finally, the output can be used to adapt the temperature of the building according to the information received.

The respondent A said that the sensors' objective is to measure and report data in the cloud in a secure and cost-efficient way and that the intelligent activities are then performed in the cloud.

4.1.3Make vs buy decision

TalkPool is both making and buying the AI technology, depending on the maturity of the project it is dealing with.
They create collaborations to develop the AI technological part, when their customer has already some knowledge of the algorithms applied in its specific business field. Whereas, if their customer has no technical expertise, TalkPool develop algorithms by itself trying to cluster business information through a co-development process.

The strategy behind this decision in mainly business driven. Thus, the company takes a leading position depending on its partners capabilities, as well as, the complexity of the project and their potential ability to whether manage it or not.

When asked to the respondent A about the strategical importance of AI for TalkPool, he said that currently AI does not represent a big part of their business. In fact, at the moment, the company is

mostly involved into the hardware part. However, given that AI is an evolving technology and it could be used in more than one of its offerings, there is potential for it to became core in the future.

In order to generate in-house AI technology, TalkPool mainly relied on the existing workers. The employees were self-learning through internet tutorials and on-line courses, and by reading up about the topic. Indeed, according to the respondent A, this was possible since, compared to other technologies, it is easy to acquire AI knowledge and generate the ability to prototype algorithms.

Given that TalkPool is not only a sensor manufacturer and user, but also a technology supplier, it was crucial for the company to have the AI technology inside its business. Hence, it was very important to invest time and resources in it.

As previously mentioned, at the moment, AI is present in TalkPool business on a small scale. However, when asked about the supply chain risks that are influencing and will influence in the future the company's choice to whether produce in-house technology or outsource it, the respondent highlighted that the traceability of data is an issue that must be taken into account. The understanding of the base upon which the recommendations from AI are made, is critical to evaluate the suitability of the algorithms. Thus, it is in this sense important to control the reliability of the technology.

So far, the company only beard costs about AI, and did not obtained returns by the technology investment. Nevertheless, costs incurred have not been very high considering that they were mainly related to employees and co-workers training and therefore the company went through this investment anyway.

4.1.4Internal organizational changes

Overall, TalkPool did not experienced big changes in the way to organize its work. The reason behind this effect is represented by the fact that the company had already set up a way to organize the work, which consisted in working in small teams with wide responsibilities, that were suitable for the AI implementation. For what concerns TalkPool employees' tasks, they did not change but, increased by the acquisition of new competences and ability to use certain tools.

In order to gather domain business knowledge of the field for which AI was applied for, TalkPool mainly clustered information by cooperating with partners when needed. In fact, the approach of co-development with the customers was often used during projects. According to the respondent A, it is necessary to have those cross-functional teams considering that to generate a specific algorithm, it is necessary to outline patterns in data applying the business knowledge of the specific product/service.

The organization, already characterized by a flat hierarchy, did not experienced any structural change related to the AI introduction. It comes that the authority relationships and culture did not modify as well.

4.1.5 Changes to the ecosystem

The respondent A agreed that AI is eliminating and creating new jobs. According to him, AI solutions are rising up efficiency by drawing more conclusions from data and therefore affecting workers. Notwithstanding, TalkPool applications have not been that advanced to enhance a job change, even though this might happen in the future. In fact, the functions and the process within the market in which TalkPool operates, did not change. The respondent A argued that this is a consequence of the fact that TalkPool is adding a value to businesses that was not included before. To give an example, TalkPool service is able to optimize processes that were not working in proper way by leveraging on information obtained by data. However, this service is not making people redundant or changing existing processes since TalkPool is only adding additional value

Moreover, the respondent A agreed that there is a big skill gap in companies, which is related not only to AI, but generally to digitalization. He argued that a lot of technologies are easy to grasp, but the understanding of them, their effects and potential benefits, represent a challenge for companies. It is often not a technology problem, but a structural management problem.

4.2Siemens

4.2.1 Company description

Siemens AG was founded in 1847 in Berlin[215]. The company has more than 372000 employees and generate on average a yearly net income of more than 89 billion euros. Siemens has been a major innovation and technology force over the years. Thanks to its continuous innovation strategy, Siemens has been creating new products, solutions and services, accessing new markets during the years. The core products of this company since its foundation, have been related to information and communications technology, going from telegraphy and telephony to computers and microelectronics. However, nowadays Siemens is involved in a lot of other fields such Power Generation and distribution, Transportation and Medical technology, Consumer goods, Drive and Automation Technology[216]. In particular, the case study of this research will analyse Siemens within the building technology sector, therefore under the perspective of Siemens as a System integrator for the construction industry.

[215]Siemens, (2019), About us (on-line website)
[216]Ibid

4.2.2AI definition and functioning

Siemens produce a lot of sensors. However, the interview focused on the sensors applied within the building technology area. In this area, sensors are commonly used in three portfolio clusters. The first cluster concerns fire detection, prevention and extension. The second portfolio pillar is around comfort and involves systems of air conditioning and heating. The third pillar concerns building security and involves, for instance, the monitoring of accesses and security hazards.
Within those three pillars, the most utilized sensors are temperature and energy usage sensors, small detectors, video camera sensors and pressure points. Those several devices interact with a system, which stores data.

When asked to the respondent B a definition for AI, referring to the building automation system, she said that intelligent activities realize when a building can optimize itself against a certain goal, which has been previously defined by using the information collected by the sensors. In this process, Siemens add unstructured data and data coming from different sources, such the use of weather forecast databases. However, this model has only just started to be applied.

4.2.3 Make vs Buy Decision

Siemens mostly develop AI in-house. However, for cases that fall outside of its core competences, such as the video case, they use to outsource. Indeed, for the optimization of building functions, which is their core area, the company developed a specific team and department.

The business strategy behind this choice is related to the objective of becoming a leader provider for quality and services within the building technologies field.

In order to start to develop AI technology in-house, the biggest investment made by Siemens concerned human resources. A fully new department and a new team was set up, by hiring additional workers. Indeed, the respondent has been hired for this reason. Other small investments were made to strengthen the IT department. However, the biggest investment consisted in people and knowledge.

Although AI will represent a critical element for Siemens' business strategy, there was not an immediate need for it within the company. Therefore, Siemens decided to invest in building its own capabilities, even though it would have taken time. This strategy reflected the long-term vision to be leader, not only in providing sensors, but also in providing digital solutions.

When considering the costs and returns enhanced by the AI introduction, the respondent said that they were more than initially expected. However, the process of integration went slow, since the new team discovered there was a gap to fill, not only related to AI, but more in general to digitalization of the whole processes. The team that was created had a digital background very different compared to other workers. They succeeded in identifying the gap and made it visible. In the long term, this strategy gave its benefits. In fact, if Siemens was to partner the AI technology, this gap would not have been visible so quickly. On the other hand, the returns have been slow since a lot of time was spent in trying to fix things head.

Overall, the main reason why the company decided to invest in AI technology came by the need to catch up with digitalization. According to the respondent, indeed, companies which do not invest in technologies will be soon kicked off by the market.

4.2.4 Internal organizational changes

In order to implement AI solutions, as mentioned before, a team with specific AI skills and competences was implemented. However, also the rest of the organization was involved in this implementation.

In this view and in order to integrate AI, Siemens created cross-functional teams combining people with knowledge and those without, creating a kick-off training. According to the respondent B, cross-functional teams are always a good way to combine different resources and functions. Everyone was aware about its own role, but it was important that different roles knew about each other. For example, workers dealing with the portfolio side, needed to understand, as well, the value for the customer, the way the product will be sold, etc.

The organization is becoming flatter because of this integration process. However, Siemens is only at the middle of it. New workers completely perceive the flat hierarchy coming whereas, “the old-style management workers” are not yet fully in the mindset. Indeed, the authority relationships, as well, are in the process of changing. In fact, the managers which fall in the “old style category”, felt threatened because of losing their usual control. Even thought, they can get the terminology of what the new team is doing and why they are doing it, they will never have the capabilities to really control things as previously, since it is out of their skills.

As said, Siemens needed to set up new offices, such as the one where the interviewee comes from. This new department was perceived as a threat, because of the creation of skill gaps within the company.

According to the respondent B, the culture of the organization will change, but at the moment it did not. There are still departments which are ignoring that.

People in the organizations were provided with new trainings, especially collaborations tools. The biggest change has been a method one. In Siemens usually, the first thing which is discussed is the technology and the technical tools, whereas workers needed to start by thinking what they need to achieve for their users, and then designing the technology.

When they needed to set up the new department, it was not difficult to gather new talents. According to the respondent, the key has been to set as language requirement only the English one. In that way, the company could have a vast array of talent supply coming from all over the world.

The respondent B argued that the change inside the organization could have been faster. However, under other members' perspective, for instance technicians, the change has been felt really fast.

Moreover, during the interview the respondent B highlighted that one additional challenge met by Siemens has been to introduce AI in a conservative and traditional market such the construction industry. The task was complex considering that this sector is not even automatized yet. In this scenario, Siemens needed to rethink about processes and introduce them to workers of the field.

4.2.5 Changes to the ecosystem

When asked to the respondent B, how AI solutions will affect workers and skills required, she said that it depends on the job and the worker's attitude. People who do not mind repetitive tasks will welcome the automation by AI. Whereas, other people will perceive it as a threat, arguing that machines cannot handle their work with the same quality. According to the respondent B, it is a matter of attitude. This mindset applies to Siemens as well. There are people very enthusiastic and actively pooling for AI solutions, while others try to find several reasons to go against AI, highlighting bad sides of it.

In addition, respondent B said that AI (and more in general digitalization) is increasing the democracy of the workplace. Independently from age, gender, background, all users can take advantage of the technologies. Therefore, a person can turn to be the perfect human resource for a company, even though he/she lacks technical skills or has a completely different background. For instance, workers that would never consider themselves appropriate for Siemens, could turn being the right ones.

According to the respondent B, AI diffusion caused a big skill gap. For example, in their customer market field (fire prevention), if one compare technicians' skills, whose work is to check if the sensors

are in good conditions, and workers configuring the platform where sensors interact, there is a huge gap between those skill levels.

4.3Anonymous company

4.3.1 Company description

The company is small in size and it is leader in automation products for moving robots and automatic trucks. In particular, for the case study of this research, the focus will be put on the segment of the distribution of systems and automation components for manufacturers of OEM (original equipment manufacturer), which is core to the company situated in Sweden. Its solutions include hardware, software and navigation, to improve automatic trucks performances. Therefore, this company was conceived as a System integrator even previously to AI introduction.

4.3.2AI definition and functioning

Even thought, the company is more a software than a hardware provider, within their offering there are sensors components for autonomous vehicles to navigate. The final product is able to detect walls, distances and can navigate in the space environment. The system working around the sensors installed into the product, is able to collect and store data

When asked to the respondent C to give a definition of the sensors, thinking about its company product, he said that that the intelligent activities are those that enable the product to understand what is happening in the environment, self-learning and therefore make decisions driven by the designed system around it. Those activities can be done at the individual component level or can be enhanced on a system level.

The AI model developed around the company offering does not use data coming from external sources, instead, it is adopting only internal ones. However, AI models which make use of additional data are in a research development stage.

4.3.3Make vs buy decision

The company is not a manufacturer of sensors devices, whereas it partners with other companies to gather them.

It was engaged in only few projects related to AI, which implied a development of AI in-house. However, for future projects the company is keener on trying to partner for AI development. Even thought, the company carried more than one project concerning AI, the respondent C, does not exclude that the strategy around it will change. Indeed, according to the him, making AI from scratch for a company that is not AI core, could make sense only if it is very big in size. It is very important

to consider collaborations for the AI case. Coherently, he stated that it is not simply a matter to decide whether to make or buy the technology. However, he argued that the decision to make or buy AI in the future, will still be influenced by the traditional factors impacting on this choice. Therefore, costs, resources and the ease of integration will be assessed. The ultimate choice depends on the additional value delivered to the final customer.

As system providers, it is strategically important to secure AI competences for the company, since they have a very important role in future products and services. However, since now, the company did not adjust its hiring program in this perspective.

Moreover, the company decided to start AI solutions projects driven by the possibility of improving the offering and in turn increase the sales. AI could make their solutions faster, cheaper and ultimately ease the customers' application of their product.

The respondent C was not able to provide the effects of AI projects in terms of costs/returns, and either to assess the control over the supply chain market, seen as the system offered is an integrated product and it is difficult to discern the several effects from it individually.

4.3.4Internal organizational changes

The implementation of AI solution projects has been done creating a new team by picking workers from different departments, which needed to change their usual tasks for project purposes. Therefore, a cross- functional team was created. However, workers remained under the supervision of their original departments.

For what concerns the organizational structure, it was not affected at this stage, considering that AI is not well established in the company. However, the respondent C provided some insights on how the structure might change in the future. He stated that the organization might become flatter and more team oriented. Nevertheless, according to the respondent, authority relationship will modify as well in the future because of AI disruption. Another element which will be affected is the organizational culture, which will become more agile and flexible. According to respondent C, this change will probably happen since AI is a disruptive technology. Currently, in the company there are a lot of interdependencies, since having about 100 employees, it represents a not so big reality. This relation among the departments make it essential to have a unified organizational culture. Indeed, for the projects that have been carried so far, the little team dedicated to AI, was perceived as acting strange from the rest of the organization. Even though, the management was pooling for this change in culture, people were still working in the same environment and the whole organization not really

perceived the change. However, the future goal is that the entire organization catch up with the group. As said by the respondent C, this process requires time and it is related to the classical organizational culture issues.

Nonetheless, the respondent C argued that if additional projects will be carried on, more changes will be done. Historically, the company has been changing in an incremental way, making small steps. However, with disruptive technologies such AI, it is important to have a dedicated part of the organization supporting and sustaining the whole product.

Currently, the employees of the organization, particularly, software developers, are encouraged to learn about AI. In order to develop the past projects, workers were not retrained but, they increased their skills and competences. However, so far it has been more a personal development type of activities.

Some additional workers with narrow knowledge of AI were hired. When the company needed to look for those talents, it did not encountered problems in finding the right ones, but in attracting them. In fact, even though, there are a lot of talents to be possibly hired, there are as well a lot of companies seeking for them.

When asked to the respondent C which other organizational implication will be experienced by companies because of AI diffusion, he stated that companies will face the challenge of applying the already developed AI knowledge and converting it into products. Research institutes, universities and start-ups are developing a lot of AI models and companies should be effective into applying them to business cases. Companies should act as integrators of AI functions. Therefore, collaboration among different entities is essential for the respondent C.

Another interesting point, which came out during the interview, regards the users to which address the AI solution. Five years ago, the company carried a project about AI with an isolated team, making a lot of use of external technologies and collaborations. This project did not have the desired outcome. The reason of this failure was individuated by the respondent C, in the fact that it was addressed to the usual customer pool, within a traditional industry. The company failed in distinguishing which customers could be open to innovation or not. According to the respondent C, the best strategy at the beginning, is to find a niche market or application, make the solution for that and propose it to the right customers.

4.3.5 Changes to the ecosystem

When asked the respondent C's thoughts on the way AI will affect workers and skills, he responded that there are mainly two effect directions. One concerns the need for completely new competences

in the software field (engineers which code AI). The second direction affects factory and warehouse' s workers, since AI solutions are mainly addressed there, to simplify their work. In other words, competences will be more sophisticated in the development side but, there will be an easier application on the user's side and therefore, less competences required by workers.

4.4 Nord- Lock

4.4.1 Company description

Nord- Lock Group offers bolting solutions. The company was founded in 1982 in Sweden[217]. It is a partner for several industries, and it is medium in size, having a total of 550 employees. Currently, it has production facilities in Europe and in the US. The Group offers a wide range of innovative technologies such as wedge-locking, Super bolt multi-jack bolt tensioning and Expander System pivot technology. This company will provide AI solution to its traditional market. In particular, the respondent of this interview is from Nord-Lock AB, which is part of the group and has its office in Malmo, is engaged in several projects around AI.

4.4.2AI definition and functioning

The company has just started the journey toward digitalization, where AI plays a part, having 5 different initiatives on a research stage. The initiative more advanced is around the company's core product, bolting joints. Even though, the solution has not been marketed yet, the company has already a strategy around the project implementation. Therefore, the company was considered suitable to be included as a case in this study.

The AI solution will service the installation of their devices by monitoring their functionality through sensors devices, instead of doing it physically on the site, as it is done today. In this scenario, the sensors are capable of controlling the tension of bolted joints. Once data are collected, they are used to build up the service to prevent maintenance. According to respondent D, the intelligent part stands in the possibility to get data from different sources and getting a whole picture of the situation. The solution becomes intelligent when it gathers and analyses data from different sources and projects the outcome picture.

4.4.3Make vs buy decision

As previously said, even though Nord-Lock has not already started to apply AI to its solution, it has already built up a strategy for the entry point of the technology. The company wants to develop the

[217] Nord-Lock, Nord-Lock, (2019), About Nord-Lock group (on-line website)

AI in-house with the support of the Cloud Microsoft tools, which it has already available for other purposes. Indeed, the company has a good cooperation with Microsoft for the cloud solutions.

This choice was taken for the business strategy intention to reach the objective of a rapid time to market[218]. AI is strategically important for the company to reach the aim of owning data lake on the cloud and the solutions developed around it.

The company did not look for new human resources since one of the workers inside the company already has developer capabilities. Moreover, when expertise is missing, the company is supported by Microsoft.

For what concerns the economic factors, the company is aware that its choices will lead to generate low margins on the solutions but, at the same time, this strategy will allow to the maintain a low risk level. Moreover, the company will benefit of a non- monetary return, which is being perceived by the market as an innovative firm.

4.4.4Internal organizational changes

A lot of diverse teams were engaged and will be engaged into the implementation of the AI solution projects. So far, the different parties involved in the projects are: the project manager; the IT department, which owns the tool to develop AI; the product owner of the bolt, which formally ordered the solution; the Technical centre, which is the department that make sure the quality of the solution is good enough**;** and ultimately the marketing department, which will need information to advertise and market the product. Moreover, it is worth to mention again that there is a join collaboration between IT department and Microsoft supporters for the software implementation part.

Since the company has not started to market the AI solution and the project is not completely mature yet, the organization has not experienced big internal changes. However, the respondent D provided information on how the company might change in the future stages. Respondent D thinks that the structure and culture of the organization will not be affected since the AI solution will not impact several areas of the organization. However, this might happen with the implementation of other projects they are planning to market.

[218]Time to market: it is defined as *"the time taken from deciding to develop new product to its market launch".* Barnes D., (2008), *Operations management: an international perspective*, London, Thomson.

The skills and the tasks of their employees, as well, will not be affected since this project does not have effects on the internal organization. However, the company might hire new developers, since at the moment there is only one employee fully dedicating to it.

The changes in the organization will not be radical and rapid according to the respondent D. Indeed, he said that *"People overestimate what will happen in two-year time, that they underestimate what will happen in ten-year time"* to argue that the changes will be gradual and come step by steps during a longer period. Thereby, real consequences will be observed only in the long run.

Moreover, the respondent D individuated an additional possible implication that will be experienced by its own company: Nord-Lock costumers will change, since the companies interested in their new solution are those in the ecosystem which deal with the installation and maintenance job. Therefore, even though they will provide the solution in the same market, it will not interest their usual customers. Consequentially, the sale's department of Nord-Lock might need a reorganization due to different expertise required to sell the product to different customers, using distinct ways of selling.

4.4.5 Changes to the ecosystem

For what concerns the changes to the ecosystem, according to the respondent D, the consequences of AI introduction will be different depending on the country. There will be a greater impact in countries with non-qualified workers, compared to countries with qualified ones. However, it will be generally positive for all the countries. Indeed, even for non-qualified workers, there is opportunity to approach with a new technology and learn it. AI will not be a technology for privileged educated people, but it will be learned by everyone since there is information about it everywhere and it is simple enough for anyone to use it. As a consequence, the lowest level of non-qualified workers will decrease, and more people will have access to information. The technology will, at least initially, create a lot of new opportunities for everyone. Moreover, the respondent D perceives AI effects as a normal consequence of the society evolution.

The skill gap inside organizations will vary according to the industries for which the AI solution are designed for and by.

According to the respondent D, a lot of people have heard about AI, however, they have not understood its potential and how it will really affect their industry. On the other hand, there are organizations which overestimate AI, since they think possible and easy something that might have be done once, but it is not easy to replicate. The respondent mentioned the expression "*The last 10% is the 90% of the work*" to mean that even though a lot has been done, there is still a lot of work to do for the AI diffusion. Therefore, again, the effects of AI solutions will be seen only in the long run.

4.5 SKF

4.5.1 Company description

SKF, Aktiebolaget Svenska Kullagerfabriken, was founded in 1907 in Sweden[219]. Since its foundation, it has been a producer of bearings. Nowadays, it is a leader in its sector, and it is big in size, with average annual revenues of 6,4 billion euros and around 45000 employees in several countries. In particular, SKF applies sensors to its bearings and provides AI solutions around its products. Therefore, it operates in the same markets also under the System integrator role. In particular, SKF operates in several markets seen as its bearings have different applications.

4.5.2AI definition and functioning

The company offers bearing units' sensors as a core product. The sensors are able to monitor bearings and its applications, wherever they are located. Data captured differ on the base of their application and are then placed into data lakes. For example, they are able to sense how the rotating equipment is performing. All those data allow the company to offer differentiated (customized) services to their customers in order to produce on time and maximise the efficiency of the application.

The intelligent activities within the solutions consist in the analysis of data and the development of an outcome on which decisions are then based on.
Data are analysed through algorithms. This requires building up the right probabilistic algorithms with the right knowledge from the application. Once algorithms are tested with a sample data, it is possible to identify patterns and other elements based on historical data. Moreover, the company use both structured and unstructured data in the business AI solutions. This helps SKF in finding new businesses and opportunities.

According to the respondent E, the more data in the data lakes are clean the better it is. It is critical to collect a lot of data, but the input data which are used for the AI model must be the right ones. Consequentially, it is also very important to then apply a clean process, in order to obtain the best outcome. However, it is fundamental to have a critical amount of data still, since there might be some elements and patterns which the company has not realized yet, that could be found in the future.

4.5.3Make vs buy decision

The company is trying to build the AI competences in-house, even though it is not a process which happens overnight. SKF hired AI expertise, but for some projects it still required a partnership with companies that are machine learning experts and know AI methods. It is important to have internal

[219]SKF, (2019), SKF History (on-line website)

expertise of data analyst and data scientist but, it is also crucial to have workers which understand the contest and processes for which the solution is designed for. According to the respondent E, in the long-term having internal capabilities will make the difference.

The business strategy applied for the decision to develop AI in-house, is related to the fact that for SKF data is considered a key asset. However, the respondent E could not provide additional information on this reasoning for confidential reasons.

For the implementation of the solutions, SKF used a mix of old competences and new ones. Indeed, roles such design engineers, application engineers and product experts, already inside the company, were coupled with developers of coding, data analyst and data scientist, which were new resources for the company. Therefore, multidisciplinary teams were formed to implement the project.

When asked to the respondent E the economic factors around the choice of making the technology, he said that it is difficult to estimate the returns and cost of the offering since the new product offering characterized a different product compared to their traditional ones.

Overall, SKF decided to invest on the technology for several reasons. They perceived themselves as an innovative company and they saw a market need for that. The company wanted to offer better solutions to their usual customers. Moreover, the creation of a new business model allowed them to growth and gather new customers.

4.5.4Internal organizational changes

When asked to the respondent E, the organization of the work system for the implementation of the solution, he replied that AI capabilities are not centric in one specific function but, impacted several parts of the organization. For instance, under the customer process perspective, one area impacted is the one of machines applications. Moreover, AI was used also to improve the customer experience by the use of detailed channels or by exploring the way people navigate the web environment.

SKF needed to have core teams, with multidisciplinary competences. However, it was also important to decentralise those capabilities and spread them on a more regional level. SKF is not a monolithic organization with technologies, therefore afterwards they needed to spread capabilities into the different areas. Nevertheless, the core capabilities should be developed by focus teams that are more central before being used in the different areas.

For the development of the projects, workers with business expertise and technical one worked together. The teams were cross-functional considering that employees from IT function, engineers, product release, data scientists and data analysts were part of it.

SKF has been working in team for a lot of time. However, with technologies such AI, it was required to work in a much collaborative way.

According to the respondent E, in order to enhance innovation, it is important to create the right environment conditions. This means that different ways of working, free thinking and new ideas must be allowed. It is important to allow errors to obtain such innovative solutions. The mindset in innovative environments such SKF, is already different when compared to very structured businesses and it has been helpful in the implementation of the AI projects. However, the respondent E reminded that it is also very important to maintain a certain structure. Too much creative people placed together could obtain good outcomes, however they might need a lot of to achieve results. Therefore, it was important to maintain a good balance of authority versus freedom.

Certain processes are in the phase of changing, such as the area related to capturing the data. Even though data use is still unknown sometimes, the company is already preparing for the collection. The future challenge is how to find the right patterns in data and then make the right decisions out of outcomes.

According to the respondent E, the speed of changes has been high. As technologies such AI are evolving fast, the organization must adapt accordingly. It was important to have a good understanding by the management on how the technology would have impacted the business. This facilitated the change process.

For SKF is important to manage the transition of that change. Even though, the company will not become a developer, there are still a lot of areas in which there is room for software competences. According to the respondent E, the changes in this sense will be incremental.

The skills and the tasks of some employees needed to change. There were some roles that needed to leave up certain competences and ways of doing things. This did not happen overnight, and only certain areas of the organization were addressed for that change. According to the respondent E, in order to face the change in an appropriate way, it was important to find ambassadors or early adopters that could help to spread it over the organization.

The company needed to hire new workers. According to the respondent E, it was very challenging to attract new people since there are not many individuals with the right competences. The demand is huge, while the offer is not. Therefore, there is a strong competition. Moreover, seen as SKF is an industrial company, it has been facing the competition against companies' giants such Google and Amazon, which were perceived as more attractive. Even though SKF has a recognized brand, it has

been challenging to show employees that it could be an attractive employer. However, SKF succeeded in bringing extremely qualified employees.

When asked to the respondent E other relevant implications experienced for the AI introduction, he mentioned two. Firstly, SKF needed to consider both the company readiness for the technology and the market readiness for it. There are cycles for technologies, and it can happen that the provider is ready to market the technology, but the customers are not. According to the respondent E, the key to success is the right timing to market. Hence, it was very important for SKF to make some considerations before making investment decisions. In fact, SKF considered the market trends, made stakeholder interviews, internal and external analysis. Then, it decided which strategy to follow. Indeed, coordinating the company pace growth to the customers' one is essential. If the market is not mature yet, filling an organization with new competences is useless.

Secondly, the respondent E said that collaborations increased. To speed up innovations, collaborations are a good path to follow. There are lot of start-ups that are specialized in those technologies, which could either become partners or be acquired to obtain competences. Therefore, SKF, as the other companies, need to be alert to what is happening in the market and pick the opportunity when possible. Working with new technologies requires having different approaches. It is important to monitor the progress of activities and evaluate what is required in each moment

4.5.5 Changes to the ecosystem

When asked to the respondent E his considerations about how the AI solution are affecting and will affect workers and skills, he argued that most of the companies are in the process of learning what will happen. Surely, according the respondent E, new resources and competences must be acquired. However, this does not mean that suddenly core competences and knowledge already available are thrown away.

The respondent E did not think that there are big skill gaps inside companies since AI technology is introduced in a gradual way. However, some gaps are still present, considering that skill gaps are created every time a new technology is insert in a business.

4.6 Summary table of empirical findings

In order to facilitate the reading of the data collected, a table reporting the main focus points individuated **(Table 2)**, which are then discussed in the analysis, is reported below.

Companies	AI Definition and functioning	Make vs Buy	Internal organizational changes	Changes to the Ecosystem
TalkPool (A)	• AI process in three steps • Use of structured and unstructured data	• In-house development (however sometimes buy) • Strategy business-driven • Not big costs • Traceability of data	• Already flat type of structure • Cross-functional teams • Culture did not modify • Employees self-learned	• AI eliminating and creating jobs • New competences must be acquired • Skill gap, related to digitalization
Siemens (B)	• Self-optimization due to data collection • Use of structured and unstructured data	• In-house development (however sometimes buy) • Big investment: human resources • Strategy business-driven • Returns more than expected • To stay competitive in the market	• New department • Cross-functional teams • Diverse skills combined • Change in flatter structure • Authority relationship are flattering • Culture might change in future • To attract talents: English language • Slow changes • Customer market not mature	• Skill gap, very big • Effects on job depend on the job and worker's attitude • Reinventing jobs
Anonymous (C)	• Understand the environment • Self-learn • Make decision based on info • Only use of internal data	• In-house development (however sometimes collaborate) • Possibly, buy as a future strategy • Strategically important to secure AI • Not possible to discern risk and economic factors from the solution	• Structure and culture might change in the future • Incremental changes • Employees encouraged to self-learn • New roles • External research must be exploited • Consider market readiness	• AI will affect jobs in two directions • Easier application for users • More sophisticated competences in the development part and less sophisticated at the factory level
Nord-Lock (D)	• Mix data to get a situation picture • Data coming from different sources	• In-house development (however collaboration with Microsoft) • Time to market objective • Resources: retrain a worker • Non-monetary returns	• Cross-functional teams • New role created • Structure not affected • Future changes will be gradual and observable only in the long run • Change of customers	• Changes of jobs depend on the countries • AI is a technology available for everyone • Skill gap will vary according to the industry and will not realize in the short-term
SKF (E)	• Developing an analysis by using data collected • Take decision on the outcome • Use of structured and unstructured data	• In-house development (however sometimes collaborate) • Data are a key asset • Returns not estimated since it was a novel product offering • Market need for the offering	• Cross-functional teams • Impacted whole organization (at the end) • Innovative culture essential • Speed of change perceived high • Incremental changes • New roles: difficult to attract talents • Increase of collaborations • Consider market readiness	• Change of jobs will be observed only in the long run • Skill gaps not present if AI is introduced gradually

Table 2: Table of summarized empirical findings

5.Analysis

In this section empirical findings will be analysed following a thematic order. First AI definition and functioning of each AI solution are discussed. Then, strategy reasoning around the decision to Make vs Buy of each company is presented. Lastly, an analysis of the Internal organizational changes

(including the analysis of the type of change) and the Changes to the ecosystem identified are given. Moreover, the findings are compared and contrasted over the different companies, when data allowed it.

5.1AI definition and functioning

The definition of AI provided by the literature is the discipline that includes theories and practices for the development of algorithms able to enhance machines to show intelligent activities[220]. Given that the AI definition is broad, the author needed to collect information on companies' AI solutions, in order to understand if they could be possibly be compared.

Moreover, as stated by the founder of the Artificial Intelligence term, Jhon McCharthy, *"As soon as it works, no one calls it AI anymore".* Even though there is not a practical and unique definition of AI, identified by scholars, it has been possible to individuate the AI technology through the description of the intelligent activities in each business application, and with the support of the technology characteristics identified in the theoretical framework (the three actions to classify AI and the four functional levels of AI). Therefore, to obtain a practical definition of AI technology it was asked to the respondents to provide one, taking in mind their projects.

The definition provided by the respondent A, describe AI as process which happens in three steps, data collection phase, interpretation of data from the Cloud and development of an output on which the decisions are based on. This definition matches with the three categories identified in the theoretical background **(1.1.1),** which are respectively *sense, comprehend and act*[221]. For Siemens, indeed, which provided a definition thinking at the building automation system, intelligence activities realize when a device, according to the information collected, is able to adjust the environment in which it is placed. A similar definition was provided by respondent C, which perceive AI as activities that enable the product to understand what is happening in the environment, self-learning and consequently make decisions driven by the designed system around it. Moreover, respondent E provided a detailed definition referring to the intelligent activities as those that analyse data through probabilistic algorithms in order to develop several outcomes on which final decisions are taken on. All those definitions describe AI through the functional level of both *reasoning and learning*[222]. Indeed, reasoning consists of the logic systems enabling AI to connect a vast array of information, while learning concerns the analysis of data to derive knowledge to be used for optimizing actions. Lastly, the definition of the respondent D can be labelled under the functions of *comprehension and*

[220] Boldrini N., 2019
[221] Purdy M., Daugherty P., 2016
[222] Ministry of Economic Affairs and Employment of Finland, 2017

learning[223]*,* since he described AI as a tool which enable to get data by recognising pictures of the environment, to ultimately project an outcome of the situation.

Moreover, it is worth to mention that all the AI solutions identified fall under the category of *Narrow AI,* considering that they are used to perform only one task and not complex problems in a human intelligent way[224]. Therefore, they fall under the category which the author aimed to analyse.

Furthermore, all the respondents agreed that intelligent activities do not stand in the devices but in the system built around them. In fact, the respondent A for example, sustained that sensor's objective is to only measure and report data in the cloud in a secure and cost-efficient way. As well respondent C, stressed on the point that it is the system working around their product, which enables the storage and analysis of data, to be intelligent, not the devices themselves. This confirms the fact that for the development of AI, the key actors for the creation of the intelligent activities are System integrators, which are the ones entitled to build up the system of the solutions, rather than being the mere developers of the technology itself.

As shown in the theory, before being effective for AI, data collected through sensors devices must follow a specific procedure. Moreover, it is possible to use in the final solution, data coming from different sources, as stated in the theory[225]. Both TalkPool, Siemens, SKF are adding to the business solution not only data captured from their devices but, also data coming from different sources, both structured and unstructured, such weather forecast data and sun radiation. Those data must be combined and follow all the processes as described in the data science hierarchy of needs[226]. As stated by the expert, the combination of unstructured and structured data represents one of the most challenging phases faced by companies during the AI integration process since the process of storing, corresponding to the second phase of the pyramid of needs, increase in complexity with unstructured data. The way data are placed and structured is essential, indeed as the expert said, *"there is no AI, without IA (information architecture)".*

The challenge mentioned by the expert with regards to the lack of data necessary to build up the AI solutions, was not mentioned as a problem by the respondents. By contrast, respondent E mentioned that his company has an abundancy of data and this could be an issue. Respondent E clarified that is important then to use the right data into the model and this is why the cleaning process has a critical

[223] Ibid
[224] Cimatti A. et al.,2003
[225] Chiang C.,2018
[226] Rogati M., 2017

function. Indeed, it represents one of the key phases of the pyramid of the data science Hierarchy of needs[227].

To conclude, it is possible to claim that even though AI is often not recognized when in action, it was possible to individuate the intelligent activities by classifying the technology's characteristics and functioning. Therefore, the companies selected could be compared. Moreover, the combination and structuring of data has been identified as one of the biggest challenges faced by companies when integrating AI, and the architecture of data has been highlighted as the critical point of the integration process.

5.2Make vs Buy decision

According to the theory, the Make vs Buy decision by companies increase in complexity when it comes to apply it to disruptive technologies such as the AI technology[228]. Thereby, in order to further investigate on in this implication with the aim of understanding how companies dealt with it, it was asked to respondents the reasoning behind their company's choice. The analysis of the findings is supported by the framework[229] presented in the theoretical background, which classifies the criteria to analyse the choice into three categories: Business strategy, Product supply chain risks and Economic factors.

Before starting the analysis on the criteria, it is worth to mention that all the sample companies adopted in-house technology solution, even though for different reasons and not as a solely option. However, some additional considerations must be discussed.

Firstly, one of the analysed companies do not see the strategy of making as long term one but, decided to instead opt for this path for the beginning of the implementation. This is the case of the Anonymous company, which think that making AI from scratch is less convenient than making collaborations for a medium company like them. Indeed, respondent C argued that one implication of AI diffusion is the increase in collaborations caused by the need of the application of the already developed AI knowledge from universities or research institutes to product solutions. In fact, also according to the theory, companies consider the speed at which they can access frontier research[230]. Hence, for the Anonymous company, external collaborations could represent the best mode to be applied in the future. Moreover, this strategy can be interpreted as a shortcut to get AI solutions. Indeed, as mentioned in the theoretical background, when opting for the buy decision a company can benefit

[227] Rogati M., 2017
[228] Ransbotham S. et al., 2017
[229] Shorten D. et al, 2006
[230] Vitale A., 2018

from the quick access to specialised expertise[231]. Therefore, it could be claimed that for the Anonymous company making was the best choice for the initial projects but, buying and collaborating is the suitable long-term strategy.

Secondly, even though all companies are making the technology, most are collaborating with few partners. Hence, those companies are sometimes opting for the Ally path[232]. Indeed, as reported in the theory, AI technology is increasing the number of collaborations[233]. This is the case of Nord-Lock, which plans to develop the AI in-house but, still leveraging on the collaborations with its partner Microsoft. SKF as well, partners when accurate machine learning and AI methods knowledge is needed. Thus, this highlights that collaboration is adopted as a remedy to an internal failure of competencies.

Even TalkPool has a hybrid strategy (make and buy). It makes the AI software itself when the complexity of the project is not so high, and it is still able to leverage on the competence and capabilities of its employees. By contrast, if the projects require more resources, TalkPool prefers to outsource the development software part instead of gathering the missing skills. However, in this case this might be a strategy influenced also by the small resources accessible for a small company like TalkPool. A strategy of buying and making happens for Siemens as well, which outsources the development of AI in the case of video. Nevertheless, the reasoning behind this choice is that this area does not fall into their core competences.

Lastly, it is worth to mention that differently from what reported by the expert in the theory, the smaller companies analysed in this research (TalkPool, Anonymous company, Nord-Lock) are producing tailored AI solutions and not applying standardize one.

Business strategy

According to the theory, when considering the business strategy, companies need to evaluate how strategic is the technology for the organization, its attractiveness and the dynamics of the industry[234].

The evidence of the application of this traditional criterion was found in all the companies analysed. Indeed, all the companies considered, see AI technology strategically important and consequently decided to produce AI in-house. For TalkPool, which is a small company, AI represented the opportunity to enter on a new market and leverage on its hardware devices assets. Even though currently AI is not core, it is viewed to become such in the future. Siemens, instead, invested in AI to

[231] Ibid
[232] Veugelers R., Cassiman B.,1999
[233] Lindzon J., 2017
[234] Shorten D. et al, 2006

achieve its aim of being a leader provider for quality and services within the building technologies field. Nord-Lock considered in-house AI as strategically important, since it will help in fulfilling its main strategic objective represented by the time-to-market. As for SKF, it adopted a Make choice since considers AI as critical for its business, taking into account that data represent a key asset for the company.

In addition, both the Anonymous company and SKF decided to make AI in-house also for its attractiveness, since it would help the companies to improve their existing offering and thus to acquire new customers and/or markets.

Siemens is the sole company that referred also to the industry dynamics when taking this decision, since its choice was additionally based upon the fact that without this investment its competitors would have kicked-off the company from the market.

In conclusion, coherently with the theoretical framework[235], all the companies decided to follow the make path since AI was considered critical for their businesses, for some of them it was increasing the attractiveness of their products, while only for the bigger company (Siemens), the choice was also influenced by the dynamics of the industry. Therefore, there was a need to develop the technology internally to absorb and develop the appropriate capabilities.

Product supply chain risk

The product supply chain risks considered by the framework are the hold-up problem, the intellectually property protection, etc[236].

It is worth to premise that this criterion was not clear for all the respondents. According to respondent A, traceability of data is a factor that pushed and will push the company to the in-house technology development, since it enables to better evaluate the suitability of the algorithms. Dissimilarly, for the respondent C, the product supply chain risks of the technology are not easy to evaluate since the development of the final AI solution is determined by several factors (hardware, specific market application) and it was difficult to discern the effects of each from the final product. Moreover, respondent B, D and E were even not able to motivate the strategy around this perspective.

Those empirical findings lead the researcher to the conclusion that when companies took the choice of making AI, the supply chain risk criterion was not highly considered but, companies were instead driven by other criteria. A possible reason to explain this evidence is represented by the fact that AI

[235] Ibid
[236] Shorten D. et al, 2006

industry is a disruptive one and the supplier market is not well established. Indeed, as pointed out by scholars, the challenge of disruption makes insufficient the traditional methods to evaluate the Make vs Buy decision[237]. Therefore, it is not easy for the System integrators to understand the mechanisms governing the market, dynamics, technology evolution and the competitive pressures. As a consequence, companies, particularly the smaller ones have difficulties in the comprehension of market dynamics and in the design of strategy around it. Often, a process of trial and error is adopted at this stage. Moreover, in line with the theory[238] of IPR, a reason that could have pushed companies on the in-house development, could be the need, particularly in a not well-established market, to protect the intellectual property, considering the innovativeness of the final AI solutions. On the other hand, taking in mind that outsourcing is normally preferred when there is the possibility to make partnerships and collaborations[239], it is controversial that some companies opted for the Make path instead of the Buy path, when still having partnerships for the implementation (hybrid strategies). However, as mentioned, other criteria such the business strategy and the economic factors, might have prevailed over the supply chain risk one, when considering the in-house production decision.

Economic factors

The economic factors refer generally to all the effects that have an economic impact. They include all the costs and returns in which the company incur when making one or the other choice, as well as the skills and expertise required to support it[240].

Therefore, it was asked to the respondent which costs and returns they considered when taking the in-house choice. Respondent A said that the costs to be sustained were very low, but the long- run returns for the company could be potentially higher. Respondent B argued that the returns of making AI in-house were even more than expected, even though they went very slow. Respondent D took the choice of producing in-house not for economical returns, but for the return of being perceived by the market as innovative. Therefore, since the degree of appropriability of innovation[241] was assessed, Siemens and Nord-Lock evaluated the in-house production more convenient.

By contrast, both the Anonymous company and SKF did not provide any explanation of this perspective. In fact, as for the supply chain risks criteria, the respondent C said that it was not possible to identify the returns of the AI in-house decision since the effects are combined with the one of all the other components of the integrated solution. Instead, respondent E, declared that it was not

[237] Kutschera H.et al, 2017
[238] Grossman S. J.,1986
[239] Shorten D. et al, 2006
[240] Shorten D. et al, 2006
[241] Love H. J., Roper S., 2001

possible to assess the return of the solution in advance, since it was a very new offering at its early phase.

For what concerns the aspect of the skills and expertise needed as support of the Make vs Buy decision, a distinction based upon the size of the companies analysed can be done.

Indeed, in line with theory, smaller companies decided to produce in-house since the cost of gathering the additional skills required was not elevated[242]. In fact, TalkPool mainly relied on its existing employees which acquired the competence needed by self-learning through internet tutorials, on-line courses and reading up about the topic. According to the respondent A, this was possible since AI is a technology that can be self-learned thanks to its simplicity. Similarly, Nord-Lock had a worker with the right competences and leveraged on the Cloud tool already owned by its IT department. Even the Anonymous company did not need hire a lot of additional resources and therefore did not incurred in high spending.

By contrast, big companies were able to acquire new human resources to obtain the skills and expertise required. Hence, they decided to produce in-house, even though major investments in resources needed to be done. Indeed, respondent B said that the biggest investment concerned the new human resources to build up the new team and to strengthen the IT department. Similarly, SKF needed to hire employees for new roles such developers of coding, data analyst and data scientist. It is worth to mention that coherently to the theoretical framework, new roles such data scientists and data engineers were required by System integrators[243]. When evaluating this choice, it must be taken into account that big companies have both a greater amount of total resources and the opportunity to spread those investments over several organizational areas. Therefore, even if they sustained relevant investments, higher to the ones to be supported for outsourcing, the potential positive effects spread through the all organization could have outweighed the higher resource spending. Thereby, in line with the theory, even the big companies sustained the investment because it was worth[244].

Overall, it can be concluded that even this perspective was analysed coherently to the traditional make vs buy decision framework. Indeed, in line with the logic of the transaction cost theory[245], the investment in AI was made since the returns could pay back the costs and the companies had the possibility to support with resources the additional capabilities required.

[242] Shorten D. et al, 2006
[243] Vitale A., 2018
[244] Shorten D. et al., 2006
[245] Williamson O., 1971

To conclude, from the analysis stated above, even though AI is a disruptive technology, the criteria of economic factors, supply chain risks and business strategy were applied in their traditional sense. Theory stated that the decision to make or buy gets more complicated for AI, considering that diverse skills are needed, AI expertise is scarce, and that AI is a disruptive technology[246]. However, no one of the companies declared that the decision to make vs buy was more complicated compared to the one taken for other type of technologies and they did not mention those issues. Nonetheless, it is worth to highlight that the analysis pointed out that some companies are still collaborating, while some are buying the technology for some cases, as a remedy to internal failure of competences. Therefore, it seems that the interviewed companies, even without perceiving it, reduced the complexity mentioned by scholars with regards to the need of very diverse skills and competences[247], by opting for hybrid type of strategies.

5.3Internal organizational changes

From the data collected through the interviews, it has been possible to define the type of changes experienced by the case companies, as well as, the organizational implications related to it. The analysis of those concepts is reported below.

5.3.1. Type of change

Through the information gathered during the interviews, it was possible to establish which type of change took place in the companies' object of the study. According to the theory, changes can be classified as evolutionary or revolutionary. An evolutionary change realizes when the change is incremental and focused on a specific target, whereas a revolutionary change happens rapidly, and it is addressed to the all organization[248].

Overall, all the companies that have experienced an evident change, seem to have faced an evolutionary change. In fact, Respondent B declared that change did not happen in a small span time. Furthermore, it started by the new area that was created for the project and only afterwards spread into the organization. Respondent C, instead, reported that changes have been incremental. Indeed, for example, changes in culture are about to be spread all over the organization step by step. Since according to theory an evolutionary change is characterised by gradual changes with a specific target[249], it is possible to outline that the type of changes observed are evolutionary.

[246] Ransbotham S. et al., 2017
[247] Ibid
[248] Jones G. R.,2013
[249] Ibid

Moreover, given that Nord-Lock is at early stages of the AI projects development and has not experienced big changes still, respondent D provided its opinion on the future changes. According to him changes will be gradual and not radical. Again, for the same reasoning stated above, it is possible to classify this type of change as evolutionary.

By contrast, according to SKF the changes experienced have been rapid in time, since the organization needed to adapt to the rapid evolution of AI. This consideration could classify the change as a revolutionary one, given that it realized in small span time[250]. However, the spread of competences through the all organization has been done in an incremental way, starting from a central unit and then spreading into the organization, and no radical changes in structure or culture have been observed yet. Therefore, even though the change was perceived to be happening in a small span time, there are more evidences leading to the conclusion that the change was evolutionary.

Lastly, TalkPool did not experience a change in structure and culture, whereas it still experienced a change in skills and competences. However, there are not enough pieces of evidences to assess the type of change experienced in this company.

Overall, the changes experienced by the companies seem to be evolutionary. However, it is to be considered that even though the companies have had more than one AI project, they might be influenced further by the technology in the future, if a greater internal development of that area will be realized.

5.3.2 Organizational changes

For what concerns the internal changes identified, they can be grouped in four different categories **(Figure 5)**: changes of structure, changes of culture, changes of roles and skills, additional internal organizational implications.

[250] Stoddard D., Jarvenpaa S. L.,1995

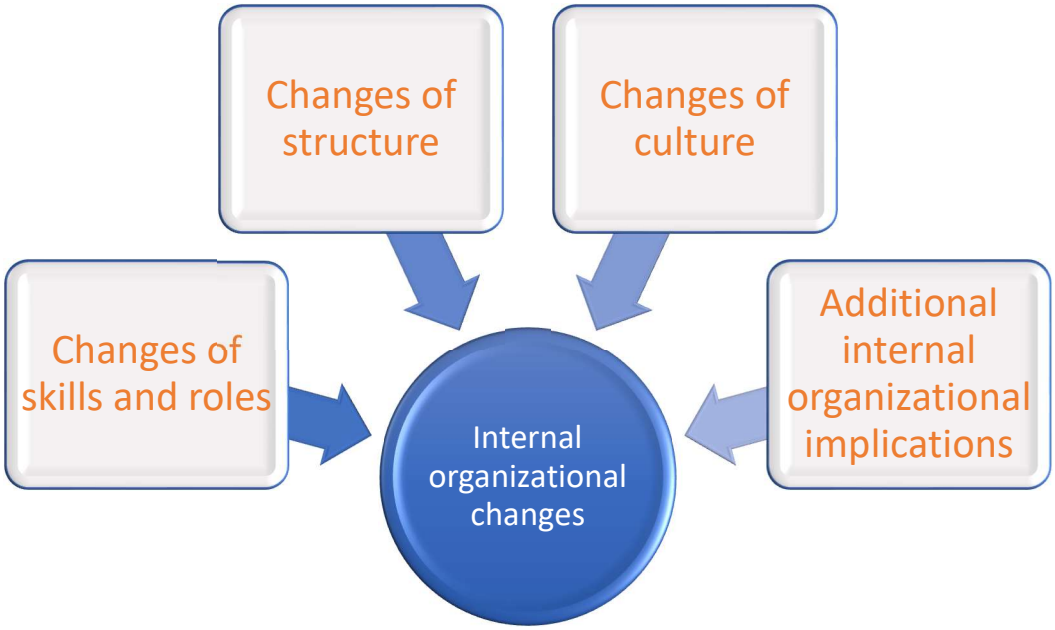

Figure 5: Internal organizational changes, Compiled by the author

1) Changes of structure

According to the theory, the organizational structures of companies integrating AI are becoming flatter because of the increase of collaborations and need to work in teams.

The empirical findings show diverse evidence towards changes in structure. Overall, some companies did not experience big modifications, whereas other showed a greater evidence. A possible explanation of this result is the specific type of structure characterizing the companies previous to the integration. Indeed, as reported in the theory, organic type of structures facilitate innovation, being characterized by free decision- making and less formalization and standards[251]. In fact, evidence shows that companies whose structure was already designed as flat, did not experience big changes. For example, since the adoption of AI, TalkPool's structure remained the same. However, it is important to mention that a flat hierarchy, which facilitated the implementation of the projects, already characterized this company. In fact, TalkPool used to work in small teams with wide responsibilities even before the AI projects implementation. Similarly, SKF, which was characterized by a flexible structure enhancing free thinking and new ideas, did not experience big changes even though the AI capabilities were not centric to a separated section, but were spread over the all organization.

[251] Dougherty D., 2001

On the other hand, companies that faced bigger changes in the structure were characterized by a more rigid and hierarchical structure. It is the case of Siemens, that being a well-established company, is characterized by a hierarchical structure, which needed to be modified to allow the AI projects implementation. Its structure become flatter and its authority relationship are in the process of changing. Those changes in structure were needed to allow the company to decrease the skill gap created by the technology and to speed up the AI developing process.

Furthermore, evidences of the fact that AI technology implementation requires flexible and flat type of structures is also expressed by the need of all the companies to work in cross- functional teams.

As for Nord-Lock and the Anonymous company, they did not experience any change as well in the authority relationship or in the design structure. Nevertheless, according to the respondents C, in the future, when AI solutions will become a bigger part of the company's projects, the organization might become flatter and more team oriented. By contrast, respondent D believes that even in the future, company's structure will not be influenced because the type of the AI solutions they are implementing will not affect the entire organization. However, in this case this could be explained with both the fact that AI is only a small portion of the business, and with the fact that the current organizational structure is perceived as appropriate for the business as a whole.

2) Changes of culture

In TalkPool the organizational culture did not modify. However, it is important to consider that, as reported previously, this organization was already characterized by a flexible culture. The same consideration can be done upon the case of SKF, that having already a type of culture, which enhanced innovation, did not incur in any culture change. Hence, it could be possible to claim that these companies have already embodied in the individuals and in the organization, those cultural elements that allow to face the introduction of innovation as a routine process. Indeed, in line with theory, culture is a factor that can boost innovation within a company[252].

Similarly, Siemens and the Anonymous company did not experience a variation of the culture for the moment. However, according to their respective respondents, they will in the future. Currently, some departments of Siemens are still ignoring that the organization is in the process of changing and this could be the cause of the belated cultural change. In the Anonymous company, so far, AI implementation teams have been working separately from the entire organization and are already perceived as acting differently by the rest of the organization. The goal is that the entire organization

[252] Pantelis C. K. et al., 2018

will catch up with that group culture. However, according to both respondent C and B, it is a process that requires time; thus it will be evidenced in a longer time period. In fact, as pointed out by scholars changing culture is timely and costly, requiring the organization to change all the several factors which define it[253].

To sum up, even though from the empirical findings it is not possible to outline that a change in culture is provoked by the AI integration, it cannot be excluded as a possible implication to be realised in the future. Nevertheless, from the analysis of the data it is possible to say that a flexible culture, which support innovation[254], is preferable for the AI implementation projects, considering that companies being characterized by different types of cultures, are converting to that type.

Taking into account the consideration made on the culture and on the structure, it is possible to claim that generally the companies did not experience radical variations. Therefore, it is not possible to apply the concept of restructuring. Indeed, restructuring concerns a process in which authority relationships, organizational culture and structure are subject to a radical redesign[255]. Even though, companies perceived their structure as flatter and their culture as more flexible due to the introduction of AI, there are no radical changes that provide the fundamentals for the application of the restructuring concept for the companies studied.

3) Changes of skills and roles

For what concerns skills required for the implementation of the AI solutions, the literature suggested that new capabilities and roles are needed into companies due to the peculiarities brought by the AI technology. Evidences of change were found in all the cases studied. In smaller companies such TalkPool and Nord-Lock, there was no need to hire new workers for specific roles such Data engineers, Data scientists and Machine Learning Engineers. Nevertheless, workers needed to implement their tasks, by an internal learning process addressed to understand how to use new tools and acquire new skills and competences. Therefore, it is possible to say that for these companies, even though new people were not hired, the peculiar roles for AI were still created by adopting internal solutions aimed to improve or create the AI related skills and knowledge.

By contrast, SKF, Siemens and the Anonymous company hired new human resources for the implementation of the project. In particular, the Anonymous company hired workers with AI narrow knowledge, which, according to theory, represent Machine learning Engineer type of roles. Indeed,

[253] Jones G. R., 2013
[254] Pantelis C. K. et al., 2018
[255] Jones G.R., 2013

Machine learning engineers are the ones entitled to produce algorithms to be integrated with the systems[256]. Instead, SKF hired both Data scientists, Data analysts and Software developers. In Siemens as well, a lot of new employees were hired to set up the AI department.

The previous researches suggested that one of the issues of AI technology is the scarcity of expertise[257]. The respondents, whose companies needed to hire new talented people, agreed that they are scarce since there is a huge demand compared to the offer. However, both SKF, Siemens and the Anonymous company were able to gather the right resources even though they declared that it was really challenging. Indeed, as reported by the theory[258], the scarcity of talents was a barrier, which has been overcame with only an additional effort in showing the attractiveness of the job position. For example, respondent E mentioned that its company met the additional challenge of competition against companies' giants such Google and Amazon, perceived as more attractive compared to an industrial company as SKF. Moreover, also the Anonymous company agreed that the real problem is not finding right talents but, instead, attracting them. According to respondent B, the key to attract talents in their case was to set the job advert with the only language requirement of English. This contributed to attract people from all over the world. Indeed, also according to the expert, internationalisation is helping the process of finding the right talents.

All the companies organized the work by using cross-functional teams. The teams were composed by traditional roles required for the product development and roles with AI expertise. For example, in Nord-Lock the different parties involved were the project manager, the IT department, (entitled to develop AI in collaboration with Microsoft), end-user of the bolt (defined as "product owner of the bolt" by the respondent D), the technical centre and the marketing department. According to respondent A, this type of co-working is fundamental for the identification of the right patterns in data and the creation of the right algorithms, considering that both specific business knowledge and technical expertise are required. This consideration is in line with what stated by the expert, that expressed the importance of collaboration between technical skilled workers and industry acknowledged workers. Given that cross-functional teams required different employees to work together and communicate by the means of their specific knowledge, it can be stated , as pointed out by the theory, that soft skills such as, communication and sharing capability of AI results, were essential for the employees[259].

[256] Vitale A., 2018
[257] Tencent, 2017; Stancombe C. et al, 2017
[258] Ransbotham S. et al.,2017
[259] Vitale A., 2018

Moreover, according to respondent B, cross-functional teams were a good tool for the creation of kick-off trainings, since different roles could learn by each other, creating the double side capability needed to develop AI solutions by mean cross-fertilization processes[260]. Indeed, as said, according to the theory, this way of operating is used to ease the communication between people with domain competences and technical ones, which is fundamental for the AI solutions implementation[261].

Another interesting aspect of the process of change of skills and competences, concerns the way those capabilities were transferred to the employees. In some companies, employees were retrained. This is the case of Siemens, were employees needed to acquire a new method change. Indeed, AI required Siemens to shift from a bottom-up approach to project design processes to a top-down one. By contrast, in other companies, the process of learning has been more a self-process. Both in the Anonymous company and TalkPool workers were encouraged to learn about AI and supported in case they wanted to personally take part to extra trainings but, no general training was provided by the companies themselves.

Even though, the organizations studied redesigned their businesses, the concept of reengineering seems to be too strong to be applied to those cases. Indeed, the tasks and roles of the employees increased rather than being subject to radical changes. Instead, according to theory, reengineering concerns radical redesign of processes, roles and tasks[262]. Moreover, this approach is often applied when there are radical changes[263], which is not the case of the companies studied. Thus, it is possible to claim that, even though certain changes in the organization have been verified due to the AI adoption, these changes cannot be conducted to the reengineering practices.

To sum up, few evidences of what highlighted in the theoretical framework have been found in the empirical findings collected. First, all the companies agreed that there is a scarcity of talents and the real challenge is how to attract them. Secondly, the additional roles required for the AI project implementation were introduced into the companies either by hiring new employees or by adding skills to existing workers. Moreover, as stated in the theory, all the companies worked in cross-functional teams and this required the development of communication soft skills. Lastly, different ways of training employees have been used by the companies studied.

[260] Cross-fertilization: it is the share of knowledge that generate the generation of new ideas. Schilling M. A. Izzo F., (2013), *Gestione dell'innovazione*, Milan, McGraw-Hill, p. 426
[261] Vitale A., 2018
[262] Philip M.,2015
[263] Jarvenpaa, S. L., Stoddard, D. B., 1998

4) Additional internal organizational implications

From the empirical findings, it was possible to identify other internal organizational implications that were met by the System integrators to implement the AI solutions. The additional implications found can be grouped under the labels “market readiness” and “exploitation of external research”.

The first label has been identified upon the thoughts of the respondent B, C and E. Indeed, respondent B reported that one of the biggest challenges faced by its company was the introduction of the AI solution in a such conservative and traditional market as the construction industry. Therefore, the company needed to rethink to all the processes of that market to prepare them for digitalization and introduce them to the workers of the field, before marketing their AI solutions. Issues regarding the customer market have been faced as well by the Anonymous company, which failed addressing the AI solution for a market that was not ready for such innovation. Moreover, also SKF reported that before making the AI investment decisions, the company considered market trends and made stakeholder interviews to assure that its customer market was mature enough. Due to technological cycles dynamic’s in fact, it can happen that the provider is ready to market the technology, but the customers are not. Therefore, it is possible to conclude that as reported by previous research[264], the immaturity of the markets constituted a barrier to the AI implementation.

The second implication highlighted is the exploitation of external research. This label came into its identification based on the data collected by the Anonymous company and SKF. Hence, according to respondent C, the real challenge faced by System integrators does not concern the AI competences development but relates to the application of the already existing knowledge developed outside the company. Indeed, as reported by the respondent C and confirmed by the theory, research institutes, universities and start-ups are developing a lot of AI knowledge and companies should be effective into applying it to business cases[265]. Therefore, collaborations with those entities will be essential for the AI diffusion in the future. A similar reasoning was provided by respondent E, which reported that its company is continuously monitoring the research market to see if there is room for new opportunities. Moreover, respondent E mentioned that one of its company’s initiative has been to acquire several start-ups, to ultimately obtain their research knowledge. In fact, as reported in the theory, many companies, such Amazon, Google and Facebook, are doing “acqui-hiring” in order to absorb the right competences[266].

[264] Ransbotham S. et al., 2017
[265] Vitale A., 2018
[266] Chui M., 2017

5.4. Changes to the ecosystem

For what concerns the changes to the ecosystem identified, they can be grouped into **(Figure 6)** changes of jobs and skill gap. To give a reminder to the reader, the ecosystem concerns the diverse actors whose activities around AI are having effects towards each other.

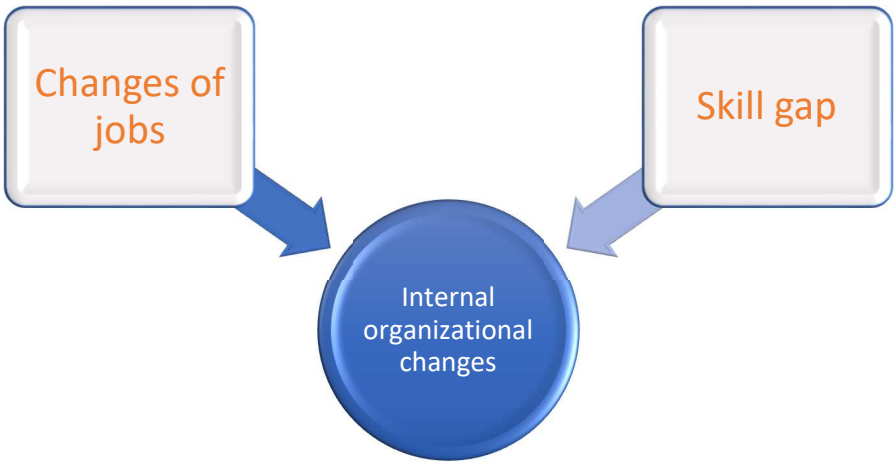

Figure 6: Changes to the ecosystem, Compiled by the author

1) Changes of jobs

Theory reported that AI solutions' introduction will particularly affect the number and nature of jobs[267]. Therefore, to assess changes of jobs that might be observed in the future, under the solution's provider perspective, it was asked to the respondents their opinion around the topic.

According to respondent A, even though AI will eliminate, it will also create some jobs. Moreover, AI will help in raise up the efficiency of work, considering that increased data elaboration provides the opportunity to derive precise and effective conclusions. In addition, not all the AI solutions will impact on the work directly. For example, TalkPool solution itself is not making redundant any employee but, only adding additional value in the customer market.

Furthermore, according to respondent B, the impact of AI will vary according to worker's attitude. Indeed, the people that do not like repetitive tasks will react positively to AI solutions, whereas those who felt threaten by them will go against and will try to resist the change. Additionally, respondent B argued that AI and all the digitalization process will democratize the workflow, by enhancing the

[267] Ransbotham S. et al, 2017

possibility for workers to reinvent their work. Resources not traditionally considered as such for a certain market, could turn to be that.

Besides, respondent C reported that AI will affect workers in two distinct directions. In one direction, which is the software field, new jobs will be created and competences required will be more sophisticated. On the direction of factories and warehouses, tasks will be instead simplified with the support of AI solutions. Thus, it is possible to claim that industry specificity does matter. Indeed, this view is in line with the study carried by Frey and Obsorne[268], which affirms that the effect of AI on jobs will be different according to the industry.

Moreover, according to respondent D, the effect of AI will be different depending on the country since countries characterized by non-qualified workers will be impacted the most. Those workers will have the opportunity to learn more and acquire some qualification in their job. In fact, as pointed out in previous reports, skills will shift from low-value activities to high-value ones[269].This consideration is in line with the expert's opinion, which defined AI as a tool supporting less skilled workers. Furthermore, according to respondent D, real changes will only be observed in the long run. Similarly, respondent E argued that even though AI will have some sort of impact on jobs, this does not mean that core competences and knowledge will be discarded. In fact, companies are in the process of learning what is going to happen, and real changes will be evident only in the long run.

To conclude, there will be several effects addressed to the job market and more in general to the society, but they will be observed only in the long run.

2) Skill gap

Given that AI solutions will require new skills, workers will need to adapt to different tools to be applied and new results to be interpreted.[270] Consequently, companies to which AI solutions are addressed are expected to face skill gap internally. The skill gap problem which realizes at the firm level, has, in turn, an impact on the jobs. Indeed, companies and institutions will need to take action to fulfil it.

Respondent B reported an example of a skill gap created on its customer market: the technician's skills working for fire prevention by checking sensors on site have very different skills compared to workers configuring the platform where sensors conditions can be observed. Consequently, action will have to be taken to fill this competences gap.

[268] Frey C., Osborne M., 2013
[269] Chitkara R. et al., 2017
[270] Chitkara R. et al., 2017

According to respondent D, the degree of skill gap varies across industries. This is consistent with the Frey and Obsorne study[271].

However, according to respondent A, the skill gap is not only caused by AI introduction but, more in general by digitalization. The same view on the skill gap was given by respondent E, which argued that skill gaps are created every time a new technology is introduced in a business. Therefore, it can be claimed that it is an effect that would happen independently from AI.

To conclude, from the evidences collected about the change of jobs and the skill gap issue, it is possible to point out that the effects of AI introduction are not peculiar to the AI technology, but they are a general consequence of digitalization. In particular, AI falls into the category of a specific type of innovation that impact of the role of workers in the business processes and, in turn, on competences. Therefore, by enhancing a change in jobs, AI solutions will more in general impact the whole society (ecosystem).

6.Conclusions

In the final chapter, the research objective is reported again in the first section. Then, the research question in answered organizing the conclusions in Make vs Buy decision, Internal organizational changes and Changes to the ecosystem. Following, practical implications and limitations are presented and finally suggestions for future researches are reported.

6.1 Research objective

For facilitating the comprehension of the findings of this thesis and provide a streamline to the reader, the research objective and question are restated below.

The objective of this thesis is to try to provide empirical knowledge of the organizational implications caused by the AI introduction by System integrators. The AI technology is disrupting several markets and due to its peculiarities, it is causing several and relevant implications. In particular, AI is eliminating certain tasks and creating new jobs. Furthermore, this technology is increasing collaborations and it is consequently pushing companies to move away from the traditional top-down organizational structure and develop team-oriented settings. Moreover, AI requires diverse skills and the selection of relevant data, which make more complicated the decision to Make or Buy the technology. Therefore, companies need to understand which capabilities to acquire, which organizational design to adopt and which technology entry point is more appropriate. For those

[271] Frey C., Osborne M., 2013

reasons, the study aimed at exploring what implications AI is causing to companies and in particular, by investigating on the reasoning behind the Make vs Buy decision of the technology and on the organizational changes occurred, to ultimately provide empirical evidences for those companies aiming to introduce AI in the future.

Previous researches around the topic are mainly focused on the technical skills required for the introduction of this technology, while this study concentrates on the organizational requirements needed to accommodate AI. Moreover, unlike much of the existing theory, this research focuses on the perspective of System integrators, which are the actors designing the AI solutions, and consequently the first ones dealing with the AI technology, which play a key role in the diffusion of it.

Then, the research question, which is of an explorative type, that this research tried to answer to is:

What are the organizational implications of AI adoption by System integrators?

In order to answer to the research question stated, an explorative qualitative type of study with the use of semi-structured interviews was applied. Business researches around AI technology and academic theories concerning the Make vs Buy decision and the organizational change have been used to support the research. Five different cases have been analysed and five people have been interviewed in order to collect empirical evidences to carry on this study.

6.2 Answering the research question

In order to answer the research question, conclusions from each organizational implication must be derived. Moreover, above all, it is important to mention that to achieve the results obtained, it has been fundamental to analyze the AI technology by exploring empirically its definition, functioning and challenges brought, to ultimately compare the cases. Conclusions derived on each organizational implication are reported below.

6.2.1 Conclusions on Make vs buy decision

The evidences found appear to be partly in contrast with what pointed out by the theory, according to which the decision to Make or Buy has higher level of complexity due to the diverse skills required to manage this technology, the scarcity of AI talents and the effects of disruption on the market. By contrast, through the analysis of the five cases studied, it can be claimed that not all those elements constitute an issue to produce in-house the AI solutions. In fact, all the companies faced the problem of internal failure of competences, which was solved by opting for a hybrid strategy (sometimes making and collaborating; sometimes making and buying).

Moreover, it can be outlined that the decision to Make or Buy the AI technology was taken by following the traditional criteria provided by the academic researches (Business strategy, Product supply chain risk, Economic factors)[272].

Indeed, the companies followed the Business strategy criterion and adopted the AI technology evaluating it as: a) strategically important for the organization; b) an element to increase the products offering and c) being important for the industry dynamics.

An interesting aspect was found in the study of the Product supply chain risk criterion, which regards the risks taken in setting the relationship with the suppliers. In fact, it was found to be the least considered by companies, when taking the Make vs Buy decision. It is possible to claim that the reasoning behind this evidence could be linked to the fact that the AI supplier market is not well consolidated due to its disruptiveness, and therefore companies are still trying to understand the market dynamics. Thereby, companies cannot formulate a strategy based on it. In fact, in the context studied the product / service markets derive from disruptive technologies for which clear rules of dominant system standards have not been established.

Lastly, even the economic factor criterion was respected in the traditional sense, since the System integrators decided to make in-house the AI, considering that the expected returns could pay back the investment and that companies had enough resources to acquire the skills and expertise required. Moreover, even though the talented people were mentioned to be scarce, companies interviewed did not indicate it as a big issue. However, they mentioned that an additional effort needed to be made in order to attract talents.

To sum up, the organizational implication that can be derived from the study of the Make vs Buy decision, is that, due to the fact that the market mechanisms are uncertain and continuously changing, and due to the fact that AI solution projects require very diverse skills, companies need to be flexible and adopt hybrid type of strategies (Make and collaborate or Make and Buy). Therefore, they must sustain certain investments internally to secure the basic AI competences and be open to collaborate when required by the context, as well as to adopt a buy strategy.

6.2.2 Conclusions on Internal organizational changes

The analysis indicated that the organizations did not experience drastic internal changes because of the introduction of AI technology to market the solutions. Indeed, the type of change that has been identified is evolutionary, therefore the changes were gradual, incremental, occurred over a long

[272] Shorten D.et al., 2006

period of time and were initially focused on a specific area. In addition, companies are still in the process of changing. In fact, even though AI is a technology arisen several years ago, it experienced a boom only in the very recent times. Therefore, companies might not have been completely impacted by the AI technology yet. However, the elements that turned out to be the most influenced by the adoption of AI and that are currently undergoing changes, are:

1) the organizational structure
2) the organizational culture
3) the competences and skills required
4) the market readiness and the exploitation of external research

From the empirical evidences and from what reported by the theoretical framework analysis, it can be stated that the organizational structure of companies introducing AI did not experience radical transformation, but it is evolving towards a flat type of structure, due to the increasing need for both collaborations and to work in cross-functional teams. Therefore, AI is taking companies to change their type of organizational structures into one organic oriented characterised by more flexibility and external openness.

Furthermore, as well as the organizational structure, the organizational culture has not been completely reshaped yet. Cultural change is a process that requires time and will be better observed in the long run. However, the observation of the reality provided small evidences of the fact that flexible types of culture, which favour innovation, could better accommodate the AI introduction. The organizational implication of this finding is that companies need to further adapt their culture to the ongoing innovation processes.

Moreover, AI brought a lot of new competences and skills. New specific roles such as Data engineers, Machine Learning engineers, and Data scientists are needed for the development of AI solutions. Indeed, those roles had to be developed within companies either by training existing employees or by hiring new ones. In this process, it is challenging for companies to attract the right talents, given that there is a greater demand than the offer of workers, due to the scarcity of talents. On the other hand, new soft skills required are the communication capacity and the capability to show AI results, in order to work in cross-functional teams. Thereby, System integrators need to take in mind the new roles and skills required when organizing the company resources for the AI solutions implementation.

Another implication which has been explored in the study, is the challenge met by System integrators with regards to the market readiness. Indeed, the AI introduction implied companies to consider not only their capacity to develop and design a use case for the technology, but also to previously assess

the maturity of the customer market and their eventual shift. In some cases, lack of readiness of the customers represented an issue for the companies which limited their innovation initiatives. Consequently, System integrators need to plan internal changes in line with the ones needed in the market in order to avoid wasting opportunities and resources.

Lastly, it can be outlined that additional focus is put on the external collaborations due to the possible exploitation of the state-of-the-art-technology and the velocity to access it. System integrators' challenge is to leverage on existing knowledge developed by universities and research institutes, to ultimately find the right applications for it. Therefore, as already pointed out in the paragraph **(6.2.2),** companies need to prepare an appropriate setup which allows for those type of collaborations.

To sum up, in order to effectively carry on their operations and implement they strategies, System integrators have to adapt the internal organizational setting by introducing appropriate changes in organizational structure, skills and culture, coordinating those activities with the readiness of markets and favouring type of settings which allows for collaboration.

6.2.3 Conclusions on Changes to the ecosystem

The introduction of AI solutions in the market generated some implications for all the ecosystem around it. In particular, this study confirmed what reported by the scholars, with regards to the number and nature of jobs, that will change because of AI solutions. This effect will have an impact not only on companies but, more generally, on the society. Tasks will be simplified and, consequently, several workers will be affected by that and their level of qualification will rise. In particular, the consequences on the job qualifications can be intended as following two directions. On the software developer side, very sophisticated knowledge will be required. On the manufacturers' side, the basic level of competences needed by workers will be decreasing. The whole set of these effects will bring a lot of new opportunities enabling even non educated people (and less educated people) to take part to the AI revolution. Moreover, AI will take to a reinvention of the work, which will enhance a new flow of work shift.

Even though the relevant changes will only be observed in the long run, it can be already outlined that the impact will be different depending on the countries and the industries specific factors. Therefore, as sustained by many interviewees, in the long run it would be possible to assist to a complete redesign of the job market landscape at worldwide level.

Consequentially, System integrators will need to take in mind that the application of their solutions will require companies to adjust their hiring programs to changes brought in the job market.

It is worth to highlight that another implication brought by AI technology, that indirectly impacted the ecosystem, is the presence of a skill gap inside companies, which can be observed differently across the industries. To fill this gap an important role can be played by the education and research actors of the ecosystem, which companies will need to take care of.

However, both those effects (general impact on jobs and skill gap) have been addressed as a normal consequence of the digitalization phenomenon and not specifically caused and limited to the AI.

Therefore, the above-mentioned changes to the ecosystem will bring a lot of organizational implications, since a new workflow will be initiated, the job qualification required will be different, and institutions and companies will need to cope with the gap of competences created in the society.

To conclude, all the aforementioned implications (on the Make vs Buy decision, on the internal organizational changes, on the changes to the ecosystem) are important for the companies, which need to be aware, to monitor the ongoing technological and market context and prepare for that. This is essential representing important suggestions to finally bring AI to the appropriate mainstream diffusions, since as mentioned by one interviewee "the last 10% in the 90% of the work".

6.3 Practical implications

As pointed out in this research, introducing a new technology within a business is not a process that happens overnight. Strategic decisions and organizational settings have not experienced revolutionary implications with relation to AI introduction. Changes happen in a gradual and incremental way over time by giving to each actor different opportunities to react and adapt at these changes. Therefore, the author would like to provide some practical implications for them. It is worth to mention that, in particular, this research points out some insights for companies facing the AI introduction in future, which represent the ultimate aim of the study.

1) Implications for System integrators

These companies are in the middle of the process of changing. They have taken the first steps and expects to modify more and more their organizational structure, organizational culture and jobs in the long-term future.

a) For these companies, an important implication is to carefully observe, analyse and foresee the AI-related changes in technology and applications which can involve suppliers, end market adopters and ecosystem, in order to catch all those signals that can anticipate and facilitate the AI adoption and the exploit related opportunities. For instance, one signal pointed out by this

research is the careful evaluation of the state-of-the art technology developed by research institutes, start-ups and universities.

b) It has been observed that System integrators are developing their AI solutions by adopting a make strategy as frontline one. This choice could be conditioned by the current strong and rapid diffusion of the AI phenomenon. However, in the future the adoption of different strategic options (e.g.: buy, collaborations) could be required more and more, caused by the increasing level of specialization required to the increase of potential AI applications. In this view, relevant implications for System integrators are addressed to develop internal capabilities aimed to deal with different external actors (suppliers, partners, customers, etc), thus strengthening both their relational and technology capabilities.

2) Implications for AI potential adopters

As reported by the theory, there is a lot of misunderstanding inside the companies about what are the resources needed to train AI and consequentially a lot of scepticism in adopting the technology[273]. Therefore, important implications can be formulated for these companies which have not yet considered to introduce AI technology and for which new technologies have always brought risk and uncertainty, since their functioning and effects are unknown and often overestimated.

a) These laggard companies may be held back by the fact that other companies are more advanced in the AI adoption process, and consequently avoiding starting the journey of AI. For these companies, this research demonstrates that it is not too late to evaluate the introduction of the AI technology being the implications gradual, related to the long-term and just started by the other companies in the market.

b) Moreover, this research highlights, for such laggard companies, the importance of the appropriate characteristics that their organization requires in order to succeed in the adoption processes (e.g. to have an organic type of structure and an innovative culture). They should start to operate to implement programs and initiatives to develop these characteristics both at individual and organizational level.

3) Implication for the education system

[273] Ransbotham S. et al, 2017

Some practical implications can be drawn also under a policy perspective for what concerns education in the field of AI, providing some suggestions to the countries willing to participate to the AI revolution.

a) Even though this study does not highlight the lack of talents as an issue for the companies, it still underlined the scarcity of them. Since the AI technology is a phenomenon expected to increase in the near future, the scarcity of knowledge people could become soon a real problem. Therefore, countries should be aware of that and try to promote some initiatives to fill this gap by incentivising the study of AI field. Some countries have already started to give a contribution in this perspective. In fact, as reported by the literature, one of the boosters of AI in the very recent times has been the growth of AI educating programs[274]. For example, Finland, with the aim of becoming the most educated country in the field of AI, started to offer free on-line courses to everyone who applies for, since 2018[275].

6.4 Limitations

It is important to mention that there are some limitations emerged during the study that might have impacted on the effectiveness of the answer to the research question.

1) Companies interviewed operate in different industries and are different in size. Therefore, they might have a different attitude toward adopting a new technology. Furthermore, even though the companies were selected following the criteria of having already completed AI solution projects, when the interviews were conducted it arose that their experience towards AI technology was different. Therefore, the results might have being influenced by that. Consequently, the findings pointed out in this research cannot be generalized for companies having different firm-specific factors and operating in different industries.

2) To build up the case studies, the snowball effect of diverse respondents inside the companies was not applied, since the interviewee was required to have some AI expertise, which delimited the number of suitable people to be interviewed. Consequently, only one respondent has been interviewed for each case. Therefore, the data collected to investigate on each case, rely on the personal view of one respondent and could be biased by its personal perception, education and role in the company.

[274] Evans H. et al., 2017
[275] Delcker J., (2019), Finland's grand AI experiment, *Politico* (on-line review)

6.5 Future research

AI technology is not completely at its early stages, but it is still at its first steps to became mainstream and be applied in several and diverse businesses. Therefore, in line with what reported by the empirical data, during the future years, several changes are expected to be observed due to the AI technology introduction. Thereby, even though several developments are going to realize in the future years, this study evidenced only some at their early stages. Following, some suggestions on potential future researches are reported:

1) This thesis has pointed out five different use cases of AI technology and how it impacts System integrators. It would be interesting for future researches to investigate on the impact of AI taking the perspective of the end user companies. This aspect could be interesting, given the changes to the ecosystem highlighted in this study, such the change of jobs and the creation of a skill gap inside companies. Moreover, users of the AI solutions might experience a different type of change, since the introduction of the technology may require redesigning business models, processes and tasks, which, in turn, might contribute to a revolutionary type of change.

2) The aim of the research was to investigate the organizational implications of AI adoption by System integrators. However, since the time to conduce the interviews was restricted, the impact on the elements analyzed might have not been investigated with the appropriate degree of accuracy. For instance, the implications on the ecosystem might be various, depending on the industry selected. Therefore, in the short-term future it would be interesting to collect additional empirical findings on each organizational implication and derive further conclusions. Furthermore, by investigating on a greater number of cases, it would be possible to re-evaluate the findings of this study to enable the generalization of the results.

3) In addition, the phenomena studied appeared to be still in a non-mature stage. For example, organizational culture did not evolve yet in the case-studied, since it requires a lot of time to be changed, but it is expected to modify in the future. Therefore, it would be interesting to replicate the research over the same case-studies in the future, by applying a longitudinal approach and observe if additional and expected implications are realized over time and which stages followed.

4) Lastly, this study was carried only on five (System integrators) companies and therefore left room for further research outside of this scope. For example, an interesting aspect, that could be possibly analyzed, according to the author, regards the contribution (and collaboration) of

different actors dealing with AI (research institutes, System integrators, final users) to the creation of innovative AI solutions and applications. In fact, as pointed out during this research, collaboration among those actors is going to increase. Therefore, it would be interesting to study how all those actors contributed/collaborated from the early stages to the final ones, on a specific single project.

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Appendix

Appendix 1- Interview guide for the expert

1. What is your role in the organization?
2. How do you define AI?
3. How does your company deal with the process of cleaning and structuring data for the effective use of AI?
    a. How costly is this process? (*in time, skills)*
    a. What are the challenges faced by companies when preparing their data for AI?
4. Are technical skills to structure data, tailored to the business/use case?
    a. To what extent is IBM's technical knowledge integrated with the specific business knowledge provided by the companies it supplies?
5. Do you receive more request regarding customized solutions or integrated solutions from companies using sensors?
6. Every time you work with other companies to implement AI solutions, how do you organize the work system (processes, collaborations, team working, tasks, skills etc)?
    a. To integrate AI in the product/processes of your customers, did you need to implement cross-functional teams?
7. Did companies *(your customers*) generally need to introduce structural/organizational change due to AI adoption? Set up new office/departments/units?
8. How do you think AI solutions are affecting workers and skills required?
    a. How have the skills/tasks of the employees of your company customers changed since the application of AI?
    b. Did they needed to hire new workers?
9. Do you think that there is still a big skills gap inside the companies (caused by the AI diffusion)?

Appendix 2- Interview guide for the companies

PART 1: AI definition and functioning

1. What is your role in the organization?
2. What are your sensors capable of? (*functions, business application, etc)*
3. Having seen that your sensors are capable of collecting data, how do you use those data?
4. Having seen that the system around your sensors is intelligent, how do you define AI (those intelligent activities)?
5. When it comes to apply AI technology to your sensor devices, are also unstructured data *(text, social media content etc.)* coming from other sources added into the AI business solution?

PART 2: Make vs Buy decision

6. Do you manufacture sensors devices, or do you buy them?

7. Have you developed your own AI, or did you partner with other companies with AI expertise? *(make vs buy)*

Business Strategy

8. What has been your business strategy with relation to this choice (*make vs buy)?*
    a. How strategically important was the AI technology for your company?
    b. Which resources did you lack in order to make it?
    c. How was the control on your supply market?

Product supply chain risks

9. Which product supply chain risks made you take this choice *(make vs buy*)?
    a. Were quality, reliability and predictability of AI critical for your business?

Economic factors

10. How convenient was this choice (*make vs buy)* in terms of costs/returns*?*
11. Why your company decided to invest/not invest in AI *(reduce costs, new ventures, new/renewed products, new markets/ revenues opportunities etc)?*

PART 3: Internal organizational change and Changes to the ecosystem

12. When you needed to implement the AI solution for your product, how did you organize the work system (processes, internal/external collaborations, team working, tasks, skills, etc)?
    a. To integrate AI in your product/processes, did you need to implement cross-functional teams?
    b. Did your organization become more team oriented/flat?
    c. How did the authority relationship change?
13. Did you need to introduce structural/organizational change? Set up new office/departments/units?
14. How did the culture of your organization change to the introduction of AI?
15. How did the functions/processes change after the introduction of AI?
16. How rapid and focused have been those organizational changes?
17. AI solutions are changing tasks and eliminating/creating new jobs. How do you think AI solutions are affecting workers and skills required?
    a. How was in your organization?
        i. How have the skills/tasks of your employees changed since the application of AI? (*ex: did you need to provide them with training?)*
        ii. Did you needed to hire new workers? If yes,
            1. How easy was to find the right competences/skills?
18. Do you think that there is a big skills gap inside companies (caused by the AI diffusion)?

19. Have you experienced other relevant organizational implications because of the AI adoption?

Appendix 3- Introductory and final interview text

Introduction

My name is Simona and I am a student enrolled in a Business Master at the University of Gothenburg. I am writing the thesis trying to explore the organizational implications of Artificial Intelligence (AI) adoption by system integrators. The focus is on the decision to make or buy the AI technology, internal organizational changes and changes to the ecosystem caused by AI disruption. I am writing the thesis with FTK, and I got your contact from them.

The interview is structured in three main parts. The first section is composed of questions related to the use of sensor devices, AI technology and their relationship. The second part regards the decision to make or buy the AI technology. The third part is made up of questions concerned with the changes in the organizations and to the ecosystem caused by AI introduction.

Before starting the interview, I need to ask if I can record the interview content, in case you feel comfortable with that. Moreover, if there is any question you can't answer me for any kind of reason, please tell me. If everything is clear for you, we can now start with the interview.

End of interviews

I am very grateful for having your time and this opportunity. In case you are interested, I can share the thesis's findings once I have finished my study. Moreover, in case I have additional questions, or something is not clear, can I contact you for any follow up?

Appendix 4- Introductory email text sent to companies

Good Morning,

I am a business student of the University of Gothenburg. I got your contact from First to Know.
I am writing this email since I am doing my master thesis and I need to collect some data for it.

The purpose of my research is to investigate the organizational implications of AI in the companies using sensors, with a particular focus on system integrators. The aspects on which I will focus on are the decision to make or buy the technology and the internal organizational changes occurred.

I believe you have good insights, that could help me in my project and would therefore be grateful if you were to have time for an interview, preferably this or next week, otherwise whenever you have time. The interview will take about 40 minutes and preferably be face-to-face, otherwise skype or telephone call could also be fine.

Moreover, if you prefer to receive the questions of the interview in advance, I can send them.

Thank you.

Best regards,
Simona Passaro

LUISS Guido Carli

LIBERA UNIVERSITÀ INTERNAZIONALE DEGLI STUDI SOCIALI

Master Degree in Innovation and Entrepreneurship

UNIVERSITY OF GOTHENBURG

SCHOOL OF BUSINESS, ECONOMICS AND LAW

Master Degree in Innovation and Industrial Management

Organizational implications of AI adoption

A multiple-case study on System integrators

Summary version

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Graduate School

Academic Year: 2018/2019

Summary Table of Contents

1. Introduction

1.1 Background

1.1.1 Artificial Intelligence disruption and its organizational implications

Industry 4.0 has been introduced as a popular term for the trend toward digitalization and the introduction of new technologies aimed to the industrial automation, such as 3D printing, Artificial Intelligence, IOT, Cloud computing. According to scholars, Industry 4.0 highlights a new Industrial Revolution where manufacturing operations are driven by smart digital technologies, data are collected and used actively through IoT solutions and machines are interconnected and able to communicate by means of cyber-physical systems[276]. Therefore, industry 4.0 will transform how things are made, how things are moved, how customers interact with companies.

Given the potential impact of all those technologies, companies must be ready to seize and manage the opportunities brought by Industry 4.0. They are trying to understand what necessary technological capabilities need to be acquired, and how to exploit the ones they already have available [277]. Even if a lot of companies adopted technological advances and experimented the related benefits, most of the research was mainly focusing only on the related technical dimensions, neglecting the organizational dimension of the introduced changes. Without properly considering and investigating the organizational and managerial implications of AI introduction and development, managers and companies risk to over-estimate the multiple digital technologies available, the related -technicalities and unpredictable potential, with a negative impact on the business decisions related to the adoption/rejection, management and development of new and currently available technologies.

Among the technologies of Industry 4.0, Artificial Intelligence (AI) is expected to have a big impact on the way organizations perform, produce and deliver value. AI is a field which embodies theories and practical techniques to develop algorithms enabling machines, particularly computers, to perform intelligent activities. Thanks to techniques such as Deep Learning and Machine Learning, AI is able to read and learn through data captured from the environment by means of specific technologies or devices such as data analytics or sensors[278].

[276] Budman M., Khan A., (2017), Forces of changes: Industry 4.0, *2017 Deloitte Development LLC*
[277] Budman M, Khan A., 2017
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When introducing a new technology, whether in a product/service or in a business process, there are implications not only on the technical side, but also on a managerial and organizational perspectives.

Given its features, AI is expected to bring diverse challenges and changes to the organizations which are going to introduce it and more in general to the all ecosystem, including society.

For example, organizations will need to cope with the effects on their organizational design, brought by the peculiarities of this technology. Indeed, AI will require organizations to move away from the traditional top-down structure and develop team-oriented settings[279]. In fact, the integration of AI requires an internal team of experts and engineers of AI's appliance working with frontline teams of the related business[280].

Another challenge which organizations will need to face, is with regards to the choice related to the acquisition or the creation of the selected technology. In fact, given that the training of algorithms requires diverse skills and the selection of relevant data, it is more complex to adopt the make-versus-buy decision traditionally faced by companies when investing in new technologies[281]. This decision might become more challenging considering that companies need to evaluate the disruptive effects of the technology on their business and on the customer market before making any evaluation of opportunities and risks[282]. Hence, the adoption of the technology could require the redesign of product/processes, adoption of new business models, change of usual customers, etc. What is more, AI is an evolving technology and companies need to consider the rate of technological change when investing in it[283].

Moreover, AI is expected to eliminate certain tasks, but at the same time, create new jobs. The skills required by employees will need to be improved and changed.[284] Individuals with the right skills and expertise are required by a lot of companies and not always easy to grasp[285]. This will not only influence the HR departments, required to put a greater focus on improving the key employee skills to integrate the new technology, but it will also impact the societal ecosystem, which will need to adapt to the several changes. Another challenge that companies will meet regards with the creation

[279]Lindzon J., (2017), How AI is changing the way companies are organized, *Fast company* (on-line review)
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[283] Bartel A. P., Lach S., Sicherman N., (2014) Technological change and the make-or-buy decision, *The Journal of Law, Economics, and Organization*, 30(1), pp. 165–192
[284] Lindzon J., 2017
[285] Ransbotham S. et al., 2017

of a skill gap inside the companies, which will force the organizations to provide training, and the society to arrange appropriate educational courses to fill it[286].

To conclude, AI adoption will involve several organizational implications which will not only relate to technical settings, but also to companies' strategic decisions, such the decision around the appropriate entry point for the technology, and organizational internal setting, such the redesign of the organizational structure. Moreover, those impacts will have in turn some effects to the whole societal ecosystem.

1.1.2 AI disrupting sensors: the role of System integrators

The global market of sensors has been growing more and more in the last years. It is expected to grow at a CAGR of 11,3% for 2022, reaching a market value of 241 billion dollars[287]. Sensors have a lot of different applications in different markets: electronics, industrial automation, transportation, security, building, infrastructure, etc. Sensor technology is growing in complexity and it relies on different specific technologies, which improve their functionalities.

One technology which is disrupting sensor devices is AI. This technology will massively increase the demand for sensors. AI is useful in sensor systems to solve problems that would have required human intelligence automatically[288]. But what is the relation which connects those two elements (AI and sensors)?

The basic food for AI is data. It represents the bottom of the pyramid of the AI hierarchy needs[289]. Data is at the same time the most underutilized asset of companies and the most powerful engine of AI[290]. With the introduction of AI there is room for a lot of challenging opportunities across different businesses.

However, applying data collected to AI is not really as easy and straight forward as it might seem to be at first glance. In fact data, to be used for the AI processes, once collected, must comply with certain features in terms of elaboration and organization, to effectively feed AI[291]. This may constitute one of the biggest challenges to be faced by companies which use sensors in delivering their value, since they need to learn how to use and elaborate data for AI, once introduced the technology.

[286] Chitkara R., Rao A., Yaung D., (2017), Leveraging the upcoming disruptions from AI and IoT, *PWC report 2017*
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[289]Rogati M., (2017), The AI hierarchy of needs, *Medium* (on-line review)
[290]Sundblad W., (2018), Data is the foundation for Artificial Intelligence and Machine Learning, *Forbes* (on-line review)
[291]Rogati M., 2017

In this complex scenario, it is challenging for companies to be able to combine the software part (AI), and the hardware one (sensors) and ultimately find the right application for their business. End users' companies are able to think at the outcome that they want from the final combined solution, but not how to achieve it. In this context, System integrator companies are playing a key role. System integrators are organizations that realize systems from a variety of diverse components, which are able to create solutions requiring hardware, software and networking expertise in several environments[292]. Those companies are contributing to the AI diffusion. Indeed, in the last years, System integrators have been key to enterprises and governments for the implementation of the right technology system and the individuation of their applications. The role of System integrators is, in fact, evolving as a consequence of the spread of new disruptive technologies such as Blockchain and AI[293].

Consequently, a lot of companies caught the opportunity of adopting AI technology for entering new businesses or to implement or upgrade functions of their existing products and businesses. Therefore, companies which were not recognized as System integrators before the application of AI, were pushed by the technological advance and evolved to become System integrator players.

1.2 Research purpose and question

AI technology is requiring companies to not only adjust their technical conditions, but also to redesign the organizational and strategic models. Organizations which introduced AI are changing their organization, processes and human resources' functions. Moreover, the traditional Make vs Buy decision of the technology is becoming more complex due to the requirements of AI skills and increasing collaboration needed.

Based on those premises, the interest in further investigating how those companies were affected by the AI introduction, which decision they faced and how they evolved their organizations, led to the development of this research.

Therefore, the objective of this research is to investigate on the organizational implications of AI adoption by companies operating as System integrators. Given that the effects brought by the AI

[292] Prencipe A., Davies A., Hobday M., (Eds.), (2003), *The business of systems integration*, OUP Oxford
[293] Babu A., (2018), The evolving role of system integrators in the era of blockchain and artificial intelligence, *PCCW Solutions* (on-line review)

technologies are several, the author has decided to **focus only on the key aspects** shaping the phenomena. These aspects are:

4) the traditional Make vs Buy (MvB) decision of the technology
5) the internal organizational changes needed to align the organization with the new technology
6) the changes to the ecosystem brought by the AI solutions

In this study, **the specific perspective analysed will be the System integrators one**. This perspective was chosen for the interesting role they play, considering that those companies are key for the AI adoption and diffusion since they act as mediators between the technology technical and business applications worlds. Those companies are the one entitled to identify the market opportunities for the new technology. Moreover, given that companies operating within this position need to have know-how and competencies of both AI technicalities and their business clients, their organizations will be even more challenged by these double-side capabilities.

The definition of System integrator is always referred as companies which can develop unique complex products through the integration of several complementary components into big product systems[294]. However, for the purpose of this research system providers are to be considered not only companies who are in this position as a core business, but also companies who had the opportunity to become such to address a solution for their own company or to leverage on a new market opportunity.

Even though the AI technology is not at its early stages, its applications in the business environment did not reach yet a maturity stage, therefore this research aims to explore the phenomena described rather than investigate on specific hypothesis. Therefore, the research question, which is of an explorative type, is:

What are the organizational implications of AI adoption by System integrators?

To sum up, by providing multiple-case examples, the ultimate objective is to offer useful insights and a general understanding of the best practises of AI introduction and related organizational consequences, for companies willing to introduce AI in the future, as well as to provide insights for the entry point choice of the AI technology.

[294] Hobday M., (2000), The project-based organization: an ideal form for managing complex products and systems?, Research Policy, 29, pp. 871–893

2. Theoretical framework

A brief description of what has been discussed in the theoretical section and how will be applied in the following chapters, is given below.

The theoretical framework has outlined and discussed the AI technology definition and functioning, the key aspects of its adoption and has identified several theories in the area of the decision to Make or Buy a technology, as well as, organizational changes theories, to ultimately be able to answer the research question on what are the organizational implications of AI adoption by System integrators. From the discussion of the implications on the key aspects stated above, it was possible to outline that some key consequences of AI adoption are: the increase of complexity of the decision to produce in-house or outsource the technology; internal organizational changes due to changes in structure, roles and competences required; changes in the ecosystem due to modifications of jobs, processes and creation of a skill gap brought by the AI solutions.

The first aspect outlined is analysed with the help of the academic framework concerning the traditional decision to Make or Buy, including specific theories related to the acquisition of disruptive technologies. The framework applied to explore the Make vs Buy decision embodies the classical concepts of the transaction cost theory and intellectual property rights, by classifying three criteria: Business strategy, Product supply chain risks, Economic factors[295]. The first criterion concerns the attractiveness of the process/product, the strategic importance of the product and the industry dynamics. Instead, the second criterion considers issues related hold-up risk, supply and transportation risks and intellectual property protection. Lastly, the economic factors criterion includes all the aspects which impact directly and indirectly on the economic and operating performance advantages, on the financial returns and on the level of skills and expertise required.

Then, theories of organisational changes are used to investigate the implications of the internal changes brought by AI technology. In particular, theories regarding the type of change are used to understand the radicalness of the internal change and to define evolutionary or revolutionary changes[296]. Evolutionary changes realise in a gradual way, happen in long time span and are focused on a specific target. By contrast, Revolutionary type of changes are very rapid and have a general focus.

[295] Shorten D., Pfitzmann M., Arvind K., (2006), Make versus buy: a decision framework, *Booz Allen Hamilton*
[296] Jones G. R., (2013) *Organizational Theory, Design, and Change*, Pearson, Chapter 3, pp. 274- 391

Following, the concept of *restructuring*[297], is used to investigate variations in the structure, whereas the concept of *reengineering*[298], is applied to explore modifications of roles and processes.

Finally, characteristics of innovative organizational forms are used to analyse the changes to the structure and the culture occurred. Innovative forms often include organic type of structures, which allow for more decisional freedom in the decision-making process, are less formalized and are characterized by a lower level of behavioural standards, being a flatter type of structures[299]. Moreover, innovative organizational cultures which promote willingness to take entrepreneurial risk, long-term planning, and the acceptance of change, better accommodate innovation[300].

From the knowledge acquired by the theories above, it is possible to compare empirical findings and ultimately answer the research question.

3. Methodology

An inductive approach, which implies the generation of theory consequent to the observations of the phenomenon studied[301], was considered as the most appropriate, given that the research is exploratory in nature, and that the technology studied is at its early stages in the selected specific context of System integrators companies. It followed that a qualitative approach was considered the most suitable method to be applied. In fact, qualitative approaches are suitable for studies aiming at generating findings, which utilize inductive approaches[302].

The research design selected for this study is the multiple case study. This design is often used in business research when a qualitative research strategy is applied, and it is appropriate to compare and contrast similarities across cases[303].

To develop this research both primary and secondary data have been used. For the collection of secondary data, a review of materials regarding the focused research and the academic frameworks to be used has been done and it included academic papers, on-line reviews and books. Instead, in order to collect the primary data, semi-structured interview's method was used. This methodology

[297] Jones G. R., 2013

[298] Hammer M., Champy J. (2009), *Reengineering the Corporation: Manifesto for Business Revolution,* A. Zondervan

[299] Dougherty D., (2001), Reimagining the differentiation and integration of work for sustained product innovation, *Organization Science*,12(5), pp. 612-631

[300] Dombrowski C., Kim J. Y., Desouza K. C., Braganza A., Papagari S., Baloh P., Jha S., (2007), Elements of innovative cultures. *Knowledge and Process Management*, *14*(3), 190-202

[301] Bryman A., Bell E., (2011), *Business research methods*, New York, Oxford University Press

[302] Ibid

[303] Ibid

allowed to focus on specific topics and at the same time having a certain degree of flexibility which enables to integrate additional insights[304].

4. Empirical findings

In order to find the sample companies to interview, the research was supported by First to Know Scandinavia (FTK), a Swedish consulting company, which helped in identifying and getting contacts of the different respondent involved into the context and affected by AI disruption.

The System integrator companies to be interviewed were selected within different industries. Therefore, companies were not designing the AI solution for the same type of market. The criteria for their selection was the company's use of both AI and sensor technology. A general criterion for all the respondent's selection has been a minimal knowledge of AI, which was needed to collect information about the sensors-data-AI functioning. Another criterion applied to select companies has been to have already completed at least one AI solution project, following the intention of studying more evident organizational changes and established Make vs Buy strategies. In this way, the phenomenon studied could be observed in a better way, having clear evidence of it.

The case studies were conducted by interviewing five companies. Among these Siemens and SKF are big in size, Nord-Lock and the Anonymous are medium and Talkpool is small in size. Moreover, at the beginning of the research the author conducted an interview with an expert of AI coming from IBM, in order to collect initial insights to develop the research project. The details of the interviews conducted, and respondent's profiles are reported in the table below **(Table 1).**

Respondent	Name	Position	Company	Interaction	Date	Duration
Expert	Frode Langmoen	Technology executive	IBM	Face-to-face	15-03-2019	38 min
A	Stefan Lindgren	Chief Technology Officer	TalkPool	Face-to-face	25-03-2019	29 min
B	Veronika Cottlehuber	Head of Digital Service Center	Siemens	Telephone call	3-04-2019	39 min
C	Anonymous	Director of product management and marketing	Anonymous	Face-to-face	4-04-2019	33 min
D	Pierre Kellner	Business developer of Smart Products and services	Nord-Lock	Skype call	9-04-2019	53 min
E	Carlos Garcia Timon	Managers of sales and business solutions in the IT area	SKF	Face-to-face	15-04-2019	45 min

Table 1: Table of respondents from case companies

The Empirical findings have been structured in four themes: *AI definition and functioning, Make vs Buy decision, Internal organizational changes, Changes to the ecosystem*. The themes were identified on the base of the information collected during the interviews and reflected the categories identified in the interview guide.

5. Analysis

The selected method for the analysis of the data collected in this study is thematic one, which is one of the most used approaches in qualitative research[305].The theme labels identified for the analysis phase, were the same used to classify the empirics. However, an additional classification has been done, by further coding two themes. The theme *Internal organizational changes* has been classified into four categories: Changes to the structure, Changes to the culture, Changes of skills and roles, and Additional internal organizational implications. Whereas, the theme *Changes to the ecosystem* has been divided into two categories: Changes of jobs and Skill gap.

During the data analysis process, the literature review has been of a great importance since it gave the key concepts to identify the reasoning behind the Make vs Buy decision and organizational elements disrupted by AI, to ultimately read the data in a correct way. Ultimately, conclusions were drawn on the base of the themes identified, which enabled to answer the research question by splitting them into conclusions of each theme identified in the analysis (*Make vs Buy decision, Internal organizational changes, Changes to the ecosystem*).

6. Conclusions

6.1 Conclusions on Make vs buy decision

The evidences found appear to be partly in contrast with what pointed out by the theory, according to which the decision to Make or Buy has higher level of complexity due to the diverse skills required to manage this technology, the scarcity of AI talents and the effects of disruption on the market. By contrast, through the analysis of the five cases studied, it can be claimed that not all those elements constitute an issue to produce in-house the AI solutions. The companies mentioned that even though the talented people could be found, an additional effort needed to be made in order to attract talents. In fact, all the companies faced the problem of internal failure of competences, which was solved by opting for a hybrid strategy (sometimes making and collaborating; sometimes making and buying).

[305] Ibid

Moreover, it can be outlined that the decision to Make or Buy the AI technology was taken by following the traditional criteria provided by the academic researches (Business strategy, Product supply chain risk, Economic factors)[306]. However, an interesting aspect was found in the study of the Product supply chain risk criterion, which regards the risks taken in setting the relationship with the suppliers. In fact, it was found to be the least considered by companies, when taking the Make vs Buy decision, probably due to the fact that AI supplier market is not well consolidated due to its disruptiveness, and therefore companies are still trying to understand the market dynamics. Thereby, companies cannot formulate a strategy based on it.

To sum up, the organizational implication that can be derived from the study of the Make vs Buy decision, is that, due to the fact that the market mechanisms are uncertain and continuously changing, and due to the fact that AI solution projects require very diverse skills, companies need to be flexible and adopt hybrid type of strategies (Make and collaborate or Make and Buy). Therefore, they must sustain certain investments internally to secure the basic AI competences and be open to collaborate when required by the context, as well as to adopt a buy strategy.

6.2 Conclusions on Internal organizational changes

The analysis indicated that the organizations did not experience drastic internal changes because of the introduction of AI technology to market the solutions. Indeed, the type of change that has been identified is evolutionary, therefore the changes were gradual, incremental, occurred over a long period of time and were initially focused on a specific area. In addition, companies are still in the process of changing. In fact, even though AI is a technology arisen several years ago, it experienced a boom only in the very recent times. Therefore, companies might not have been completely impacted by the AI technology yet. However, the elements that turned out to be the most influenced by the adoption of AI and that are currently undergoing changes, are: the organizational structure, the organizational culture, the competences and skills required, the market readiness and the exploitation of external research.

For what concerns organizational structure and culture, companies did not experience radical transformation, but they are evolving towards a flat type and an innovative type of culture, due to the increasing need for both collaborations and to work in cross-functional teams. Therefore, AI is taking companies to change their type of organizational structures into one organic oriented and to change their culture into innovative oriented ones, characterised by more flexibility and external openness.

[306] Shorten D. et al., 2006

System integrators need to be aware of that and adopt the suggested type of forms to facilitate AI introduction.

Moreover, AI brought a lot of new competences and skills. New specific roles such as Data engineers, Machine Learning engineers, and Data scientists are needed for the development of AI solutions. Indeed, those roles had to be developed within companies either by training existing employees or by hiring new ones. In this process, it is challenging for companies to attract the right talents, given that there is a greater demand than the offer of workers, due to the scarcity of talents. On the other hand, new soft skills required are the communication capacity and the capability to show AI results, in order to work in cross-functional teams. Thereby, System integrators need to take in mind the new roles and skills required when organizing the company resources for the AI solutions implementation.

Another implication which has been explored in the study, is the challenge met by System integrators with regards to the market readiness. System integrators need to plan internal changes in line with the ones needed in the market in order to avoid wasting opportunities and resources, in case the customer market is not mature yet.

Lastly, it can be outlined that additional focus is put on the external collaborations due to the possible exploitation of the state-of-the-art-technology and the velocity to access it. System integrators' challenge is to leverage on existing knowledge developed by universities and research institutes, to ultimately find the right applications for it.

To sum up, in order to effectively carry on their operations and implement they strategies, System integrators have to adapt the internal organizational setting by introducing appropriate changes in organizational structure, skills and culture, coordinating those activities with the readiness of markets and favouring type of settings which allows for collaboration.

6.3 Conclusions on Changes to the ecosystem

The introduction of AI solutions in the market generated some implications for all the ecosystem around it. In particular, this study confirmed what reported by the scholars, with regards to the number and nature of jobs, that will change because of AI solutions. This effect will have an impact not only on companies but, more generally, on the society. Tasks will be simplified and, consequently, several workers will be affected by that and their level of qualification will rise. The whole set of these effects will bring a lot of new opportunities enabling even non educated people (and less educated people) to take part to the AI revolution. Moreover, AI will take to a reinvention of the work, which will enhance a new flow of work shift. Therefore, as sustained by many interviewees, in the long run it would be possible to assist to a complete redesign of the job market landscape at worldwide level.

It is worth to highlight that another implication brought by AI technology, that indirectly impacted the ecosystem, is the presence of a skill gap inside companies, which can be observed differently across the industries. To fill this gap an important role can be played by the education processes and programs developed by the actors of the ecosystem.

To sum up, System integrators will need to take in mind that the application of their solutions will require companies to adjust their hiring programs to changes brought in the job market.

To conclude, all the aforementioned implications (on the Make vs Buy) decision, on the internal organizational changes, on the changes to the ecosystem) are important for the companies, which need to be aware, to monitor the ongoing technological and market context and prepare for that. This is essential representing important suggestions to finally bring AI to the appropriate mainstream diffusions, since as mentioned by one interviewee "the last 10% in the 90% of the work".

6.4 Practical implications

Introducing a new technology within a business is not a process that happens overnight. Changes happen in a gradual and incremental way over time by giving to each actor different opportunities to react and adapt at these changes. Therefore, the author has provided some actors-specific practical implications.

Implications for System integrators: These companies are in the middle of the process of changing, they have taken the first steps and expects to modify more and more their organizational structure, organizational culture and jobs in the long-term future. First, they should carefully observe, analyse and foresee the AI-related changes in technology and applications which can involve suppliers, end market adopters and ecosystem, in order to catch all those signals that can anticipate and facilitate the AI adoption and exploit the related opportunities. Secondly, even though System integrators are developing their AI solutions by adopting a make strategy as a frontline strategy, this choice could be conditioned by the increasing level of specialization required to develop potential AI applications. In this view, System integrators are addressed to develop internal capabilities aimed to deal with different external actors (suppliers, partners, customers, etc), thus strengthening both their relational and technology capabilities.

Implications for AI potential adopters: As reported by the theory, there is a lot of misunderstanding inside the companies about what are the resources needed to train AI and consequentially a lot of scepticism in adopting the technology[307]. Therefore, important implications can be formulated for

[307] Ransbotham S. et al, 2017

these companies which have not yet considered to introduce AI technology and for which new technologies have always brought risk and uncertainty, since their functioning and effects are unknown and often overestimated. First, these laggard companies may be held back by the fact that other companies are more advanced in the AI adoption process, and consequently avoiding starting the journey of AI. For these companies, this research demonstrates that it is not too late to evaluate the introduction of the AI technology being the implications gradual, related to the long-term and just started by the other companies in the market. Moreover, this research highlights, for laggard companies, the importance of the appropriate characteristics that their organization requires in order to succeed in the adoption processes (e.g. to have an organic type of structure and an innovative culture). These companies should start to operate in order to implement programs and initiatives to develop these characteristics both at individual and organizational level.

Implication for the education system: Some practical implications can be drawn also under a policy perspective for what concerns education in the field of AI, providing some suggestions to the countries willing to participate to the AI revolution. Even though this study does not highlight the lack of talents as an issue for the companies, it still underlined the scarcity of them. Since the AI technology is a phenomenon expected to increase in the near future, the scarcity of knowledge people could become soon a real problem. Therefore, countries should be aware of that and try to launch some initiatives to fill this gap by incentivising the study of AI field. Some countries have already started to give a contribution in this perspective. In fact, as reported by the literature, one of the boosters of AI in the very recent times has been the growth of AI education programs[308]. For example, Finland, with the aim of becoming the most educated country in the field of AI, started to offer free on-line courses to everyone who applies for, since 2018[309].

[308] Evans H. et al., 2017
[309] Delcker J., (2019), Finland's grand AI experiment, *Politico* (on-line review)

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