LUISS

Department of Business and Management

Course of Managerial Decision Making

THE IMPACT OF INDUSTRY 4.0 ON CORPORATE STRATEGIES.

Digital Transformation and Continuous Innovation.

Prof. Luigi Marengo
SUPERVISOR

Prof. Luca Panaccione
CO-SUPERVISOR

Sara Elia
CANDIDATE

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INTRODUCTION

Retaining a competitive advantage in this century requires striving for continuous innovation and taking in serious consideration a digital transformation. Furthermore, due to the fourth industrial revolution, there has been a wave of innovative technologies that is pervading the economy and, as all the previous industrial revolutions, is having a momentous impact on society. Therefore, it is becoming increasingly necessary to implement Industry 4.0 technologies in companies, because they have proven to be able to improve considerably firms' performances in various industries. These technologies are several and are able to affect every aspect of an organization. Operations, transportation, production, designing, clients' perception of brands and all activities conducted in a firm can be considerably improved with innovative tools and the results are so noticeable that it is inevitable that Industry 4.0 has a direct impact on businesses' entire corporate strategies.

The first chapter of this thesis begins with an introduction of the topic. The competitive landscape of this century is presented and it is apparent how the most valuable companies in the world, such as Apple, Microsoft, Facebook, Amazon, Alibaba and so on, are all firms with a clear digital strategy and a distinct technological advantage. Consequently, it is evident that pursuing a digital strategy is an essential point for the management in companies that wish to reinforce their position in their industry, instead of risking to be overcome by new entrants or by other incumbents that have decided to reinvent their business.

The chapter is structured according to this logic, so there is a brief overview regarding competition and the degree of digitalization common in different industries. Then, the concepts of digital transformation and Industry 4.0 are discussed. The purpose is outlining the most important notions to achieve a successful digital transformation and explaining some of the Industry 4.0 technologies: big data and analytics, autonomous robots, simulation, horizontal and vertical system integration, the industrial internet of things, additive manufacturing, artificial intelligence, virtual and augmented reality.

In the second chapter, there is a focus on how it is not sufficient to reinvent a business only once, in general. In fact, not even being a digital disruptor protects businesses from being disrupted by other new entrants or competitors in the future. Moreover, while the typical reaction to disruption has been an attempt to legally block innovation and having various initiatives be declared illegal in several industries in the past, these approaches are not sustainable in the long run. The best way to avoid being surpassed is centering the corporate strategy on the idea of continuous innovation and adapting to technological advances, seeing them as the opportunities they are and not only as challenges.

The chapter analyzes the digital transformation of the supply chain, focusing also on digital supply networks. Then, it continues by introducing the impact that Industry 4.0 technologies have on the customer decision journey and on the experiences that firms are able to offer to their clients, thus strengthening their brands.

The third chapter is an analysis of different industries. Various practical examples are examined, in order to evaluate the impact of Industry 4.0 technologies in the real world and not only in theory. These are meant to give a glimpse of the variety of their applications and their significant impact on companies. In particular, the industries that are discussed are banking, automotive, airport, airlines and healthcare.

Finally, the dissertation is concluded with observations regarding the general impact of Industry 4.0 on the economy as a whole, the society and the nature of work itself. The technologies introduced with the fourth industrial revolution also have an important potential role to play, considering a solution to the issue of scarcity of natural resources. They could be the key to achieve a circular economy, decrease waste and realize a sustainable industrial value creation from the point of view of economic, social and environmental sustainability dimensions.

CHAPTER I

1.1 Competitive Advantage in XXI century

Maintaining a competitive advantage in the new century is becoming increasingly challenging; adopting efficient strategies and being open to changes to respond to disruption from new incumbents is essential.

In the last years, digital transformation has proved to be crucial to grow the business and boost performance. In an article published on the Harvard Business Review in 2016, an analysis had been done on the USA landscape and the way in which digital innovations impacted it. The authors began by citing research done by the McKinsey Global Institute that noted how the U.S. economy operated at only 18% of its digital potential and the broader economy did not show the kind of productivity gains that digital technologies should have enabled. This result was explained by differentiating between the "haves" companies and the "have-mores" ones. These terms are used by the authors to differentiate two groups separated by a wide gap due to the way in which they handled digital technologies, accessible to almost every individual, company and sector in the USA economy. Basically, the "have-mores" groups included companies and sectors that were using their digital capabilities more, to innovate and transform how they operated.

The 18% figure was useful to compare how the entire economy was performing compared to the "have-mores", which had evidently a significant competitive advantage. Excluding some exceptions, the technology, media, financial services and professional services sectors mostly ranked among the have-mores, whereas, generally, the laggard sectors included government, health care, local services, hospitality and construction. The most digitally advanced sectors increased their productivity and improved profit margins, but their extraordinary performance was not enough to compensate the others, whose lower productivity weighted more on the broader economy due to their contribution to GDP and employment.

This study underlined visibly how the way in which companies implemented the technologies at their disposal impacted enormously their overall performance. A strong digital strategy and a digital transformation are necessary for established companies in order to create a competitive advantage for the firm and not be substituted by new incumbents in the market that could otherwise be the ones to revolutionize the offer of the same goods and services to clients.

The article also emphasized how, according to the authors, the capture of the full potential of digitization, instead of only this 18%, would be worth at least $2 trillion to the USA economy. Thus, how encouraging the "haves" companies to close the gap with the "have-mores" should be an

important issue to include in the policy agenda. It is in the interest of the State to promote an environment in which proper digitalization is possible, in order to grow and thrive. *(J. Manyika, G. Pinkus & S. Ramaswamy, 2016)*

In this thesis, we will analyze the impact that Industry 4.0 has on corporate strategies with the digital transformation of the companies and the results obtained by each firm that decided to implement innovative technologies will be underlined. Thus, we shall observe together the benefits of a digital strategy and how it generates a competitive advantage by examining different business cases.

1.2 Countries' competitiveness

It is important to consider the USA scenario, considering the influence it has on the global economy. It is essential to remember that the most valuable companies in the world are American ones such as Apple, Alphabet, Microsoft and Amazon, followed by Chinese ones such as Alibaba. China is also a very promising digital market, because it has the world's largest internet user population, 721 million, as well as India, which with its 462 million internet users is another great market with huge potential for global players (even if the use of multiple languages and various infrastructure challenges represent a problem).

On the other hand, the European Union has 412 million internet users; however, it is not a single market and its fragmentation undermines the potential it would have had. From this, we can immediately notice that politics, regulations and the level of economic development of a country are of fundamental importance to determinate the degree of attractiveness for a digital market. Observations regarding digital access itself are crucial. All countries present a different environment, barely 50% of the world's population has the possibility to use the internet and, for example, in many countries numerous websites or digital companies are blocked.

Still, the opportunities are several. According to an article published in 2017 by B. Chakravorti, A. Bhalla and R. S. Chaturvedi, the number of mobile connections existent exceeds the number of people on the planet and the number of people with access to a mobile phone is higher than the ones that can use a toilet. Thus, it is evident that the prospects of the possibilities available with clever and innovative implementations of digital technologies are innumerable.

This article includes also the Digital Evolution Index, created thanks to a collaboration between the Fletcher School at Tufts University and MasterCard. They analyzed the digital evolution of 60 countries, which appears to be the outcome of four drivers:

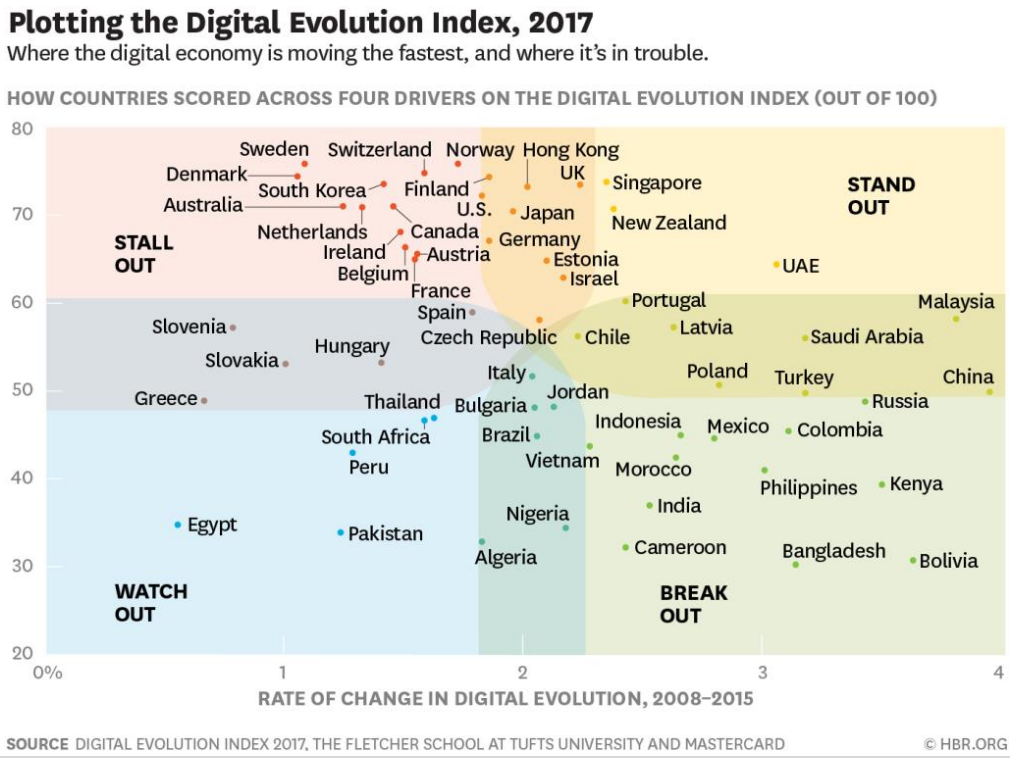
- **Supply conditions.** They distinguished three kinds of infrastructure: access infrastructure (communications sophistication, coverage and security); transaction infrastructure (access to financial institutions and electronic payment options); fulfillment infrastructure (quality and performance of logistics and transportation infrastructure).

- **Demand conditions.** They measured how digitally engaged consumers were. Their willingness and ability to spend online, their openness to alternative digital payment options available, their actual use of digital devices, mobile connections etc.

- **Institutional environment.** They assessed the legal environment, including IP and investor protections, and how much the government used digital technology. Themes like transparency, rule of law and regulatory quality were taken into consideration too.

- **Innovation and change.** They individuated three subcategories: inputs (financing options, talent retention, start-up capacity), process (level of sophistication of firms' business processes, level of R&D…), and outputs (degree of connectivity across networks, mobile devices, digital entertainment, social media etc. that support the propagation of new products, ideas and business models).

The Fletcher School at Tufts University and Mastercard examined the competitiveness of a country's digital economy considering the *current state* of digital evolution, determined by the four drivers mentioned above, and the *pace* of digital evolution over time, measured by the momentum, i.e. the growth rate of a country's digital



evolution score over the period 2008 – 2015. The *momentum* is a lead indicator of a country's future digital potential and prospects. The following chart was created thanks to these observations, countries are divided into four zones - Stand Out, Stall Out, Break Out, Watch Out - or are at the border of multiple zones.

The "Stand Out" countries are the highly digitally advanced ones that have high momentum. They are leaders in driving innovation and continue to improve their existing advantage efficiently. However, maintaining steadily high momentum over time is challenging because expansions characterized by innovations are often difficult. Secondly, "Stall Out" countries are these that have a high state of digital advancement but a slowing momentum. Then, there are "Break Out", which are countries currently low-scoring regarding their degree of digitalization but that are evolving rapidly. Their high momentum and propensity for growth would make them highly attractive to investors, however, they are often penalized due to fairly weak infrastructures and poor institutional quality. "Break Out" countries should focus on improving these aspects to cultivate innovation. Finally, the "Watch Out" countries are the ones that have a low level of digitalization and low momentum.

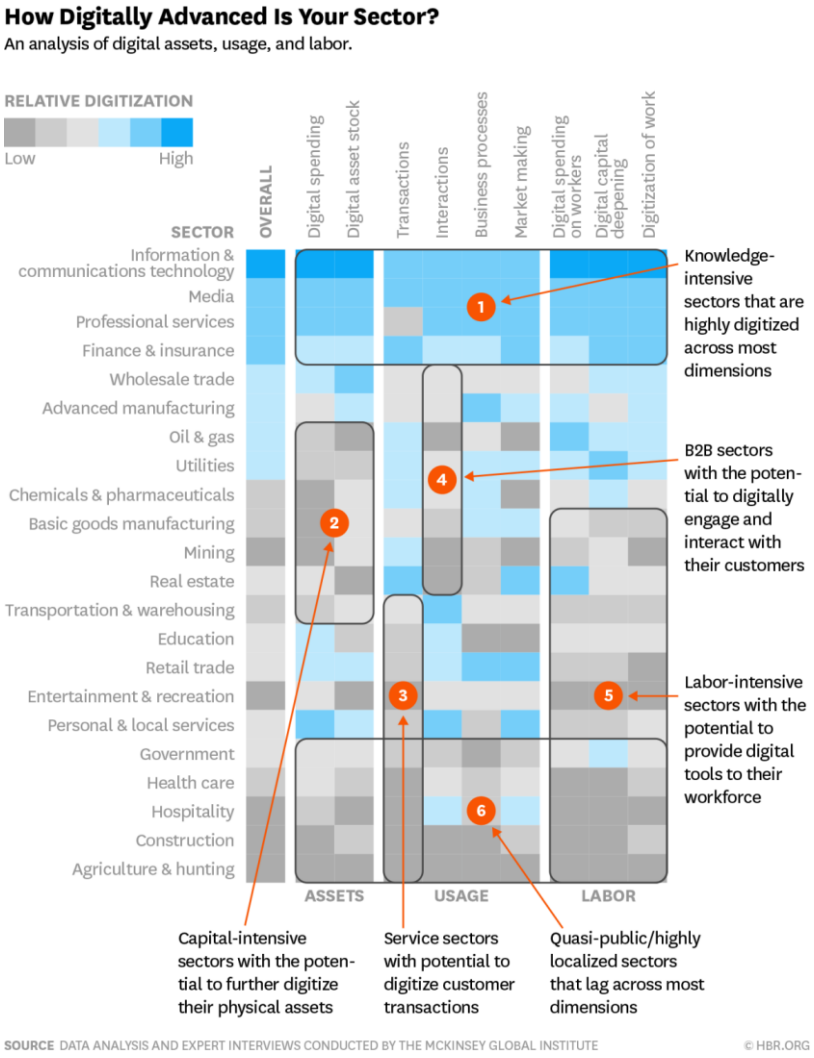
As we can see, both the USA and Germany are at the border of "Stand Out" and "Stall Out" categories. They ought to look to the higher-momentum countries' policies and try to adopt a similar approach to be more competitive. Italy is at the border between the "Break Out" and the "Watch Out", whereas, undoubtedly, the most interesting region in the world from a digital point of view speaking is Asia, especially China and Malaysia. *(B. Chakravorti, A. Bhalla & R. S. Chaturvedi, 2017)*

We can observe how Italy has been placed at the border of the "Break Out" and "Watch Out" zones, extremely close to the other two categories too. It is basically at the center of the graph, certainly an interesting position. In Italy there have been attempts from the government ("Piano Nazionale Industria 4.0") to create conditions that promote the adoption of Industry 4.0 technologies in companies; their potential is acknowledged and it appears essential to proceed with the digital transformation of Italian firms in order not to lose ground in the international market.

In the following chapters, after an introduction to the terms "Digital Transformation" and "Industry 4.0" and the presentation of a few of the fundamental innovative technologies available for firms, we will appraise how successful their implementation is by highlighting the benefits they created in different industries.

1.3 The most digitally advanced Industries

P. Gandhi, S. Khanna & S. Ramaswamy wrote an article in 2016 in which they underlined how, in order to achieve productivity benefits from digital advances, companies have to do more than just buy the latest technologies (assets). Firms need assets like computers, servers, networks and software, but the focus should also be on how they use these technologies (usage) and how they integrate the digital tools into employees' tasks (labor). Digital usage indicates the form of transactions, customer and supplier interactions and internal business processes and digital labor means having a digitally empowered workforce. Using these three categories, they delineated the chart shown in the figure.



We can observe that IT, Media, professional services and finance/insurance sectors tend to belong to the group that has more technology, uses digital means to interact with costumers and integrates the digital tools in labor, reorganizing the internal structure of the business to make more efficient the everyday work of the employees. It is also obvious, however, that there is much room for improvement in all the other sectors.

The observations necessary to elaborate on the chart above were several. Regarding digital assets, the index measured the degree to which companies invest in hardware, software, data and IT services etc., considering both direct purchases and contracts with third parties. Moreover, the extent to which

they are digitizing their physical assets, i.e. smart buildings, connected vehicle fleets and big data or IoT systems that improve the maximum performance obtainable through the equipment, systems and supply chains.

Secondly, regarding digital usage, the level of digital engagement with customers and suppliers is studied. Companies in the leading sectors use more extensively digital payments, digital marketing and design-led product development. It is more probable that they use software to manage back-office operations and customer relationships. Furthermore, they usually use e-commerce platforms and social technologies. Burberry, for example, has set the bar among retailers by seamlessly integrating social media and immersive experiences into its physical stores. These usage-related innovations are likely to have profound implications on business models and economics across the value chain in the coming years.

What really makes a difference, however, is the degree to which firms let employees handle digital tools to improve productivity. Technology has to penetrate everyday work, "digital talent" should not be in a separate department. Firms need to let all employees develop digital skills and invest in cultural change. *(P. Gandhi, S. Khanna & S. Ramaswamy, 2016)*

1.4 Digital Transformation

With the increasing digitalization spreading in the world, meaning the growing penetration of digital technologies in our society, where digital products and services seeped inexorably in the everyday life of individuals, we have briefly seen in the previous paragraphs that even business are forced to concede how business rules have changed. People's behavior is unwaveringly determined to be influenced and altered by the use of technology and some businesses do not hesitate to employ new technologies to conquest or conserve a competitive advantage in their industry. This is the reason why, in order not to be surpassed by competitors, all firms should consider a digital transformation.

With the term Digital Transformation, we described a managed adaptation of companies to assure sustainable value creation, considering the disturbance in the global market caused by the unstoppable progressing of digitalization. Current business models must be re-evaluated because they may be prone to become obsolete in the future digital economy. Firms might have to completely modify their own business models to anticipate the disruptive models of potential future competitors and use digital innovations to prosper in the digital era.

Many parts of the digital economy present low entry barriers, therefore new competitors have the opportunity to alter and conquer the market. The competitive pressure is especially strong due to the powerful, digital-native companies that endlessly revolutionize numerous traditional business sectors. The impact of digitalization on the physical world thanks to embedded systems, smart devices and sensor networks is undoubtable too. Moreover, digitalization also empowers customers, for example regarding the spreading of information through social media. Consequently, it becomes even more important for companies to focus on customers and manage end-user interfaces. *(H. Gimpel & M. Röglinger, 2015).*

A digital transformation in a company means using innovative "technologies to impact three organizational dimensions of the firm: externally, with a focus on digitally enhancing the customer experience and altering its entire life cycle; internally, affecting business operations, decision-making and organizational structures; and holistically, where all business segments and functions are affected, often leading to entirely new business models". *(M. H. Ismail, M. Khater & M. Zaki, 2017)*

1.4.1 Digital Disruption

Digital disruptors are organizations that manage to generate an enormous shift in an industry by efficiently implementing digital technologies. Uber is one of the classical examples. In fact, this firm managed to become the world's largest taxi company without owning vehicles by finding owners of good cars and offering them the opportunity of earning money by registering on their website and offering a ride to Uber's clients. Thus, for the company, there was the evident benefit of not having to cover the costs of the vehicles, differently from traditional taxi services, which put the firm at a significant advantage. Considering that the profits of a company are equal to the revenue minus the costs, it is immediately intuitive to notice the impact of this business model.

Another case is Airbnb, an accommodation provider that does not own any real estate. The company gave the opportunity to everybody that had a spare room to register on their web-site to rent it. Therefore, instead of having to construct new houses, the company managed to simply find existing space available and make it accessible in the market.

Alibaba is also an interesting example, it is a valuable retailer but it has the advantage of not having any inventory. Knowing that the cost of inventory is substantial, it is obvious that this is a remarkable difference compared to traditional models. There is also Spotify, a company that created the possibility for clients to pay a single subscription fee and have access to all their favorite songs. Instead of having to buy whole albums for one or two songs, clients can directly listen to all the

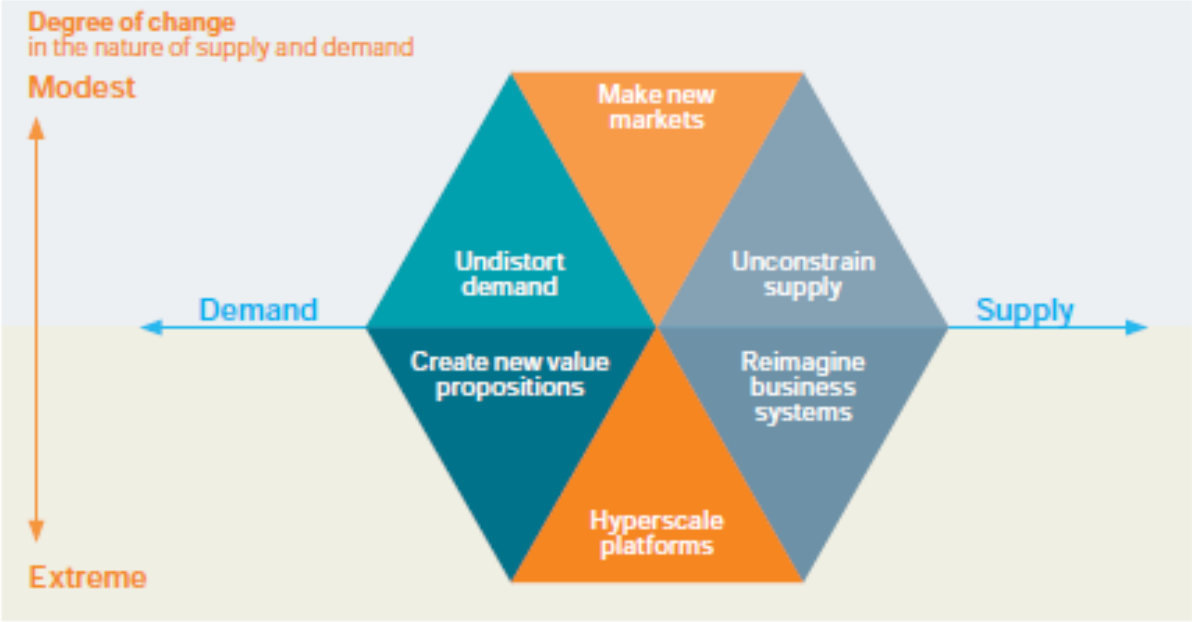
individual tracks in which they are interested. This possibility exists only thanks to the digital age, because, regardless of the client's preferences, in the past, it was more profitable and cost-effective for firms of music providers to distribute albums and people were forced to buy for their products because there were no alternatives. Nowadays, thanks to digital technology that alternative has been invented, a seemingly much-preferred solution for clients to the dismay of traditional media companies.

Obviously, digital disruption includes various kinds of changes and we should not take into consideration only the more eye-catching cases. For example, let's think about the trends in the automotive industry regarding the study and creation of driverless cars or electric cars. The diffusion and success of electric cars would eliminate the need to depend on traditional fuels and there would be tremendous consequences on the current supply chain in the automotive sector. The petrol stations, the tankers, the tanker's drivers would all be entities that would be affected by this disruption. It is palpable that the issue should be taken seriously by all companies in all sectors. In the following paragraph, we will analyze which ones are the more glaring elements that may result in a potential disruption and how the management should react to protect a business. Nevertheless, as already stated, digital transformation is a step that appears to be unavoidable in order to remain competitive in the long-term in the XXI century and every company should adamantly decide to integrate it in its business model.

1.4.2 Facing Digital Disruption with a Digital Strategy

For decades, businesses have deployed technology to reduce costs and complexity, make better products and develop new business models. However, as we briefly already introduced previously, the new potential of technology poses major new challenges for management and it is essential for businesses to reorganize their strategies for the digital age. In this paragraph we will examine the main elements of digital strategy, paying attention to which aspects of a business present the higher risk of disruption and should be changed by the management to avoid digital disruption from competitors and improve the firm.

At McKinsey, experts have developed a useful framework to guide management in the creation of a proper digital strategy. The framework is based on a structure that follows Demand and Supply, like in the basic principles of Economics; however, it also takes into consideration the degree of change. As we can see in the figure below, the top of the framework represents a modest degree of change in the nature of supply and demand, whereas at the bottom we have an extreme degree of change.



Degree of change in the nature of supply and demand. McKinsey Quarterly (2016)

The introduction in the company of digital technology is necessary because it exposes those sources of supply that were previously impossible or uneconomic to provide. Digitization removes distortions in demand, giving customers more complete information and creating a situation in which it is necessary to unbundle aspects of products and services, formerly combined or kept separate by necessity, convenience or to increase profits. The continuously strengthening of customers' empowered behaviors and expectations form conditions to which companies must respond.

Newly exposed supply and undistorted demand give new entrants an opportunity. Examples of successful implementations of this advantage are Airbnb and Uber, but they are not the only organizations that managed to become competitive in this way. The key is lowering transaction costs by reducing information asymmetry. Airbnb exposed supply by individuating the possibility to rent space that belongs to the general population. In this way, it avoided all the costs usually necessary in order to build rentable spaces, which gave it a momentous advantage. Moreover, Airbnb exposed consumer demand, which apparently always existed. People that desired variety in accommodation choices, prices and lengths of stay. Another example is Uber that, similarly, did not need to spend money on numerous new cars.

In the framework, these examples are also optimal cases to explain "New markets making", which refers to finding new ways of connecting supply and demand, and the idea of "Unconstrained supply", as is the case of YouTube with its millions of aspiring film producers. Then, we have "Undistort demand", which indicates how nowadays we have the possibility to determine a perfect matching of

the products to the demand. Whereas, in the past, firms were unable to perfectly match their products to what the customers wanted. For example, let's think about newspapers. They have different sections, from business to fashion and puzzles. Not everybody is interested in reading all of them, but in the past, it was more convenient to bundle all sections to a common distribution network. Today it is possible to discover new demand, it is conceivable to unbundle it, tailor the demand to different clients and price more accurately. This means that firms should adapt and also try to avoid stickiness and simplify the entire distribution process, prioritizing immediateness and ease. A suitable example is Spotify; after giving clients the possibility to choose individual tracks to listen by paying a single fee, it is much harder to sell them whole albums.

Consequently, it is evident that success is made possible by identifying unmet demand and responding appropriately to escalating expectations. Nowadays, consumers have empowered behaviors because, thanks to technology such as apps and the internet, they have access to a lot of information and they manage to find exactly what they want, as well as where and when they want it. Preferably for the lowest price available. In this way, clients start to fulfill their own previously unmet needs and wishes. Technology alters products, services and the way customers prefer to use them; the result is a "purification" of demand and companies are forced to adapt.

Regarding customer expectations, clients pretend increasingly improved user experiences. They do not compare anymore the company only with its direct competitors, their new standards depend on their experiences with companies like Apple or Amazon. In both business-to-business markets and consumer ones, people are progressively accustomed to having their needs fulfilled at places of their own choosing, on their own schedules and often gratis. Companies need to adjust accordingly or someone else surely will.

A business model may be exposed to potential disruption, in the case in which demand becomes less distorted, if:

- Customers cross-subsidize other customers. Cross subsidization, in general, refers to a situation in which a product is supported by the earnings of another product, sold by the same company.
- Customers must buy a whole article even if they want only a part of it. For example, being forced to buy a CD to have a single song
- Place and time are not flexible, so customers are not free to get what they want where and when they wish
- Customers have user experiences that do not compare to global best practices

- Firms do not identify and target customers properly (pricing, advertising etc.)

In these cases, the solution is improving search and filter tools, introducing streamlined and user-friendly order processes, using smart recommendation engines, providing custom bundled and digitally improved products.

The potential disruption, in the case of unconstrained supply, is possible if:

- Customers use only a part of the product offered, which is not entirely useful
- Production is inelastic to price
- Users could become suppliers
- Fixed or step costs are high

Competitors can find new supply if underutilized assets exist, Airbnb is just one of many possible examples. The company in these situations can react in advance by unlocking themselves existing but underused forms of supply or by assembling redundant capacity with digital means, turning the product in a service, digitizing physical resources or labor and using the sharing economy.

Finally, market makers have a fundamental role. Without innovative ways of linking supply and demand, the potential of the connection between previously unused supply and latent demand would not have such a significant impact. Make new markets consists of matching these two aspects, revolutionizing the market and surpass competitors. A brilliant case is Wikipedia, which unleashed latent supply that was willing and elastic, even if unorganized, and unbundled the product. Nowadays, people do not have to buy numerous volumes of an encyclopedia, information is easily and quickly available with a simple search input. It is possible to directly find the details of the topic of interest, without losing time or money. Another case is represented by Google's AdWords, which offers to information seekers the possibility of freely insert search inputs and to paying advertisers the possibility to pay for key-words, to appear more frequently and to target more precisely the kind of customers they want. Both customers and companies are satisfied and search costs are lowered.

The vulnerability of a market to new market makers depends principally on how difficult transactions are for customers. It is necessary to verify if there are:

- High information asymmetries between customers and suppliers, i.e. low transparency
- High search costs
- Fees and layers from intermediaries
- Long lead times to complete transactions, i.e. if the transaction requires a long amount of time

The risk that competitors could propose a challenge offering a real-time and transparent exchange of information, the elimination of intermediaries and automated and rapid transaction processing would be considerable. Through search and comparison tools to promote transparency or other methods.

This part studied the market realignment that transpires as a consequence of the connection between new supply and purified demand. Now we will focus on the bottom of the framework, where situations with an extreme degree of change are taken into consideration; a fascinating situation that, however, poses momentous potential troubles for unprepared businesses, without a suitable digital strategy.

Thanks to extreme changes, companies may have to endure competition even from adjacent markets and companies with originally entirely different business objectives. This is possible thanks to the "reimagining of business systems", "hyper-scale platforms" or the "creation of new value propositions". "Reimagine business systems" means fundamentally changing the cost structure in the supply-side by automating, virtualizing, disintermediating or becoming much more accurate and predictive. Whereas, "Hyperscale platforms" means creating an entirely new value chain and new ecosystems and "Create new value propositions" means using digital technology to improve the value to the customer. In fact, it is possible to enrich the product with information, make the product social or transform it into a service.

We have seen how purifying supply and demand means giving clients what they want in innovatively and more efficiently. However, this is not the end of the potential of disruption. The true novelty is due to how companies satisfy the clients' expectations, which escalate with the evolution of the markets. Firms invent new value propositions that offer people unparalleled products that they did not know nor wanted previously, thus creating demand for new needs and new profitable markets. A famous example is the sale of the first smartphones, which permitted access to the internet from a mobile pocketable tool. The new propositions link the digital and physical worlds, exploit connectivity and the profusion of data. Many advanced business-to-business models also include remote monitoring and machine-to-machine communication to deliver value.

The firm is exposed to potential disruption regarding new value propositions if:

- Information or social media could significantly improve its products or services
- The products offered are physical and unconnected from the internet
- There is a substantial amount of time between when customers purchase a product or service and when they receive it
- The customer must get the product in person, e.g. groceries

To solve these weaknesses, it would be better to improve the connectivity of physical devices, add social media to products and services, add digital features, use a digital or automated distribution and consider completely new delivery and distribution models.

In order to deliver new value propositions, however, it is necessary to rethink or reimagine the business. Firms that tried to perfect their value chains are often astonished when new entrants invent new methods to generate profits. The indicators that may indicate a danger of disruption are:

- A redundant value-chain, e.g. repetitive manual work
- Entrenched physical distribution or retail networks
- Industry's margins are higher than ones of other industries, thus they may tempt new entrant
- Industries have high variability in cost and perceived value

In these cases, the company should reorganize its value chain. A good strategy would also be removing intermediaries and interact directly with customers, using digital channels and virtualizing services. For example, the New York Times virtualized newspapers, which offered a different user experience for clients, reducing distribution and production costs. Another two cases are Walmart and Zara that have digitally integrated supply chains, which create cheaper but more effective operations.

Finally, Hyperscale Platforms permits having a huge influence and control thanks to process automation, algorithms and network effects formed by the interactions of billions of users and devices. To understand better their potency, it is sufficient to think about famous cases such as Google, Tencent etc. In specific product or service markets, companies with Hyperscale Platforms usually have different objectives compared to traditional industry players. For example, Amazon introduced the Kindle mainly to sell books and Amazon Prime subscriptions; the competitor was Sony, whose aim was only earning money from e-readers. Obviously, Amazon had more flexibility in pricing than Sony. It is essential not to fail to defend a business from this kind of risk, in which there is the need to face competition from companies from different ecosystems. Another classic case is how the diffusion of smartphones completely overcome the camera industry, substituting the printed photos with quick and numerous digital copies.

Hyperscale Platforms are also useful to create new barriers to entry. For example, GE Healthcare's platform, Centricity 360, created an information barrier. The platform allows patients and third parties to collaborate in the cloud. The risk of disruption due to hyper-scale platforms can be determined by verifying if a business present one of these characteristics:

- Current business models charge customers for information

- Interactions between users and suppliers in the industry are not governed by a single dominant platform
- The potential for network effects is high

In these cases, it would be advisable for the firm to begin to provide free information and establish a platform that connects users and suppliers in the industry. *(M. Hirt, A. Dawson & J. Scanlan, 2016)*

1.4.3 Achieving a Successful Digital Transformation

In order to achieve a successful digital transformation, clarifying the long-term objectives is essential. It is necessary to evaluate the change readiness of the entire company, classify probable problems, vulnerabilities, opportunities and the related risks. For example, new revenue streams could be possible thanks to recently digitally enhanced products, services and customer interactions.

Secondly, it is imperative to ensure that the new digital technologies are integrated with the core values and business goals of the company. The entire organization must be united by a common and clear purpose, all stakeholders should be perfectly informed regarding the strategic plans of the firm, to ensure success. Thus, internal communication regarding all these aspects is of fundamental importance and must be done with attention and responsibility to ensure that the organization is continuously evolving with the technologies employed.

Technological decisions are also decisive, the role that these tools play in achieving strategic goals must be evident. For example, the technologies may have an enabling role for new business opportunities or a purely supportive one to realize business requirements. The firm's attitude towards these innovative technologies and its capacity of exploiting them must be carefully considered. Companies generally tend to either adopt well-known and widely-used technologies, effectively acting as unpretentious market followers, or become market leaders by introducing new revolutionary technology solutions. The difference is due to how much the firms are investing in developing their skills in hypothesizing ways in which digital technologies would be able to impact their business.

Variations in the interaction between firm and customers must also be taken into consideration from a strategic point of view. Examining eventual benefits in the customer journey, whether it provides an enriched customer experience thanks to new digital technologies, is recommendable. All the customer touch-points should be evaluated and monitored in order to deliver an integrated experience to clients. A seamless experience for customers across various digital and physical, platforms, communicating the same image, brand, communications etc. on all channels. Investments in R&D

can also offer aid to companies in developing digitized solutions to anticipate customer needs, instead of limiting to respond to existing ones. Digital innovation should be perceived as an integral part of the firm overall strategy. New opportunities such as agile and new flexible working initiatives should determine a constant digital transformation.

Another important point is the company's culture, which must be managed properly. Simply imposing new technologies on employees can be daunting and unproductive. Rather than overwhelming employees and produce a counterproductive effect, it is better to guide them in adapting rapidly to change from the beginning. The culture inside the firm often proves to be one of the biggest challenges in a digital transformation due to the resistance of many individuals, but it is a critical success factor in technology-induced business transformations. The workforce is essential for the proper utilization of digital tools and for the reputation of the organization.

Moreover, management must try to hire people with the necessary skills and abilities. Identifying immediately the skills required and secure individuals with the proper background through internal training or external talent acquisition is paramount. Also, the right internal governance and external collaborations through partnerships or acquisitions are essential. Internally, firms have to take multiple structural choices to support the execution of their digital transformation strategy and to decide whether new operations should be assimilated into existing structures or separated in new units. Externally, companies can gather the needed know-how with takeovers, in the form of mergers or acquisitions, or with fostered partnerships. Alternatively, it is also possible to resort to external sourcing.

Finally, strategic decisions should also focus on methods to improve operations. Thanks to the use of new data, tools with predictive capabilities etc. it is possible to obtain important insights and optimize the firm's supply chain and the company's interaction with customers. Operational agility, quality and efficiency can be increased; we will see practical examples in the following chapters of the thesis. *(M. H. Ismail, M. Khater & M. Zaki, 2017)*

In an interview with James Bilefield, the McKinsey advisor describes which ones are the three steps to success in digital transformation according to him. Firstly, Awareness. Knowing that there is an issue in the company and that a change is required. The way in which the issues can be addressed varies. Typical examples are altering the language used, dress codes, the office environment etc. Certain senior managers become more visible, leaders start to be more open to more junior levels of the organization compared to the past and so on. Thus, the style of management tends to become more informal.

The second step is considering the way in which the company judges itself, the key performance indicators (KPIs) and the measures used for individuals, teams and the entire organization. In order to try and drive real change, it is necessary to know how high those new KPIs need to be. Finally, the actions taken by the company are to be considered; For example, Apple put a designer on its executive team or Burberry made a designer its CEO.

Moreover, Bilefield clarifies its opinion on the occasions in which executives in legacy companies are confronted with a struggle due to a challenge posed by an aggressive digital disruptor. In these instances, the management sometimes reaches the conclusion that it is necessary to completely overhaul the company's business. However, according to McKinsey advisor James Bilefield, this decision would not be sensible. A digital start-up can disrupt the market, but legacy companies should not undervalue their own competitive assets. Therefore, even if, typically, a proper digital transformation should always include also a broader business transformation, the broader one must be seen as an opportunity to review numerous aspects of the business's operations and improve them, maintaining the efficient aspects that led to the success of the firm in the past and that shall continue to be an advantage in the future.

Bilefield underlines how some necessary changes may be harder than others to implement. Using new technology, finding new talents and skills, improving the organizational structure and the operating model, introducing new products or services etcetera are certainly significant transformations but they are usually doable, if not easy. The most challenging step is the cultural transformation in businesses that have very deep legacy and cultural roots.

In the article, the McKinsey advisor emphasizes that it is important to focus on the power of words to influence the culture. The language used internally in the company regarding products, customers, opportunities etc. and externally to customers or clients may have a very powerful impact on how the business is conducted and the possible outcomes that can be achieved. The language is the first step to change the people's habits, in order to make them become accustomed to thinking differently in the long term through repetition. Verbal communication should heavily depend on what the company is actually delivering to its clients, which shall contribute to rethinking the way the business operates along the same lines. Only in this way, a powerful shift in culture is conceivable.

The company needs to be in a state of constant revolution, continuous improvement, change and evolution in how things work. It is not sufficient to implement a change and then relax and wait for the next five years of business as usual. Bilefield thinks that a company must adapt to the new reality of the industry in which it is operating, encouraging a new momentum and rhythm in its business that

reflects it. Changes can be gradual and evolve toward an end goal, which becomes clear over time. *(Seitz, 2016).*

1.5 Industry 4.0

Historically, all industrial revolutions had a tremendous impact on the world. The First Industrial Revolution marked a period of development in the 18th century that converted largely rural, agrarian societies into industrialized, urban ones. Goods that had previously always been meticulously crafted by hand began to be produced in mass quantities by machines in factories, thanks to the introduction of new discoveries and techniques in industries sectors, like the textile and iron ones. The first industrial revolution started in Britain in 1760 with the incredibly game-changing results due to the discovery and implementation of steam power, then it spread to the rest of the world between the 1820s and 1840s.

The second industrial revolution came in the late 19th to early 20th centuries (1850-1970). As a consequence, cities became incredibly larger, old factories prospered, pre-existing industries grew, new industries (like oil, electricity and steel ones) expanded and people's lives changed radically. Rapid discoveries in the creation of steel, chemicals and electricity improved production, including mass-produced consumer goods and weapons. It became much easier to move using trains, automobiles and bicycles. Ideas and news quickly spread, due to the invention of the radio, the telegraph and the paper machine, which enabled the selling of cheaper paper, causing a broader distribution of books and newspapers. Life became faster and time was tracked with clocks, instead of the sun.

Then, the third industrial revolution happened in the second half of the 20th century, a new type of energy was discovered, with a potential that far surpassed its previous forms: nuclear energy. This revolution permitted the diffusion of electronics, telecommunications and computers. It became possible to obtain miniaturized material that would later be used in researching space and biotechnology. Whereas, for industries, the era of high-level automation in production began, due to two major inventions: automatons and robots.

The term Industry 4.0 indicates the fourth industrial revolution, meaning the diffusion of the use of new technologies that "blur the lines between physical and digital worlds", permitting the access to innovative and valuable data in real-time. The data collected has the potential to fundamentally

change how companies operate, thanks to its analysis through powerful analytics tools, such as visualization, scenario analysis and predictive learning algorithms.

This has been possible due to three factors. Firstly, the cost of these technologies swiftly declined in the last decades, which means that companies need less money to invest in digital technologies. Thus, the number of companies that is capable of undertaking a similar investment and benefit from it is significantly higher. In general, the whole innovative process is more easily accessible to each firm interested in the effort. Secondly, computing power and technological capabilities increased enormously. In particular, between 1992 and 2002, computing power grew at an average of 52 percent per year. This led to a noteworthy increase in the amount of data that firms could gather, store and analyze. Furthermore, these two advances, lower costs and improved power and capabilities, had exponential consequences. In fact, people were able to combine information technology (IT) and operations technology (OT).

Nowadays, companies have the ability to collect an enormous quantity of data from physical assets and facilities in real-time, reach new insights through advanced analytics and, consequently, determine the most efficient strategic decisions for the business. The decisions can, in turn, be realized with the implementation of advanced physical technologies, like robotics, drones, additive manufacturing and autonomous vehicles. In short, usually people think about Industry 4.0 as the creation of the possibility to use big data to personalize experiences properly, AI to deliver rapid expert service and facilitate resolution, predictive analytics to anticipate and pre-empt customer problems and predictive insight to understand the life journeys of individual customers and identifying the points where firms can add value. However, the possibilities of the application of industry 4.0 technologies are endless and the unique limit is creativity and imagination. We will see in detail different implementations of different digital innovative technologies and the significant impact they have on businesses and, consequently, on corporate strategies.

Industry 4.0 will lead to the opportunity to reach a higher level of efficiency and change traditional production relationships among suppliers, producers, and customers. Some technology trends form the building blocks of Industry 4.0 are big data and analytics, autonomous robots, simulation, horizontal and vertical system integration, the industrial internet of things, additive manufacturing, artificial intelligence, virtual and augmented reality.

Big data and analytics, in an Industry 4.0 context means the collection and comprehensive evaluation of data from many different sources, from production equipment and systems to enterprise, customer-management systems. It will make it possible and become standard to support real-time decision making. Autonomous robots, on the other hand, should arrive to interact with one another and work without issues besides humans, learning from them. It will comport a reduction of costs and the availability of a greater range of capabilities than those used in manufacturing currently. Thirdly, simulations should be used in plant operations, because they permit to control real-time data, by mirroring the physical world in a virtual model, including machines, products, and humans. Consequently, the operators can test and optimize everything immediately the next product in line in the virtual world, before deciding what to do in reality after observing the outcomes. Thus, machine set-up times would lower and overall achievable quality would increase.

Moreover, with horizontal and vertical system integration in industry 4.0, universal data-integration networks evolve and allow completely automated value chains. Thus, companies, departments, functions and capabilities become much more unified and interconnected. The fourth industrial revolution also opens the door to the opportunity to enrich devices, even unfinished products, with embedded computing. This phenomenon is indicated with the term "industrial internet of things". Imagine a reality in which there are connections between all devices across the home, the car and the office etc. Leading firms are thinking about how this possible connectivity and the resulting inundation of data should be handled. Field devices could communicate and interact with one another and with more centralized controllers and real-time responses would be possible, thus decentralizing analytics and decision making.

Other important technologies connected to Industry 4.0 are additive manufacturing, artificial intelligence, virtual and augmented reality. These will be explained in more detail in the following sub-paragraphs. It is important to consider cybersecurity too, because, with the integration of these technologies in fundamental industrial systems and manufacturing lines on such a great scale, it is of essential priority to defend them from attacks. Assuring secure and reliable communications, sophisticated identity and access management of machines and users are considered significant. *(D. Gish, A. Mussomeli & S. Laaper, 2016).*

1.5.1 Additive Manufacturing

The term "Manufacturing" is derived from the Latin word "manufactus", which means "made by hand". It indicates the concept of making products from raw material by using various processes that

include hand tools, machinery and computers. Thus, Manufacturing is a study of the processes required to create specific parts from raw materials, in order to assemble them in a final product. The Manufacturing process is a part of the production process, which consists of converting raw materials into finished goods with the application of different types of tools, equipment, machine tools, manufacturing processes etc. There are three main types of production systems: Job production, Batch production and Mass production.

Job production refers to a situation in which there are operators that work on a single job and complete it before proceeding to the next one, which may be similar or somewhat different. The production, basically, requires only a fixed type of layout. In general, the fixed-position layout is a production technique used to assemble products that are too large, bulky or fragile, because it is not possible to safely or effectively move them during production. In this layout, instead of moving the product through an assembly line or a set of assembly stations, it remains in a fixed or stationary position during the whole production process and personnel, supplies and equipment assemble it on site.

Alternatively, in situations in which it is necessary to focus on the manufacturing of products that present some variety we talk about batch production. Precisely, regarding products composed by similar parts with very little variation in size and shape and not in large quantities. In this case, the same manufacturing facility tends to be used for the batch production of different products or items over time. Every batch may be repeated only once, at certain periodical periods or in irregular intervals. For this kind of production, it is better to use a process layout, in which equipment is arranged according to its function forming different departments (e.g. milling department, drilling department etc.).

Finally, with mass production, we refer to the production of large quantities of identical products, which creates the necessity for a line layout type of plant, in which equipment and machines are arranged according to the sequence of operations of the product. The items are moved along a line, a set of interconnected work stations, by a conveyor (i.e. mechanical handling equipment that moves materials from one location to another. E.g. Conveyor belts, roller conveyor, overhead chain conveyor etc.).

In this thesis, we are focused on international companies and corporations, so we will proceed by referring to mass production. As we have said, manufacturing consists of changing, modifying pre-

existent materials to create the parts that are used in the formation of a finished good, product. Thus, it is evident that knowing the characteristics of the available engineering materials is really important. The raw materials used to manufacture products in factories or industries are generally extracted from ores, natural rocks or sediments that contain minerals with elements such as metals. The ores are extracted from the earth through mining and refined to extract their valuable elements. Usually, the ores are converted into a molten form by reducing or refining processes in foundries. The resulting molten metal is then poured into molds to form ingots, which are pieces of relatively pure materials (like metal) cast in this shape to be suitable for further processing.

The ingots are processed in rolling mills to obtain typical shapes of material supply such as bloom, billets, slabs and rods. These forms are then subjected to other several manufacturing processes in order to create usable metal products of different shapes and sizes. All these processes used in manufacturing to change the ingots into usable shapes may be classified into six major groups: primary shaping processes, secondary machining processes, metal forming processes, joining processes, surface finishing processes and processes affecting change in properties. *(R. Singh, 2006)*

Nowadays, however, there has been a rapid proliferation of Additive Manufacturing which integrated manufacturing with design and modeling, generating a rapid prototyping technique. While in traditional techniques materials are either removed through machining, drilling or grinding techniques or cast into molds, Additive Manufacturing (better known by the term "3D printing") consists of using revolutionary technology to create complex shapes, building them up layer by layer. This creates a higher level of design freedom and the possibility to achieve in the future Direct Manufacturing. *(T. Pereiraa, J. Kennedyb & J. Potgieter, 2019)*

In order to truly understand additive manufacturing, we will examine the generic steps of the manufacturing process of a part using additive manufacturing technologies:

- It is necessary to have a 3D file converted into a "standard" 3D format. Then, it is best to verify immediately if the part includes inaccuracies or characteristics that would prevent it from being manufactured with this technique, such as geometries with a high risk of drooping when 3D printed, non-closed vertexes, etc. Sometimes, a reparation process is preferable, in order to guarantee a good subsequent manufacturing result and some designs may require the presence of support structures during the printing process. Alternatively, if the issue is that

specific problems preventing manufacturing have been identified, a partial re-design of the part may be required to correct the issue and to ensure a successful manufacturing process.

- After confirming that the part is manufacturable, a slicing process is applied to the 3D file. This could be considered the most crucial stage of the additive manufacturing process because it is this division of the 3D model that enables it to be manufactured layer by layer.

- The file is ready to be sent to the Addictive Manufacturing machine. The manufacturing itself begins once that the machine parameters are fixed, there are numerous ones (such as layer width etc.) and their selection depends on the required specifications. Production time changes depending on the kind of Additive Manufacturing technology used, the number of parts produced simultaneously, their complexity and layer width

- At the end of the manufacturing process, a post-processing phase may be required. There are different methods for each kind of technology. For example, Stratasys POLYJET5 technology requires the removal of the structure supports with a water jet or FDM6, "Fused Deposition Modelling" and other metallic powder-based technologies require their removal with mechanical tools. Finally, after the end of the additive manufacturing process, the parts normally need further treatments such as heat treatments, polishing, etc.

There are currently two generic applications for which additive manufacturing is widely known: product development and manufacture of final parts. Regarding the development of new products, the importance of Additive Manufacturing technology is creating the possibility and capacity to support the design and engineering process with the construction of individual elements or parts and prototypes. All of this would not have been feasible using traditional technologies, which present several technical limitations; using additive manufacturing technologies, everything is produced quickly and costs decrease. We will now observe how additive manufacturing technologies have an application in every step of the product development process, with an impact more than estimable.

In the first phases of the product development process, after the individuation of a new idea and the early development work with the initial sketches and design concepts has started, additive manufacturing gives the opportunity to support the concept stage of the process with the creation of non-functional prototypes, or ones with limited functionality. These prototypes are typically mainly aesthetic and have the purpose of making the concepts corporeal, in order to create the possibility of

making initial assessments and appreciations using them. In this phase, additive manufacturing has a tremendously important advantage over any other traditional manufacturing technologies, because it is the only method capable of manufacturing simple and realistic design concepts, in a short time and at a low cost.

Then, the various concepts are evaluated and the best designs, one or several of them, are selected. Afterward, Additive Manufacturing technologies can also be used to produce demonstrators and prototypes for engineering testing. The peculiar feature of additive manufacturing in this phase of product development is that it decreases the technical time and cost limitations associated with traditional technologies; this is due to the fact that it provides freedom of design, as we have previously explained, and this technology can be applied with rapidity and ease. Therefore, the use of additive manufacturing generates a rise in the number of design and engineering iterations and makes it possible to distribute more rationally the cost of demonstrator and prototype manufacture.

The design and engineering at the beginning of the product development process are needed to individuate a final comprehensive and developed product concept. At this point, with Additive Manufacturing technologies it is possible to proceed with the realization of other prototypes, this time functional, in real size or in scale, appropriate for proper testing. Even in this phase, the benefit is a shorter manufacture time and a rationalization of the cost, in particular, changes of design cost considerably less. All aspects that contrast with the usual limitations of other technologies.

On the other hand, regarding the second generic application of additive manufacturing technologies, manufacture of final parts, the situation is more complex. We have easily summarized how they are used as an important tool to generate and develop a product, however, it is only in some cases that they can also help in manufacturing parts or final products. In fact, it depends on the specific technology used by the company. Generally, the term “additive manufacture” encompasses a variety of different technologies, which all share the concept of “layer by layer” manufacturing that we have introduced at the beginning of this paragraph. Each one of these technologies has different characteristics in terms of materials, technical capabilities, limitations etc. As such, some of these additive manufacturing technologies are suitable only for the manufacture of aesthetic or functional prototypes that we already explained.

In order to verify whether an additive manufacturing technology can be implemented also to produce final parts or products, it is necessary to demonstrate that the manufacturing process is technically

satisfactory for its intended application, as is the case for any type of technology. Basically, the process must guarantee a reproducible result and the expected quality, given a certain material, a technology or machine and one or more manufacturing references.

Now that we have summarized the generic aspects of additive manufacturing, we should reflect on its benefits and downsides. Firstly, among the most well-known and developed of the current additive manufacturing technologies, none are suitable for applications that need particular precision, save if more than one of these technologies are combined. Still, even if technical capacity is important, it is not the only aspect people ought to take into consideration to determine whether they should invest in additive manufacturing technology to industrialize a part or a product. In fact, the elements that make a real difference are the cost of the material needed, the energy consumption required, the processing time, the post-processing activities etc. All elements that vary tremendously and ought to be measured and assessed in every specific case.

In general, however, we can still make some broad statements. Firstly, while traditional manufacturing technologies need high initial investments for molds, manufacturing tools, and etc., additive manufacturing gives the possibility to produce the first series of parts or products without any supplementary investment beyond the additive manufacturing technology itself. Thus, the initial costs may be significantly lower if people decide to use additive manufacturing technologies. Moreover, there is also the option of subcontracting professional additive manufacturing services, which would decrease the initial costs even further. Furthermore, additive manufacturing may be preferable in cases in which the product has to be greatly personalized when the product life cycles are short etc. For example, customization is considerably easier, in fact, no additional tooling is required and the production of a modified part is as straightforward as the production of the original design. We should also underline how, being a layer-by-layer fabrication process, additive manufacturing technology is also capable of generating geometric shapes of great complexity, with cavities and forms not conceivable with traditional technologies.

There are also various drawbacks though. Primarily, the cost of the raw materials needed for an additive manufacturing technology may be significantly higher than the ones required in a traditional manufacturing process, therefore for high production volumes, additive manufacturing tends to be less competitive. In short, additive manufacturing technologies are not more economically convenient if the volume of units is such that it amortizes the investment required by traditional technologies. Moreover, the range of available materials is still limited compared with the ones available for

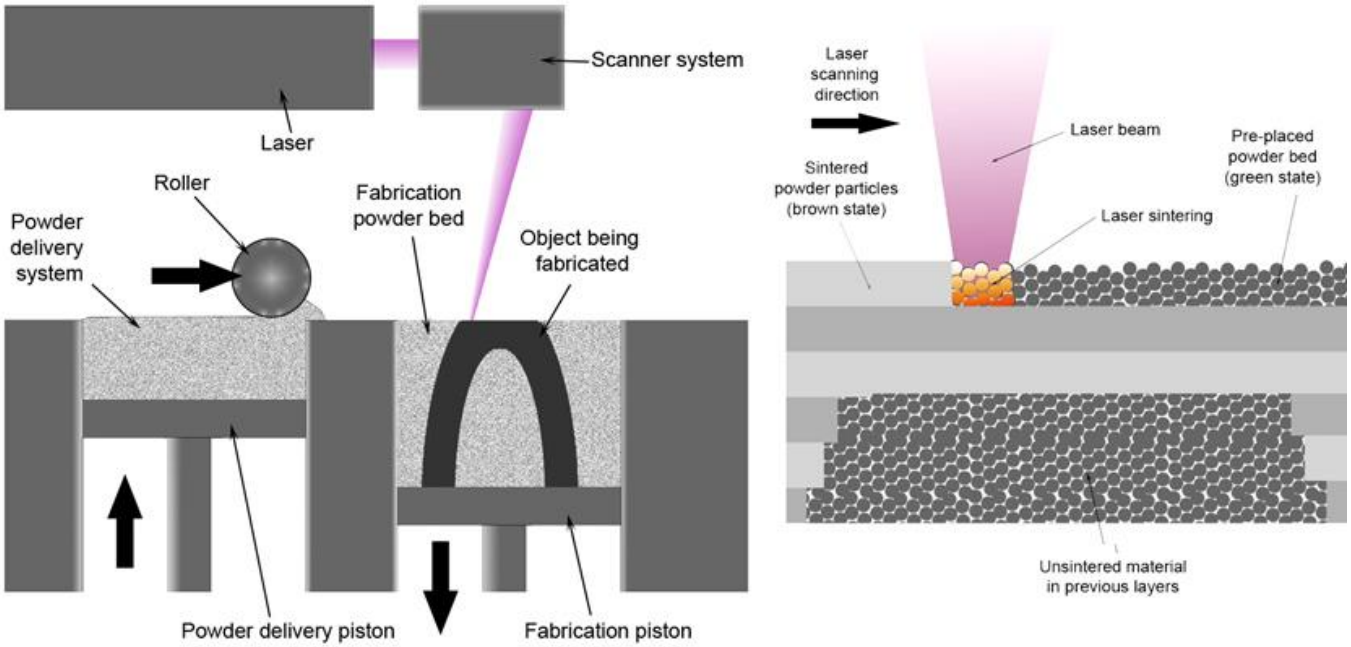
traditional technologies, even if there have been improvements, and there are still some uncertainties due to a lack of standards in assuring the long-term quality of the products produced with this relatively new technology. *(D. S. González & A. G. Álvarez, 2018)*

1.5.1.1 Additive Manufacturing Technologies

Layer by layer manufacturing is a very basic concept that can be implemented in different ways and with different results. In fact, different technological approaches exist and, as stated previously, when people mention "additive manufacturing" they do not refer to a single specific technology. We will now rapidly examine the main technologies, in order to clarify this idea.

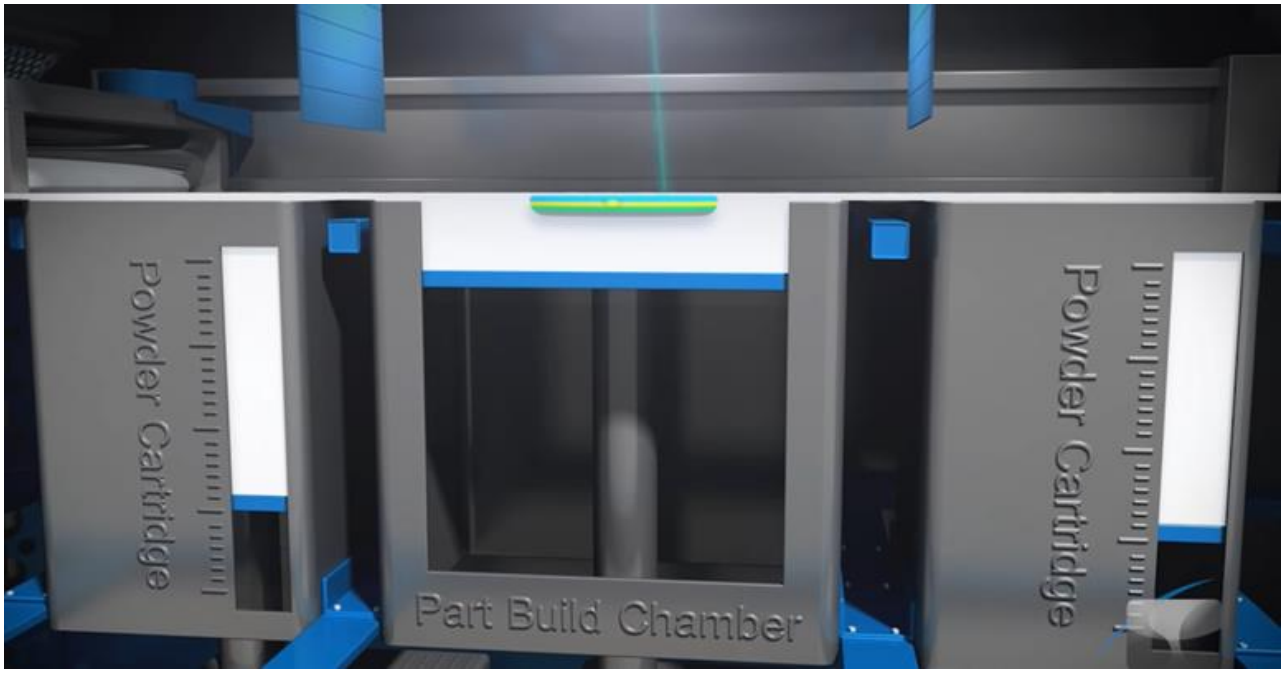
Firstly, let's introduce Powder Bed Fusion. It consists in depositing a fine layer of material in particles, which is then sintered or melted by a selective heating source. The materials used usually are plastics or metals and it is typically applied to manufacture functional models or final products and parts. Its process includes the following commonly used printing techniques: Selective laser sintering (SLS), Direct metal laser sintering (DMLS), Selective laser melting (SLM), Electron beam melting (EBM), Selective heat sintering (SHS) and Multi-Jet Fusion (MJF).

- Selective Laser Sintering (SLS) is a technique that uses a laser to sinter the particles of the top layer of material in powder ("bed"). The laser aims automatically at certain points in space because it follows a digital 3D design model, scanning the surface of the powder bed and heating and fusing the material together. Once a single layer is complete, the powder bed is



Selective Laser Sintering. D. S. González & A. G. Álvarez, 2018.

lowered to make room for the next layer. It follows a layer by layer logic because a roller continues to spread a thin new layer of powdered material on top of the previous one on the power bed after the laser is used, proceeding in this way until the end. The objects produced by selective laser sintering technology are encompassed by unsintered powder, which provides supplemental strength and eliminates the need for support structures. The final object is allowed to cool, the bed is raised and a worker removes the build chamber from the printer, transfers it to a cleaning station and retrieves the printed parts, by removing the excess powder. A high percentage of unused powder can be reused, and this technology conserves a lot of waste material compared to traditional ones.



Selective Laser Sintering. Stratasys.

- Direct Metal Laser Sintering (DMLS) is a technology-based on the same principles as Selective Laser Sintering, however, it uses a bed of powdered metal. A high-powered laser sinters the particles without melting them. A new layer of powder metal is then applied and sintered, and gradually the object is created. In the end, the product is left to cool, the item is retrieved and the excess powder removed is usually recycled for later use. Basically, the only difference between the Selective Laser Sintering and the direct Metal Laser Sintering processes is the material used in these techniques. Both involve sintering rather than full melting, however, DMLS is used exclusively with metal, whereas SLS is typically used with other materials such as plastics, nylons and ceramics.

- Selective Laser Melting (SLM) is a technique similar to Direct Metal Laser Sintering and Selective Laser Sintering too. However, the difference is that the power hit in the points indicated by the computer from the 3D model is fully melted by the high powered laser, instead of just sintered. Thus, a very high temperature is necessary, because each layer has to be heated above the metal's melting point. This whole process happens in a controlled atmosphere of inert gas, in a low oxygen environment. The mechanism remains the same, the platform is lowered layer by layer and a thin layer of particles is spread each time, until all the points indicated by the data in the computer are melted and the item is completed. Even in this case, the final object must be cleaned, the remaining unused powder is removed and some post-processing is needed to eliminate support structures, improve its properties etc.

- Electron Beam Melting (EBM), which is a Selective Laser Melting technology. However, this process uses an electron beam to fully melt the powder metal particles of each layer. Thus, it is a high-speed stream of electrons that hits the powder and melt them. The rest is the same, so the build platform is lowered and new powered material is coated on top for each layer until the object acquires its form. The process needs a vacuum because it is essential to avoid collision between the electrons and the air molecules. Of course, post-processing is always required.

- Selective Heat Sintering (SHS) is also similar to Selective Laser Sintering. It uses a thermal print head to sinter thermoplastic powder, instead of the laser with Selective Laser Sintering. The benefits of using a thermal print head come from the possibility of having a much smaller 3D printer and a cheaper one too, because thermal print heads are much less expensive to purchase compared to lasers. Moreover, no support structure is necessary.

- Multi-Jet Fusion (MJF) is a technology in which the layers of powder material on the platform are applied by a mechanical arm. An ink, "fusing agent", is distributed by another arm on the powder in order to encourage the absorption of infrared light and a "detailing agent", which protects individual grains from the sintering process. In fact, an infrared energy source is used on the building platform and it fuses only the inked areas. The heat energy from infrared radiation lamps is the differentiating characteristic of this technology. Multi-jet fusion is more rapid compared to the other technologies introduced previously, such as selective laser sintering, because the entire layer is fused at the same time instead of targeting and sintering individual particles. The process continues layer by layer as we have seen in the other types

of power bed fusion technologies until the item is complete. Then, it is put in a cooling station. At first, the majority of the unfused powder is removed by vacuum tubes and later an operator finishes the job manually.

Secondly, we have Fused Deposition Modelling (FDM). It is characterized by the extrusion and fusion of thermoplastic, typically in the form of a filament, through a nozzle; the nozzle deposits the filament on a build platform, where it instantly cools and solidifies. The previous layers act as a foundation for additional extruded material and, in this way, items are built from the bottom up in a layer by layer logic. A rough comparison to visualize the process better would be a motorized glue gun. The material used is thermos-plastics and it is applied to generate illustrative models and sketches or functional models. Some machines have a nozzle that can follow the 3D design in both horizontal and vertical directions, while others have ones that only move horizontally and the building platform is lowered in the vertical axis to maintain the current layer at a constant height. A second nozzle may also be necessary to provide a support structure with a filament composed of a different material. Although this technology has been essentially based on the use of plastic materials, its principle of operation makes it possible to use for the deposit other kinds of material; in fact, any material capable of being fluidly injected and subsequently solidified could be an alternative.

Direct Energy Deposition (DED) is another class of additive manufacturing. While powder bed methods were characterized by the fact that the powered material was spread on a platform and in certain points it was melted by a heat source, directed energy deposition additive manufacturing systems use a nozzle mounted on a multi-axis arm to put the material on a base or component, then this material is melted. Four or five-axis systems move both the nozzle and the base at the same time, independently from each other, this gives the opportunity to build more complex geometric shapes. Because of this aspect, a flat starting surface is not compulsory, so this technique is particularly appropriate to add new material to existing parts or repair components. In fact, the new material can be directly deposited on the damaged parts.

- Laser Engineered Net Shape (LENS) is a technique that permits to fabricate metal parts thanks to the direct deposit of melted metal powder. A deposition head provides the metal powder, relying on gravity or pressurized gas; the powder is later melted by a high-power laser. Typically, the laser beam is focused through the center of the supply head. The table onto which the object is printed moves horizontally to create the desired pattern of the layer and when complete, the deposition head moves vertically to generate the next layer. The process takes place in a controlled atmosphere of inert gas (argon) and no oxygen in order to improve

layer adhesion and to control the product properties. In contrast to Selective Laser Melting technology, the metal powder is only applied where required.

- Electron Beam Additive Manufacturing (EBAM) is a technology that differs from Laser Engineering Net Shape because an electron beam gun is used to produce a molten metal puddle and another metal material is fed into that pool. The substrate plate moves the item in order to make it possible for the machine to add material just where it is needed and the deposit solidifies immediately after being separated from the heat source of the electron beam. This sequence is repeated layer by layer until the creation of the desired 3D object is finished. This process also requires a vacuum environment, without the need for inert gases.

Thirdly, we have Vat Photopolymerization. All types of vat photopolymerization use as material special resins called “photopolymers”; the liquid photopolymers' molecules are quickly bound together when they are exposed to certain wavelengths of light. The process through which we obtain this solid state is called “photopolymerization”. Generally, this kind of 3D printers is characterized by the fact that the liquid photopolymer is held in a container or vat, whereas the build platform tends to be partially immersed under the surface of the liquid. The printer directs the light source following the inputs delivered by a CAD file. After the solidification, the build platform is immersed again in the rest of the resin and each step is repeated until the layers are finished and the items have been fully created.

Vat photopolymerization is recognized as a fast and accurate additive manufacturing process that can be used to print large models and prototypes according to the possibilities afforded by the size of the specific vat and build platform. Nevertheless, photopolymers do not have robust structural characteristics, so the items build with this technique are naturally more disposed to degradation and deformation over time. Furthermore, the objects sometimes need special treatments or supplementary tooling, it depends on which process and polymers are used. These considerations tend to make vat photopolymerization excessively expensive for some applications.

- Stereolithography (SLA) is a technology where the build platform is submerged into a vat, filled with a liquid resin. An ultraviolet laser solidifies this resin because the light makes the chains of molecules linked together, creating solid polymers that form the first layer of the desired 3D object. To create the other planned layers, the build platform is either lowered or raised slightly, it depends on the machine used. If the item is created from the bottom up, thus raising the platform, only the photopolymer needed to keep the bottom of the build vat continually filled is required, so bigger volumes can be produced. This technique needs

support structures to avoid deflection due to gravity and to let the newly formed layers to attach firmly to the pre-existing structure. In the end, the final item is submerged in a chemical bath to eliminate the remaining resin in excess and it is later relocated to an ultraviolet oven in order to complete the curing process. Only afterward the support structures can be removed.

- Digital Light Processing (DLP) is a technique similar to Stereolithography, however, it uses a projector light to solidify the liquid resin instead of a laser. This digital projector displays at once a single image on the entire platform and layer. The solidified pattern is composed of square pixels because of the digital screen of the projector, so the layer is characterized by small rectangular bricks. The build platform moves for each layer until the end. The item can either be raised out of the resin, leaving a narrow space at the bottom of the container for uncured resin or it can be immersed in a vat of liquid resin. In any case, when the 3D object is finished, it has to be subjected to post-processing to eliminate the required support material.

- Continuous Digital Light Processing (CDLP) is a technique also referred to as CLIP, "Continuous Liquid Interface Production". The build platform is in contact with a liquid photopolymer resin in a vat. Part of the base of this vat, the "window", is transparent to ultraviolet light and a digital light projector forms an uninterrupted sequence of ultraviolet images that pass through this window and solidify the resin. The resin does not get attached to the window because the pool of resin is situated on an oxygen-permeable membrane, which forms a dead zone. This technique differentiating characteristic, compared to other additive manufacturing technologies, is that the platform is elevated continuously and the new resin flows under the item that is being created. Essentially, the exposure to the UV light, replenishment of the resin and the raising movement of the item happen simultaneously.

In addition, there is Material Jetting (MJ), a process that consists of expelling thin layers of liquid photopolymer with a nozzle, which moves horizontally over a build platform, where the desired item is formed. Drops of material are dropped following the 3D design data and the polymer is solidified with an ultraviolet lamp immediately. The build platform is lowered for each layer. For some intricate geometries and extensions, it is necessary to add support material, the machine jets a different, gel-like material. In the end, when the items are completed, this support material is eliminated with water or a solution bath.

- Nanoparticle Jetting (NJ) is a technique that uses ink-jet technology to create metal parts from material in liquid form. The liquid material is composed of metal nanoparticles, which are

suspended in a liquid prior and later released on a build platform in small drops with the ink-jet nozzle. Both metal and support material are placed onto the build platform, where the heat from its surface breaks the suspension and the metal pieces are melded together. The material is usually held in sealed containers, easily inserted in the machine, thus eliminating the need to handle metal powders. Sometimes support material is needed, but it is easily removed at the end.

- Drop on Demand (DoD) is a technique similar to material jetting. The difference is that there is not a constant stream of material, it is only deposited when necessary. The droplets of material are placed by a nozzle when a thermal or piezoelectric actuator generates pressure. The material solidifies directly when it deposits and the desired 3D item is formed in this way, layer by layer, until the end. If support material is needed, the final object is immersed in a warm liquid solution to dissolve it.

Then, there is Laminated Object Manufacturing (LOM), which uses rolls of adhesive-coated material. The material is used in the form of sheet, these tapes are sprayed with a solvent and then stacked. The solvent acts as an adhesive, bonding them together. A heated roller is passed over the sheet of material, melting its adhesive and then the material is moved to the build platform. The designated shape of the desired item is cut using a laser or a blade, whereas crosshatches are drawn on the rest of the surface to simplify the extraction of the material in excess at the end. As the sheet is pressed on the platform, it is glued to the previous layer and the process continues with the platform being lowered until the item is completed.

Finally, we should briefly explain Binder Jetting (BJ) too. It is a process that uses a thin layer of powder material spread over a build platform. A binding agent is directly deposited by a print head on the layer in the pattern guided by the computer data. Thus, the powder is bound together. In short, the process is quite similar to Selective Laser Sintering, however a binding agent is used rather than a sintering laser. Complex shapes can be formed due to the fact that the unused powder remains around the object, supporting it until the end. This remaining powder is removed later and the final item is usually coated with an adhesive glue to improve its mechanical and structural properties. *(D. S. González & A. G. Álvarez, 2018)*

1.5.2 Artificial Intelligence

The term Artificial Intelligence can have different meanings. We assume it refers to creating computers or machines somewhat intelligent, but it is not clear what we intend by talking about "intelligence". In 1950, Alan Turing was the first person that asked himself whether machines could think, even if, at that time, only the first computers were being built. The term "Artificial Intelligence" would be later coined in 1956 John McCarthy, who is usually considered the father of AI. He did so when he participated in a conference on the campus of Dartmouth College, an event that represented the beginning of AI research, led primarily by the attendees and John McCarthy himself for many decades. According to McCarthy's definition, Artificial Intelligence is "the science and engineering of making intelligent machines". *(Noel Sharkey, 2012)*

During the years, there have been many different definitions, but most of them can be classified into the following four categories:

- systems that think like humans
- systems that act like humans
- systems that think rationally
- systems that act rationally

Thus, the definitions vary because, generally, they differentiate between two aspects. AI is seen as a way of thinking or a way to act and AI aiming to imitate the behavior of human beings or strive for rationality. *(Kok, Boers, Kosters, van der Putten & Poel, 2016)*

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Artificial Intelligence includes different techniques:

- Natural Language Processing (NLP). Deep machine learning makes it possible for machines to recognize, process and react to speech-based commands. This is the type of artificial

intelligence used for providing Virtual assistants, an increasingly common addition in businesses.

- Expert Systems, the imitation of human experts
- Planning and Optimization
- Robotics. Robots were already used in manufacturing, logistics and warehousing, however, the artificial intelligence makes them autonomous and this is a significant difference.
- Vision, which includes Image Recognition and Machine Vision
- Speech, that can indicate the translation from speech to text or from text to speech
- Machine Learning, which refers to the automated detection of meaningful patterns in data. People encounter machine learning without even realizing it. For example, personal smartphone assistants use them as well as search engines like Google and Chrome. Person assistant devices use machine learning to gather and polish information, they study previous interactions to reach results tailored to the users' personal preferences. Whereas, search engines use machine learning to improve users' search results. Every time people execute research, algorithms at the back-end monitor and process their response to the results showed.

Machine Learning, in particular, is now frequently used. It is a common tool in almost any task that entails information extraction from large data sets. Examples of technology based on machine learning are the way in which:

- search engines learn how to show the best results, while placing profitable ads
- an anti-spam software learns to filter email messages
- credit card transactions are secured by a software that learns how to detect frauds
- digital cameras learn to detect faces
- intelligent personal assistance applications on smart-phones learn to recognize voice commands

These are just some of the possible uses now commonly employed by companies in their goods and services, whose technical characteristics are not recognized by people desensitized to technology.
Machine learning tools focus on trying to endow programs with the ability to learn and adapt, in the same way in which human's skills or abilities are learned through experience, rather than following explicit instructions. This is necessary because the complexity inherent in these applications, which have to detect a wide set of patterns, makes it impossible for a human programmer to provide explicit and detailed directions on how the tasks have to be executed. In any case, AI and Cognitive automation AI-powered chat-bots have demonstrated provide an instant service support function for

customers enabling conversations across apps, online and SMS and instant messaging. AI is improving decision-making capabilities and providing support staff with complex information immediately at their fingertips. *(Shai Shalev-Shwartz & Shai Ben-David, 2014)*

1.5.2.1 Robotics

The co-founder, president and chief technology officer of Rethink Robotics, Rodney Brooks, did an interview with McKinsey, in which he described his thoughts regarding the robot revolution. He declared that its potential has not yet been fully realized, that the robot revolution has only just begun. According to him, in the future there will be a diffusion of the use of robots because things have changed, the technology has much improved and its cost is not prohibitory high anymore. He believes that robots will probably start to be used not only in manufacturing, but also in other fields, such as the service sector.

Over the last 50 years, when people spoke about robots they referred to the industrial robots common in factories. These robots are known as being able to go repetitively through a series of motions, executing the same tasks with outstanding precision. These are the kinds of robots, however, that were introduced with the third industrial revolution. Basically, they operate in the same way they did then, when computation and sensor were exceedingly expensive. Considering that, as we have explained in paragraph 1.5, nowadays the cost of technologies declined substantially, so companies need less money to invest in technologies like robots, computing power and technological capabilities increased immensely. In fact, now it is possible to have a system capable of real-time 3-D sensing, thanks to the right computation as well as robots that can interact properly with people, due to a sufficient understanding of human-computer and robot-computer interactions. The revolution consists in the fact that an ordinary person, not capable of programming, is able to interact with a robot and make it learn to do something useful.

When robots were introduced in the third industrial revolution, they had to be shown a trajectory. Then, they were only able to follow that trajectory, they did so very accurately but it is still a very limited skill compared to their current learning capabilities. Nevertheless, this old method is exactly how the vast majority of industrial robots still present in factories today are programmed.

The new robots have a lot of built-in software that contains a striking amount of common-sense knowledge. For example, the robot knows on its own that if it does not have anything in its hand, it cannot put anything down. Thus, any ordinary factory worker can make the robot execute complex

tasks, without the need to know programming. In practice, the learning process is easy to implement for the workers that have no idea of how to build robots or how they work. Employees simply have to show robots the objects and what to do with them, the robot is then able to extrapolate on its own and understand the implications.

Let's analyze now the reason why this learning process is possible, step by step. When the factory employees want the robot to do something new, they have to grab its arm and move it over an object. There's a camera on the arm; the camera captures the image of the object and shows it to the robot. In this way, the robot learns how the object looks by moving them around. For example, the robots could bring it down or press close their fingers over it. The purpose is studying it from various angles and memorizing its appearance. With this method, it is sufficient for employees to show the robot the things it has to use, where to pick them up, where to put them etc. The robot is capable of putting all the information together and do the new task by itself afterward.

Rodney Brooks underlines that he firmly believes that manufacturing will definitely experience a radical change. Nowadays, manufacturing happens halfway across the world compared to where the goods produced are consumed. However, now it is possible to transport the CAD systems, which contain all the information on what and how the object needs to be manufactured, around the network of a business. We can easily imagine a future in which companies responsible for the design stuff will only sell the CAD package, which would be later bought and produced by local suppliers.

Furthermore, if we consider how changing demographics causes a growing difficulty in finding the labor for the service sector, it is evident that there is a problem and a solution must be found. Our society is based on a service economy and a lack of people willing to do service jobs is worrying. Robots could represent the solution for making the service economy continue to grow anyway. It is a matter of creating an intelligent system, capable of sensing, computation and mechanical actuation in the world, which can accomplish tasks previously reserved to people. According to Rodney Brooks, it is conceivable. Cleaning robots already exist, making them do something different like getting things into or out of cars, up or downstairs, into or out a house and other simple tasks is surely plausible. *(R. Brooks & M. Chui, 2014).*

1.5.3 Augmented and Virtual Reality

Virtual and Augmented reality are other technologies that are becoming more commonly used in order to provide immersive experiences for employees and customers. Virtual Reality consists of using a computer to visually simulate an artificial environment where users can interact with objects

and be fully immersed. While, on the other hand, AR creates in real-time a digital overlay of information over physical elements. For example, enriching the real and visible environment adding extra information. The capacity for immersion with Augmented Reality is lower compared to virtual, however, it is in some cases preferable. In many professional contexts, in fact, it would not be advisable to employ Virtual Reality because users should not be completely isolated from the real environment.

Moreover, another option is the Mixed Reality, characterized by merging the real and virtual worlds. Thanks to this technology, virtual objects are "anchored" to the real environment, instead of being overlaid. Consequently, the level of immersion tends to be higher compared to Augmented Reality and lower compared to Virtual Reality. In truth, though, the differences between Mixed Reality and Augmented Reality technologies have been difficult to determine precisely. Therefore, the term Augmented Reality usually I the one that is used primarily to indicate also Mixed Reality. *(L. Probst, B. Pedersen & L. Dakkak-Arnoux PwC, 2017).*

Augmented and Virtual Reality technologies can be used to train the employees in a business because they permit a better interaction between humans and machines. The possibilities in practice are multiple. For example, they can help in improving the speed needed to reconfigure production lines, in supporting shop-floor operators, explaining how to assemble parts, improving warehouse efficiently, minimizing risks and so on. Their implementation in manufacturing has been tested successfully in various industries and the way in which they create the opportunity to interact in an innovative way with workers, the working environment, the entire business and the clients have been amply proved. *(L. Damiani, M. Demartini, G. Guizzi, R. Revetria & F. Tonelli, 2018)*

CHAPTER II

2.1 The necessity of continuous innovation

We have seen in Chapter I how Digital technology and Industry 4.0 have substantial repercussions on businesses. In some instances, the threat of digital disruption has pushed companies to reinvent their business strategy with optimal results. Whereas, in other cases, it has threatened or end companies' existence. It is essential to realize that even businesses who are at the head of digital disruption are forced to continuously reinvent and transform themselves and their businesses in order to continue to excel and not be surpassed.

The danger presented by the threat of digital disruption is not solved with a single digital transformation. Reinventing a business once or being a digital disruptor does not protect businesses from being disrupted by other new entrants or competitors in the future. The only way to avoid being overcome is by respecting a strategy centered on continuous innovation. The same is true for the implementation of Industry 4.0 technologies. Their adaptation has a significant impact on the companies' corporates strategies, on their efficiency in production, development, transportation and so on, as well as in the customer experiences that they are able to offer to their clients. Attract more clients increases revenues and technologies decrease costs, so profits increase. However, paying attention to every innovation or, better yet, trying to lead the innovation is the best way to maintain always an advantage.

Implementing only once an innovative technology and then returning to stagnancy, means embracing the high possibility of being surpassed in any case by more attentive competitors. This is why, as we will see, leading successful companies like Amazon continue to invest in innovative solutions by taking risks. We shall now observe, in general, the consequences of undervaluing the importance of changes in companies and then, in the following paragraphs of this chapter we will analyze the impact of Industry 4.0 in the Supply Chain and in the Customer Experience that firms offer to their clients in detail.

The first business case is Netflix, which is an example of how it is not sufficient to reinvent a business only once in order to remain competitive. The company is now delving into advanced hyper-personalization thanks to interactive technology, however, it could prove not to be sufficient. Another business case is Blockbuster, which lost its dominance in the media entertainment industry after failing to focus and take seriously its competitors. Finally, we shall talk about Amazon. This is a company that is always looking at the future and making long-term plans. Nowadays, its constant

attempt to improve has naturally pushed it into experimenting with the implementation of various Industry 4.0 technologies, but we will examine this aspect afterward, in paragraph 2.3.1.

2.1.1 Business case: Netflix

Netflix is an Internet subscription service company, which provides subscription service streaming movies and TV episodes over the Internet and sending DVDs by mail. In 1997, Reed Hastings and the software executive Marc Randolph co-founded the company to offer online movie rentals. The following year, Netflix launched also netflix.com, the first DVD rental and sales site. Then, in 1999 the company began to offer a subscription service, which consisted of having unlimited access to DVD rentals after paying a single low monthly fee. In 2000, Netflix decided to strengthen this service by adding to the website a personalized movie recommendation system, which accurately predicted users' preferences thanks to the ratings they gave to the content visualized.

In 2002, Netflix made its initial public offering. The company was enjoying a period of growth, in fact, the following year its users increased to 4.2 million. Streaming was introduced in 2007, it allowed clients to instantly watch television shows and movies on their personal computers. Then, in 2008, Netflix concluded partnerships with consumer electronics companies, in order to stream also on the Xbox 360, Blu-ray disc players and TV set-top boxes. The following year, the company did the same with consumer electronics companies, in order to stream on the PS3, Internet-connected TVs and other Internet-connected devices. Finally, Netflix became available on the Apple iPad, iPhone and iPod Touch and the Nintendo Wii from 2010.

In 2010, the firm launched its service in Canada. The following year in Latin America and the Caribbean and it arrived to Europe in 2012, where it continued to expand later on. Then, in 2013, the firm launched for the first time original content, such as programs like "House of Cards", "Hemlock Grove", "Arrested Development" and "Orange is the New Black". It is in 2016 that Netflix finally became available worldwide, covering 190 total countries. And in 2017, the firm registered 100 million customers globally. *(Netflix official website, 2019).*

Basically, Netflix started by being only a DVD-by-mail company and, according to a CNN article, it still is one for 2.7 million subscribers in the USA. The company earned $212 million profit last year only from this service. This is linked to various reasons. Firstly, Streaming Netflix video requires a lot of bandwidth, Netflix consumes 15% of all USA internet bandwidth, according to a 2018 industry report. Many rural areas in the United States, however, have no broadband access. While the Federal Communications Commission estimates that 24 million American citizens are in this category, the

US Postal Service can assure the mailing service. The second reason is that Netflix's mailing service is convenient and offers a great range of selection options. The online streaming service is quite limited compared to approximately 100,000 DVDs.

The problem, however, that Netflix could face concerns the content itself due to the fact that everything is covered by copyright law. While Netflix's DVD library remains the same, Movies and TV shows can vanish from streaming services depending on licensing deals and Netflix competitors, like Disney, do not want to share their content or ask for an enormous quantity of money to do so. There is no reason why they should, considering that they could easily create their own streaming service. For example, WarnerMedia reportedly billed Netflix $100 million for the episodes of "Friends." Moreover, recent movies that won the Oscar may not be immediately available on streaming, however, they can be rented. In fact, movie studios try to earn as much as possible thanks to DVD sales and rental fees, before allowing them to appear on streaming services. *(N. Monahan & B. Griggs, 2019).*

As we can observe, Netflix has to carefully manage its available content, its costs and its competition to achieve its customer experience objectives. Originally, its content was largely based on English production, but now due to the firm’s dubbing and subtitling initiatives, it offers additional local content. Furthermore, there are a lot of shows in development with local talent and themes. To control costs, the company has organized a wide network of local cable operators and distributors to optimize marketing efforts in localities where its brand and content are not as popular as in the USA.

Netflix is now focusing on how to remain competitive compared to Sky, Amazon etc. The company is currently continuing its experiments in advanced hyper-personalization thanks to interactive technology. Creating story branching options, Netflix aimed to create content controllable by the viewer, who is able to select among options and influence the plot of the story. An interesting idea, that’s for certain. It will, however, remain to be seen if it is sufficient in order not to lose shares of the market. The idea to innovate their original DVDs business has been plenty successful and it gifted to the company a lot of notoriety. Still, it is not enough to reinvent the business once, we shall see if the firm will manage to achieve other significant innovations or succumb to and be outpaced by the competition. *(J. J. Hernandez, D. Conway & T. Knight, 2018).*

2.1.2 Business Case: Blockbuster

Blockbuster opened its first store in Texas, when the company was founded in 1985 by David Cook, a computer programmer. Blockbuster’s early success was due to his background. In fact, Cook

programmed Blockbuster's computers to track inventory and consumer preferences and, thanks to the resulting customization of store selection according to local neighborhoods, the firm flourished because of its ability to provide the films that clients wanted in each store.

The company grew quickly with the help of Wayne Huizenga, founder of WasteManagement, who thought that Blockbuster had immense potential and purchased a controlling interest in the firm with two colleagues in 1987 for $18 million. He steered the company through various acquisitions. In one year, from owning only eight stores and eleven franchised ones, Blockbuster become the largest video chain in the world in 1988 and in 1991 it owned 1,654 stores only in the United States. Blockbuster expansion strategy continued and it relied on buying out video and music chain competitors, such as Erol, Sound Warehouse, and Music Plus.

After Huizenga, the company was purchased by Viacom for $8.4 billion. However, it began to faltered with this change in management and in 1996 it had lost half of its original value. Viacom's choice had been to try and use Blockbuster stores as outlets for Paramount and MTV merchandise, books, toys, and selected clothing, instead of prioritizing the rent of movies. In 1996, Blockbuster Entertainment Corporation was renamed Blockbuster, Inc. and the name of retail stores changed from Blockbuster Video to simply Blockbuster.

In 1997, Jim Antioco became the CEO until 2007. He refocused on its video rental business and profits were increasing again. However, Blockbuster made numerous mistakes regarding new media and new competitors, because the firm was not able to respond to the new challenges in the industry. These were the years in which Internet and subscription services emerged, in direct competition compared to Blockbuster's traditional video rental business and damaging the dominance that the firm had enjoyed in the sector until then. Netflix, with his DVD by-mail subscription service, was the best-known new competitor.

As we have seen, Netflix asked his clients a simple flat monthly fee and, in addition, it did not charge any late fee. On the other hand, Blockbuster persisted in charging late fees and it also began to ask for a monthly fee. The company finally began to try and compete with a by-mail subscription service in 2004, but it was too late and Netflix had already absorbed a large part of its customer base. Later that year, Blockbuster decided to discontinue its late fee program but the situation was worsened by the fact that the management decided to focus on expanding into the videogame rental market, instead of continuing to pay attention to video rental competitors like Netflix.

In 2007, John Antioco was replaced as CEO by Jim Keyes, who had been elected with the approval of Carl Icahn. Icahn had gambled on an acquisition deal of Blockbuster with another company,

because he owned many shares of both. The acquisition failed and he reacted by pushing for a restrain on costs for Blockbuster Online and restoring late fees. Both decisions were firmly contested by Antioco, but when Ichan managed to substitute him, the new CEO gladly approved the cuts and the value of shares temporarily increased. As a consequence, though, after a few years, Blockbuster filed bankruptcy.

From this analysis, we can observe the various stages of the company, but let's observe more details. Blockbuster Business Model originally relied on its retail channels. Then, in 2009, Blockbuster launched BLOCKBUSTER Express® with NCR Corporation ("NCR"). BLOCKBUSTER Express® used branded vending kiosks to compete directly with a competitor that used the same method to rent movies. Moreover, Blockbuster finally made its products available through the mail and digital distribution channels.

In order to help improve the digital channel, Blockbuster purchased Movielink from a consortium of movie studios in 2007. Thanks to this decision, the website gave customers the opportunity to download the movies they preferred on their personal computers. The firm also formed partnerships with third-party consumer electronics device developers to digitally deliver media entertainment to clients through devices like Internet-connected televisions.

Jeffery Stegenga, Chief Restructuring Officer of Blockbuster, attributed the firm failure to five key events:

- Competition increased considerably in the entire media entertainment industry;
- Technological advances altered the landscape of the industry;
- Consumers' preferences changed;
- Disruptive new competitors grew quickly;
- The general economic environment was not favorable.

From this information, evidently, Blockbuster became aware of the fact that its original set-up based on stores and inventory efficiency was not competitive anymore in the twenty-first century. However, despite its attempt to use new retail channels, the company continued to struggle against its competitors. This was due in part to a lack of focus and to a late start in considering seriously the new competition in the industry, however, the mortal wound was due to the final change in management. When the new CEO blindly reversed all the late innovation that had let the firm continue to float in the market, the situation declined rapidly and it was not surprising that Blockbuster ended up filing for bankruptcy protection. Its real failure seems to be a lack of innovation. The firm was not able to

reinvent its business in order to react to the changing reality and its initial success in the industry rapidly turned to dust as a consequence. *(T. Davis & J. Higgins, 2013)*

2.1.3 Business case: Amazon

In 1994, Jeffrey Bezos changed the book-selling industry by creating the first virtual bookseller Amazon.com online. The idea, however, rapidly began to be expanded over the years and Amazon arrived to sell basically everything. Due to its impressive growth, it is currently one of the most valuable companies in the world.

In order to grow, Amazon continually transformed and improved itself. It has not only expanded its core business by selling other products, from electronics to fashion to groceries; the company also explored new business areas and developed new technologies as we will see in paragraph 2.3.1. In 2005, Amazon Prime was introduced, in 2007 Amazon Music and Amazon Kindle. These are just some of the projects that the firm successfully concluded. It is threatening other businesses like Netflix and TV networks and it has become a leader in cloud services. In 2014 Amazon also introduced the first smart speaker to select customers, Echo. The Echo is the platform for Alexa, Amazon's virtual personal assistant, and therefore the key to a wealth of consumer data and purchasing decisions. *(L. DePillis & I. Sherman, 2018)*

As we have seen, the most important point to remember regarding digital transformation is that resisting innovation is always a bad choice. Amazon's strategy has always been pushing for innovation, instead of resisting it, and it has indeed resulted in a lot of profits. Obviously, some of the innovations introduced by the firm failed, such as Amazon's smartphone Fire, but many others were celebrated. Amazon often took risks and it has developed the ability and willingness to not only go beyond its own core business but also potentially cannibalize parts of itself. For example, Amazon's Kindle mined its original focus on book-selling and, in fact, in 2010 e-books outsold hardcover books. However, another firm would have done the same had Amazon not introduced the Kindle.

"As a company grows, everything needs to scale, including the size of your failed experiments. If the size of your failures isn't growing, you're not going to be inventing at a size that can actually move the needle. Amazon will be experimenting at the right scale for a company of our size if we occasionally have multibillion-dollar failures. Of course, we won't undertake such experiments cavalierly. We will work hard to make them good bets, but not all good bets will ultimately payout.

This kind of large-scale risk-taking is part of the service we as a large company can provide to our customers and to society. The good news for shareowners is that a single big winning bet can more than cover the cost of many losers. Development of the Fire phone and Echo was started around the same time. While the Fire phone was a failure, we were able to take our learnings (as well as the developers) and accelerate our efforts building Echo and Alexa."

(Cit. Jeffrey Bezos, 2018 letter to shareholders)

In the 2018 letter to Shareholders, Jeffrey Bezos described another good example: the reason why Amazon decided to open its first offline store and how the firm proceeded in order to differentiate its service from traditional ones. The decision was due to the fact that nowadays nearly 90% of retail remains offline and, in comparison, Amazon currently remains a small player in global retail. After considering for many years how to offer customers a good and innovative service in physical stores, Amazon finally managed to invent something that would enhance the customer experience and decided to open one. The idea was given a name, Amazon Go, and the vision was clear: eliminating checkout lines, the worst thing about physical retail. Instead of forcing clients to wait in line, Amazon created a store where they could simply take what they wanted and leave. Certainly, the implementation of this project was technically very difficult, however, thanks to computer scientists and engineers, it was a success. Amazon designed and built its own proprietary cameras and shelves and invented new computer vision algorithms. It was necessary to stitch together imagery from hundreds of cooperating cameras and the technology had to work so well as to recede into the background and be invisible. *(Amazon Report 2018)*

The lesson from this business case is noticing how the key to success is continuing to innovate continuously, instead of waiting for competitors to do it. By surpassing and reinventing its business activity, a firm may be able to maintain a competitive advantage and not be outdone easily.

2.2 Industries Reaction to Digital Disruption

It is known that incumbents, as established companies, have sometimes reacted aggressively to digital disruption in some industries and tried to use legal measures and regulatory influence to respond to the challenges and threats it represented. The common reactions seem to be blocking innovation by having it declared illegal or altogether ignore the danger posed by it. The incumbents seem content to ignore the disruption threat if they feel confident due to their size, if there is a pre-existing

regulation or if they believe in customer inertia. Alternatively, when incumbents perceive the new entrants as a significant threat, they tend to react viciously.

Nowadays, with Industry 4.0, innovation is due to new technologies that are possible to the research conducted over time since the last industrial revolution, as we have explained in Chapter I. These often are more efficient and create a significant advantage for companies that decide to adopt them properly. It is improbable that these technologies could be declared illegal, except for when there is a security issue to consider, as we will see with drones and similar inventions. Still, only some way in which technologies like Artificial Intelligence may be applied could potentially be prohibited, however, the technologies themselves are not at risk.

This is indeed fortunate because as mentioned above the traditional responses of incumbents to disruption are often legal. Instead of focusing on leveraging new technologies opportunities to drive improvements in their own businesses, established companies tend to prefer to avoid it. We will now discuss general cases again, which do not concern Industry 4.0 technologies. Still, it is important to highlight that, when it is possible, competitors prefer to focus on legally blocking innovators and that such circumstances are also possible for some applications that include the use of Industry 4.0 technologies.

For example, Peer-to-peer lending pioneers like Prosper, LendingClub and OnDeck are challenging some of the traditional functions of the banking industry. LendingClub issued over $9 billion in loans in 2016, but received very little attention from the banking industry since it began its operations in 2009. On the other hand, we have the business case of Aereo, which was a New York City-based firm that developed technologies. This company allowed users to access over-the-air (OTA) HD programs on their internet-connected devices, using a miniature antenna that subscribers rented for a small monthly fee. American broadcast companies believed that Aereo was a considerable threat and decided to battle it in court. After a series of court rulings in favor of Aereo, the US Supreme Court ruled against the company for violating copyright laws and Aereo was forced to stop.

In the following paragraph, we shall examine Uber's situation. The various attempt to legally block the company's activities had different results depending on the countries considered. It is a very good example to analyze how regulation can be used to prevent innovation, even if it has evident benefits. In the end, it is the level of influence of the incumbents in the industries threatened that makes a true difference.

2.2.1 Business Case: Uber

Uber is simply an app that connects drivers with riders. The original idea was creating the possibility of requesting a ride by tapping a smartphone. This inspiration came to Travis Kalanick and Garrett Camp, when they got stuck in Paris on a snowy evening and were unable to find a taxi and the company launched in 2009.

Uber CEO, Khosrowshahi, had enough expertise to begin a new company, due to his previous position as CEO of online travel company Expedia. The firm now operates in 65 countries, with a main headquarter in San Francisco and major offices in London, Sao Paulo, Mexico City and Amsterdam. It is possible to request a Uber ride in more than 600 cities in the world. Moreover, the company is planning to introduce also air transport with the "UberElevate" project. Instead of being limited to urban transport, this project would permit the firm to offer rides with a vertical take-off and landing aircraft, briefly "VTOL ". This would certainly reduce commuting time and guarantee rapid and dependable links between the suburbs and the city, significantly decreasing distances from hours to mere minutes.

The application is really easy to use, which explains its popularity. The first step is requesting a ride. Then, there is an Uber driver profile, which gives clients all the information they want on the driver that accepts their request for a ride. It provides a name and a photo, so customers can recognize the driver, as wells as details on the vehicle, such as the model and the license plate. In this manner, clients can be sure of getting in the right vehicle for their Uber ride and there are no problems, everything is sure and comfortable. Moreover, customers can read the review of previous clients, such as compliments and ratings and know how experienced their drivers are.

Uber has done everything possible to make the whole process simple. It is also possible to change the pick-up location. It is sufficient to tap on the originally agreed pick-up location on the map screen on the phone and write a new location or drag the pin that signals the client's location to a new spot and directly set another pick-up location. Any change is shown immediately as an update on the driver's app. In addition, in order to avoid difficulties in meeting, there are in the "add pick-up notes" option, which lets clients give the driver extra details ahead of time. Information like how to be recognized on a busy street and so on. *(Uber official website, 2019).*

Due to its simplicity, the app quickly became a favorite alternative for customers. Therefore, Uber began to pose a serious threat to the taxi industry. It started in 2014 in New York and then the problem spread as the app began to be used and gained popularity in other cities. Consequently, it has faced

considerable continuous opposition in most of the cities in which its services have been launched and this opposition against Uber was sometimes supported by the help of regulators.

Nowadays, Uber is able to operate legally in a growing number of countries and cities but not all of the attempted ones. In fact, regulatory approval has proved to be elusive in some jurisdictions. In some regions or cities, Uber decided to launch its services despite the absence of regulatory approval, engaging in "spontaneous liberalization". This choice has been criticized from different points of view. Some declare that there is no justification for ignoring rules that are necessary to protect the services' users and non-users from the risks that are inherent when carrying passengers on public roads, while others think that there is an element of public good in testing the boundaries of restrictions regarding the competition.

Uber had such an impact on society because it was a disruptor in an industry populated by players that had usually become complacent and failed to meet clients' expectations. The various struggles with different transportation authorities around the world were due to the fact that Uber does not fit into the legal regimes that regulate traditional taxi services. An industry heavily regulated and with barriers to entry, such as a limited number of taxis allowed to operate in a given city.

Uber and similar other online platforms have triggered massive protests from taxi companies and their drivers because they claim it represents "unfair competition". They are accused of not having to comply with the regulatory requirements that weight down traditional taxi companies. Consequently, in several jurisdictions, taxi companies and associations have tried to convince authorities to declare Uber's activities illegal with various degrees of success. Trade unions and left-leaning politicians are hostile to what they perceive as the Uberization of the economy because it would mean transforming theoretically good and well-paying jobs in precarious occupations. Obviously, though, the reality is not quite as positive as portrayed.

It is not hard to understand why consumers love Uber, it is evident. It offers rides considerably cheaper compared to taxis and the quality of the service itself tends to be higher. Clients also appreciate the simplicity of being able to book a vehicle using their smartphone and observe on the app the car approach, knowing exactly when the drivers will arrive without any doubt. The possibility to rate the drivers is also an incentive to assure politeness and safety during the driving service. Furthermore, payments are done electronically so there is no need to have cash and tips are not expected.

Overall, Uber is much more efficient, it reduces transaction costs, makes it possible to allocate resources, information and prices better. On the other hand, Taxi services are quite basic in nature.

Taxis move people from point A to point B for a fee. Taxis are typically driven by low-skilled workers that do not offer an elegant service. The industry is regulated to an astonishing extent and often the number of licensed vehicles and fares are significantly regulated. This high degree of regulation has been viewed as a burden by the industry but, at the same time, it has created barriers to entry, which let the industry fossilize. In fact, the taxi industry is characterized by an impressive lack of innovation

Considering all these points, it is truly unsurprising that Uber managed to rapidly conquer such a large customer base. It is undoubtable that there is unmet demand, however, the taxi industry has proved to be organized very well and it often managed to exert pressure on regulatory authorities in various countries and attempts to gain an authorization to launch Uber services have frequently not been successful.

As we have already mentioned, Uber has tried to launch its services without regulatory approval. In truth, it is difficult to determine if its services should be assimilated to traditional transportation services. After all, Uber is essentially a marketplace connecting occasional private people willing to give a ride to individuals for a small price in their free time and passengers seeking a ride that want to use software applications. Due to the nature of the service, it is unclear whether Uber should be subject to the same regulatory frameworks as the transportation industry.

On the other hand, the difficulty of successfully launching a two-sided platform has to be considered too. Uber probably resorted to expanding without regulatory approval because its platform had to gain scale as quickly as possible in order to be sustainable. It is necessary to draw users from both simultaneously. For example, imagine a situation in which Uber attracted a huge number of potential drivers, but only a few interest clients as passengers or vice-versa. It is easy to understand the choice to proceed after making these observations. Moreover, we should underline that, for Uber, the cost of having to terminate its operations in a country after a court ruling is not prohibitive, because the firm does not have to fire any worker and there is no infrastructure involved.

Considering that transportation services have considerable political weight, Uber probably also hopes that its clients will pressure the regulators to grant regulatory approval. A hope that has its basis in the fact that often clients learn to enjoy Uber obvious efficiencies, such as booking convenience, quality of service and lower costs, as we previously described and explained. People that had the opportunity to use this kind of service are unlikely to easily allow it to be discontinued. *(D. Geradin, 2015).*

2.3 Digital transformation of supply chains

Industry 4.0 takes innovation to another level. One of the consequences of the availability of these technologies is the creation of circumstances in which it has been favorable to rethink the way people design the supply chains. In fact, new technologies make possible higher levels of operational effectiveness. It is important to focus on how to leverage the emerging digital supply chain business models and understand how to create a digital supply chain. Supply Chain 4.0 is:

- Faster. New product distribution methods reduce considerably the delivery time. It is possible thanks to advanced forecasting approaches, such as predictive analytics of internal (e.g. demand) and external (e.g. market trends, weather, school vacation etc.) data. These Forecasts are done weekly or every day. In the future, it is feasible to imagine "predictive shipping", whose patent is already owned by Amazon. The idea is that products would be shipped before specific orders by customers. Individual orders would later be matched with the shipment that was already transporting that order towards the customer region, rerouting the good to the precise destination requested by the client. Thus, the delivery is more rapid because the product ordered was nearer to its final destination.

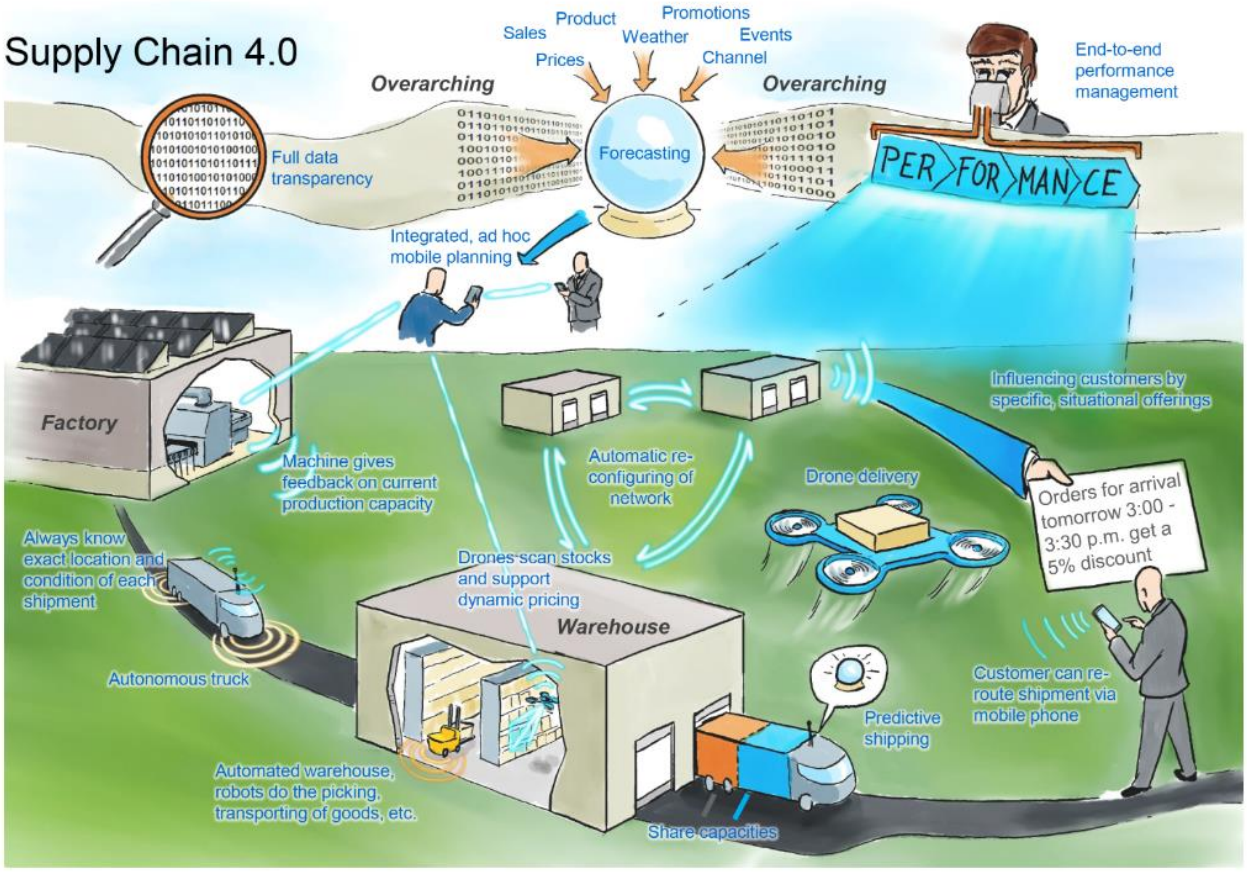
- More flexible. Due to real-time planning, a flexible reaction depending on changes in demand or supply is possible. Planning becomes a continuous process, which is able to react dynamically to changes or limitations, such as real-time production capacity feedback from machines. A significant improvement compared to the traditional planning cycles and frozen periods, now minimized. The increased flexibility also makes it possible for the firm to reroute shipments during the delivery processes, as described above. Among the new business models, there is also the Supply Chain seen as a Service. Instead of having resources and capabilities in-house, some companies could decide to pay for a supply chain service. The specialization and focus of service providers would allow the creation of economies of scale and economies of scope.

- More granular. Since customers tend to prefer more and more individualized goods, micro-segmentation and mass customization ideas seem to be the most suitable solution. Managing customers in more granular clusters and having an extensive spectrum of appropriate goods to offer would be the best way to respond to the growing demand for individualized products. In fact, this method would allow customers to choose among numerous "logistics menus" according to their preferences. Moreover, there are many new transport concepts, for example,

as drone delivery. These new methods allow firm to be efficient in handling single and high-value dense packages.

- More accurate. New performance management systems are able to assure real-time, end-to-end transparency throughout the entire supply chain. It is possible to share synthesized top-level KPIs like the overall service level, but also very granular process data, like the exact position of trucks in the network. An opportunity to make available joint information for all levels of seniority and functions in the supply chain of a business. In this way, by integrating all the data, all stakeholders are able to take decisions knowing simultaneously the same facts. Performance management systems will be able to "learn" to automatically recognize risks and they will adjust supply chain parameters accordingly in a closed-loop learning approach.

- More efficient. Due to the automation of physical tasks and planning, it is possible for the business to be more efficient. Robots handle boxes and similar items automatically in the warehouse process, by receiving them, unloading them, packing them and shipping them. Then, autonomous trucks transport the goods in the network.



Source: McKinsey

As we can see, Supply Chain 4.0 consists basically of implementing Internet of Things, using advanced robotics and leverage big data obtained with advanced analytics in supply chain management. The key is automate everything, place sensors everywhere, create networks and analyze all the resulting data to have a better performance and clients more satisfied. However, a component we should take into consideration is digital waste, which prevents supply chains from leveraging the potential of Supply Chain 4.0 if not avoided. There are three kinds of digital waste sources:

- Data capturing and management. Often, available data is collected in a system or handled using paper and so on and the information is not updated frequently. For example, in some cases, after receiving advanced shipping notifications in warehousing, the information is not used to optimize the inbound process.

- Integrated process optimization. Even in companies that have adopted these processes, frequently not all information is leveraged to reach the potentially best planning results. Moreover, in most companies like this, automatically determined planning or statistical forecast data is often manually overwritten by planners, an action that obviously has a negative impact on the final forecasting accuracy. The process optimization between companies has not reached its full potential, in order to leverage it properly internal organizational, governance, processes and incentives should be aligned between the different partners in the supply chain.

- Physical process execution of humans and machines. Warehouse operations could be optimized by using available data correctly. Allowing the real-time allocation of new orders and dynamic routing would create a big impact and there are also new opportunities to leverage for this purpose, such as wearables like Google Glass etc.

The potential impact of Supply Chain 4.0 is considerable. According to McKinsey research, its adoption could result in a few years in up to a thirty percent reduction of operational costs, a decrease of seventy-five percent in lost sales, a decrease of inventories by up to seventy-five percent and an increase in the overall nimbleness of the supply chains. Thus, eliminating the current digital waste and implementing new technologies would cause an improvement regarding the operational effectiveness of supply chains.

McKinsey reached these conclusions by studying various cases and quantitative calculations. The performance indicators are significantly correlated. A better inventory profile will result in an improved service level and lower cost. In fact, low customer service is generally caused by a false promise to clients, like unrealistic lead time, or a wrong inventory profile, which lets clients order goods that are not available in truth and so on. Lost sales occur when the required items are not available and customers consequently decide to prove another brand. Observations are valid both for business-to-customer and business-to-business cases. Moreover, it seems that a correct implementation of a supply chain can reduce costs, such as warehousing, transportation etc. by up to thirty percent. *(K. Alicke, J. Rachor & A. Seyfert, 2016)*

2.3.1 Business case: Amazon

Amazon is one of the companies that is continuously trying to improve its supply chain, therefore it is a perfect example for Supply Chain 4.0. In these years, the firm is experimenting with advanced robots and autonomous delivery services to improve its operations. We shall see now in detail what Amazon is actually doing in this regard.

Sean Scott was responsible at Amazon for making shopping and friction-free. Then, he invented Amazon Scout, an innovative and fully-electric delivery system ideated to safely get packages to clients using autonomous delivery devices. The devices were created by Amazon in the research and development lab in Seattle. They are quite small, they roll along sidewalks at a walking pace and they should be able to safely and efficiently navigate around pets, pedestrians and anything else in their path.

In January 2019, Scott wrote an article in which he announced that these devices were going to begin to deliver packages from that moment in a neighborhood in Snohomish County, Washington. The experiment started this year six Amazon Scout devices, which were responsible of delivering packages during the week at daylight hours. They are capable of autonomously following a delivery route, however, it was decided that at the beginning they were going to be accompanied by an Amazon employee. *(S. Scott, 2019)*

In August 2019, Scott wrote another article on Amazon's official web-site, in which he declared that over the previous months Amazon Scout had successfully delivered the packages as intended and that the initial experiment had had great results. The devices proved to be able to safely and autonomously navigate the many obstacles in the streets, such as trashcans, skateboards, lawn chairs, pedestrians

and so on. They also resisted changes in temperatures and climate, from rain to sun and heavy snowstorms.

Consequently, Scott announced in August with this article that Amazon was going to expand the ground of this experiment and begin to deliver packages with Amazon Scout also in Southern California. The project remains in field test mode at the firm, however, the potential of Amazon Scout as an autonomous delivery service is indisputable. The devices will continue to be tested and improved, in order to hopefully be introduced in the future as a well-established and commonly-used Amazon new delivery system. *(S. Scott, 2019)*

Moreover, in July 2016 Amazon had announced its partnership with the UK government to explore the safe use of drones for delivery. This is a project linked to Amazon Prime Air, which Amazon is conducting to develop an even more rapid delivery system, simultaneously safe, environmentally sound and capable of enhancing the company's services.

Amazon is implementing innovative technology by pioneering autonomous drone technology, in order to try to offer its clients even faster deliveries compared to the one-day service that they are able to assure nowadays. This is due to the fact that it is undeniable that customers are always looking for better services and more convenient options. Therefore, Amazon constantly tries to improve its already impressive delivering system that has been a success for years.

In 2019, in MARS Conference (Machine Learning, Automation, Robotics and Space) in Las Vegas, Amazon presented one of its Prime Air drone designs. The purpose had been trying to build fully electric drones, able to fly up to 15 miles and deliver packages under five pounds to clients in less than thirty minutes. The focus was on efficiency, stability and safety. This year, Amazon decided to formally request a FAA approval (Federal Aviation Administration) to begin to conduct commercial drone deliveries in the United States.

"When Amazon launched the Prime program in 2005, two-day delivery was the exception. This year we demonstrated our commitment to our customers by announcing our expansion of one-day delivery with Amazon Prime. We anticipate Prime Air will be the same type of game-changing service for our customers. Prime Air is driven by innovation, yet inspired by aviation tradition. We will always optimize for safety ahead of productivity, scale, or economics. We are deeply committed to working in lock-step with regulators, and will only proceed and scale when, together, we are fully satisfied that it is safe to do so. Granting this petition will serve the public interest, helping the

FAA gather data that will advance the future of UAS cargo delivery operations and the safe and efficient integration of UAS into the National Airspace System (NAS) more generally."

(Amazon Petition Letter for Exemption to the FAA. July 16, 2019. From page 1-2 out of 29)

The design of the drones is hybrid, the drone is able to do vertical takeoffs and landings, like a helicopter, and it is efficient and aerodynamic, like an airplane. It effortlessly transitions between the vertical-mode to airplane mode and vice-versa. Moreover, the drones are independently safe because Amazon decided to use the latest artificial intelligence (AI) technologies building them. It means that they are able to react independently to the unexpected. Whereas, normally, other drones would be unable to do the same, if they are autonomous but built relying simply on communications systems for situational awareness.

In transit to a destination, the drones are able to identify static and moving objects coming from any direction. For this purpose, Amazon used diverse sensors and advanced algorithms, such as multi-view stereo vision, in order to detect static objects and proprietary computer vision and machine learning algorithms, in order to detect moving objects. On the other hand, when the drone is approaching the ground to descend for delivery, it is able to find a small area around the delivery location that is clear of people, animals or obstacles by using explainable stereo vision and sophisticated AI algorithms skilled in detecting people and animals from above. Wire detection is one of the hardest challenges for low-altitude flights and it is fundamental because in the yard of clients there are clothes-lines, telephone wires or electrical wires etc. Amazon solved this issue by inventing and employing computer-vision techniques, which let drones recognize and avoid wires.

Finally, the potential environmental impact is considerable too. Prime Air is one of the many sustainability initiatives that Amazon is using to achieve its Shipment Zero objective. In fact, the company aims to make all Amazon shipments net-zero carbon, with 50% of all shipments net-zero by 2030. An electric drone, charged using sustainable means, is a vast improvement compared to traditional vehicles regarding emissions and energy efficiency topics. Moreover, not only this impact would be observable in the company's transportation solution for delivering, but also regarding clients' habits. In case of emergency, customers would be able to remain at home and request the delivery of a product immediately, without having to use their car to run to a store. The result would be a measurable decrease in fuel usage and emissions. *(J. Wilke, 2019).*

Another addition to Amazon's supply chain is the introduction of advanced robots. Amazon started using robotics after the acquisition of Boston-based Kiva Systems in 2012, now renamed Amazon

Robotics. As Amazon's second-largest acquisition at that time, it represented a strong signal of its future intention toward creating collaborative and automated environments with human workers and robots. Nowadays, the kinds of robots at Amazon are palletizers, robo-stows and drive units. Palletizers are robotic arms with grippers that are capable of recognizing and grabbing totes from conveyor belts and load them on pallets for shipping or stowing. The robo-stow is another type of robotic arm, which lifts pallets of inventory to different levels in fulfillment centers or puts them on drive units. The drive unit itself is a robot that transports packages around facilities.

M. Coyle, wrote an article in 2019 on this matter, describing the machines as "orange… about the size of a big suitcase". She was referring to the drive units, robots with conveyor belts on top and that look like mini treadmills. Amazon associates control them thanks to a software that monitors their activity.

"We will need to hire more people to help sustain the increased productivity levels. This is the chain reaction of job growth we strive for when designing robotic systems"

(Cit. Steve Campbell, director of Amazon Robotics Product Strategy)

The robots used by Amazon are small drive units designed to help the associates. Humans and robots work harmoniously together to manage faster shipping times, maximize inventory and maintain a lower cost for clients. For example, in the article we a statement of one of Amazon employees, Kachura, one of five flow control specialists at Amazon's Denver sortation center. In the sortation center packages from the company's fulfillment centers are sorted by zip code before being delivered. Kachura's job is managing inbound and outbound package volume and distribution. In order to do it, she and her team are supported by approximately eight hundred robotic drive units, which are responsible for the heavy lifting.

"We employ the same number of people now that we did before we had the robotics field. The robots just pick up the extra workload."

(Cit. Cathryn Kachura, control specialists at Amazon's Denver sortation center)

Amazon implemented drive units robots in 26 out of its 175 worldwide fulfillment centers. Presently, Amazon has 100,000 drive units in total as well as six robo-stows and 30 palletizers. Robotic automation has substituted human workers for certain tasks, however, this is true only for duties like carrying pods of inventory and transporting pallets through buildings. Overall, they only perform the less desirable and the dullest tasks.

Due to robots, it became possible to store forty percent more inventory. Having more inventory means it is less likely for items to run out, so it is easier to respond to clients' orders. Job creation is another of the benefits observed after their implementation. In fact, since 2012 Amazon has added more than 300,000 full-time jobs globally, regarding positions in IT, in servicing and in maintaining robots. Furthermore, the fulfillment centers with robots often need more employees because inventory is transported at a faster pace and extra associates are preferable. At the moment, the projects are successful and the company is planning to expand the presence of robots to other centers in the near future. *(M. Coyle, 2019)*

2.4 Digital Supply Networks (DSNs)

In the previous paragraph, we underlined how the digital transformation in companies includes also supply chain management. Essentially, the digital revolution is changing also the way itself in which products are designed, created and transported to clients. An interesting aspect to scrutinize is the creation of the Digital Supply Network (DSN).

In general, a supply chain is a network between a company and its suppliers to produce products or services from raw materials and deliver them to a firm's customers. In short, the entire process encompasses the movement and transformation of raw materials into finished products, the transportation of those products and their distribution to the end-user. Thus, the entities involved are producers, vendors, warehouses, transportation companies, distribution centers and retailers.

Efficient Supply Chain Management is essential to optimize the firm's supply chain to reduce costs, have a rapid production cycle and be competitive in any business industry. Supply chains were traditionally linear and sequential, following these steps: design, plan, source, make and deliver. However, the model of many supply chains began to change in order to adapt the supply of the products offered to the demand present in the market and avoid unnecessary costs due to uncertainty. Nowadays, instead of following a stable process, supply chains are often characterized by a dynamic, interconnected process, which may readily evolve over time to optimal conditions. Moreover, it is

possible to observe how, in the last years, supply chains are becoming progressively more dependent on technology.

With Digital Supply Networks we refer to digital supply chains that combine all the information collected from different sources and locations to improve the production and distribution of the firm's products. Practically, the technologies create a virtual world that reflects the physical world and generate an integrated and holistic view of the entire supply network in real-time. Consequently, this allows DSNs to cover a fundamental role in the strategic planning and decision making processes of the company. *(D. Gish, A. Mussomeli & S. Laaper, 2016).*

2.4.1 From Traditional Supply Chains to DSNs

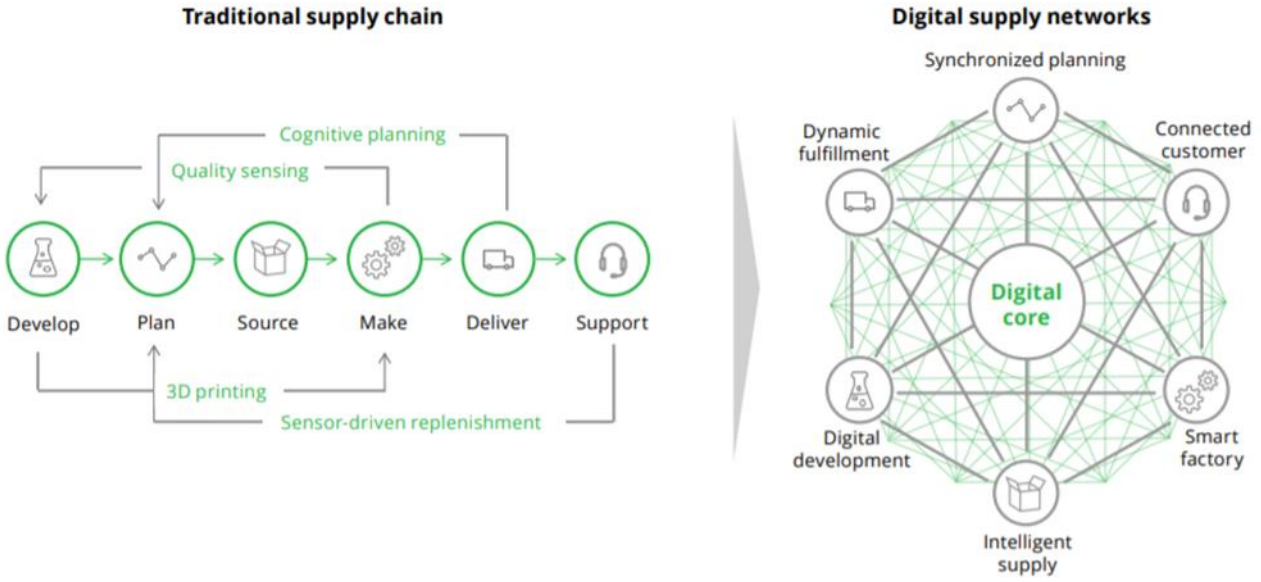
The factors discussed in chapter I regarding major technological and digital developments had an enormous impact on the traditional supply chain. Firstly, objectives such as monitoring each phase of the operation process or understanding patterns in customer and supplier demand are not time-consuming or excessively expensive anymore. The linear process of designing, creating and transporting products remains the same, tied with an underlying data flow that connects all the nodes of the supply chain, dynamically and in real-time. These new interconnections have improved supply chains by forming efficient and predictive networks.

Moreover, the combination of the innovative studies on matter manipulation and the new technologies, that are used in companies in the production process, to implement them leads to increased flexibility and capability of capital equipment. Thus, less capital equipment is needed because it becomes more efficient.

Eventually, this creates the opportunity to modify the traditional, linear supply chain nodes to dynamic networks. Therefore, companies are able to differentiate more and the digital connectivity, possible due to technology, decreases the time between the transmission of information and the resulting material actions.

Basically, while supply chain management has classically differentiated supply chain activities in planning and then execution phases (procurement, manufacturing and distribution), in truth, this separation no longer represent the reality, because it does not consider the new possibilities through digital technologies. DSNs are characterized by substantial connectivity among areas thanks to the interactions among each node and every point of the network. This result in multilateral communications, whereas the traditional supply chain was much more disconnected in comparison.

In this way, DSNs solve the problem of the "delayed action-reaction process" of the linear supply chain because they constantly use real-time data to improve decision making due to correct information, assure transparency and incredibly facilitate collaboration across the entire supply network. In fact, the traditional barriers of time and space gradually dissipate, an undoubtedly momentous improvement considering how, in comparison, linear supply chains use periodic relayed forecasts and plans, which become progressively outdated and inaccurate with each stage.



Shift from traditional supply chain to digital supply network. Deloitte University Press

As already discussed, the continuous flow of information that characterizes DSNs and the ability to access information in real-time makes it possible to avoid many of the difficulties inherent in linear supply chains. For example, the multinational grocery retailer Tesco is trying to maximize revenue by decreasing the probability of out-of-stock products. Tesco uses weather data to forecast demand for weather-dependent products (such as ice cream) thanks to its predictive analytics tool, adjusting accordingly the inventory and supplier orders in advance on a store-by-store basis. With this method, Tesco saved approximately $140 million. Changing orders depending on the weather conditions forecasted was theoretically possible for the local grocer even using the traditional supply chain, however, the reaction would not have been enough swift to prevent out-of-stock situations. DSNs decide in real-time according to data, therefore communications in the supply network are more rapid and efficient.

The characteristics of the DSNs are easily summarized. Firstly, DSNs allow faster data transmission, due to sensors or other location-based tools that constantly send data to have integrated views of multiple aspects of the network with practically no-existent latency. A complete picture of the entire

supply network creates the conditions for more informed strategic decisions. In fact, in the connected community the multiple stakeholders, such as suppliers, partners, customers, etc., are able to be to communicate and share data directly. Thus, the process assures that all stakeholders always make choices with the same information, letting machines identify the best operating decisions. This collaboration between machines and humans is defined as "Intelligent optimization", the term indicates the collaboration of workers and technology to analyze data properly and achieve the optimization of decision making.

Moreover, DSNs guarantee transparency and instant visibility across multiple phases of the supply chain in the same moment. Instead of having to piece together different pieces of information from multiple sources manually or with other systems, DSNs track constantly material flow in the companies, coordinate schedules, control financial choices holistically and monitor equilibrium between supply and demand. Thus, we can conclude that DSNs facilitate holistic decision making. It is possible to understand noticeably the trade-offs of each decision and broader strategic transformations are easier. Rather than planning singular improvements in the supply chain, companies can quantify how the supply network as a whole can be enhanced to generate growth. *(D. Gish, A. Mussomeli & S. Laaper, 2016).*

2.4.1.1 Business Case: Siemens PLM

Siemens is an engineering company with over 24,000 developers of digital innovation technology. This firm aims to help companies transform their businesses, it embraces the belief that only with a fully digitalized business model companies can have enough power and flexibility to accelerate all processes, enhance production operations and remain competitive. In fact, the use of smarter, faster and cheaper robots and additive manufacturing processes in factories is disrupting and transforming the manufacturing industry. Furthermore, these smart tools and factories are also connected thanks to Internet of Things (IoT), which gives the chance to take even more advantage of the potential of big data, whose added value grows the shorter its deliver is. Having the right data at the right time, in real-time, makes a momentous difference in making the right business.

Siemens created a Product Life-cycle Management (PLM) Software that weaves a digital thread that creates a tapestry of information that connects people with data and applications in real-time. Many companies use different applications and systems, which creates several problems for workers. Employees may waste too much time looking for information or entering data in multiple platforms because of their inefficiency. Moreover, often there are also serious security problems regarding data

management to consider. Even simply sending emails may lead to loss of intellectual property. Siemens PLM Software guarantees secure data management by collecting all the knowledge in a single system.

The foundation of the digital enterprise is Teamcenter, the platform that facilitates collaboration. It enables everyone to collectively manage all the product's information and share the latter with the whole organization. Thus, it facilitates coordination and it is less likely to incur errors due to miscommunications. Moreover, the PLM System transforms Design, it enables a smart system-driven design development thanks to the integration of mechanical, electrical, software and electronics designs. It also incorporates the innovation of Convergent Modeling, thanks to which it is possible to create a so-called dynamic "digital twin" of the product. This digital twin is useful because it provides the opportunity of predicting the performance of the product through simulations.

Global operations are also optimized. It is possible to balance assembly lines, verify employees' safety, monitor robots' performance etc. Basically, the system is capable of improving production efficiency. Everyone in the company can access the information on these connected smart virtual models ("digital twins") and on the real-time production during all its phases (ideation, realization and utilization). The result is a smart innovation environment that represents a transformed model compared to the traditional supply chain.

Companies that use the PLM system can truly experience the noteworthy benefits of digitalization, such as a substantial decreased time-to-market, additional production flexibility and considerably reduced costs. The value of the PLM system consists in being a single source of information in the entire company's global value chain and in the constant analysis of every aspect of the business, including the consumers' experience. *(Siemens PLM Software, 2017).*

2.5 Consumer Experience and Industry 4.0

In order to truly understand the impact of Industry 4.0 technologies on corporate strategies, we must examine how they are improving all the various aspects of businesses. We have seen they have direct application on the supply chain, but it is important to consider also how much their use has proven to be an improvement in enhancing the customers' experience.

In any digital transformation, as we will also see in chapter III, it is fundamental not to lose sight of the clients. As we mentioned before, technologies should be implemented correctly in order to be able to measure a significant positive outcome. Neglecting how the clients react to those changes,

however, would be as grave as it would be to neglect the culture of the company and the way in which workers have to get used to their new tools. If both from an internal and external point of view, changes due to the implementations of innovative digital technologies are not embraced and integrated, the results would be devastating. As we have already talked sufficiently about the importance of changing the company culture and make sure that workers adopt a new mentality, it is now time to focus on the clients' reaction. It is essential to remember that these digital technologies have to represent an improvement for everybody. They should reduce the time normally wasted, make procedures easier, add enhancing features to goods and services, generate more profit or reduce costs for the management perspective etc.

"Many organizations are struggling to turn their strategies into reality. The successful ones are focusing on the customer."

(Cit. Lisa Heneghan, Global Head of Technology, KPMG International)

A fundamental truth is that CEOs need to continue to focus on clients. This is the reason why it is so important to make sure that each company is able to provide new experiences, especially since competitors unceasingly raise customer expectations. Some of the innovative technologies introduced in Chapter I, such as artificial intelligence, machine learning, predictive analytics, augmented and virtual reality etc. are drastically altering how different brands manage to engage and interact with their customers.

In KPMG global survey in 2018, 70% of CEOs said they felt an increased responsibility to represent their clients' best interests and 67% wished to build clients' trust in various brands. Many of them also agreed that guarding the security of customers' data must be one of the key roles of a CEO and that Industry 4.0 technologies were being used to reposition their brand to respond to the new expectations of millennials. In the report, it is clearly underlined how brands that managed to master customer experience excellence generated much more value compared to the other ones.

According to KPMG experts, leading companies discovered the economic value making clients' expectations and customer experience align. Removing friction in the customer journey has shown incredible results and now many brands that followed this strategy have realized that customers should be regarded as assets, be protected and cultivated; reaching the point in which companies begin to consider customers' loyalty and trust as a kind of equity in the business.

Businesses should go beyond the traditional segmentation of customers and focus on truly comprehending what each client wishes as individuals. The key is engaging clients innovatively, not just offering simple products and services. In fact, it seems that many customers have begun to distinguish among brands by considering if they a higher vision and integrity, not only interested in aiming to increase value for the shareholders. Therefore, businesses should try to communicate their core beliefs openly and convincingly.

The leading firms identified by KPMG in their global survey seem to have in common four aspects, which signal how these companies managed to achieve such success in enhancing customer experiences:

- Understanding customers' minds and evolving needs. Comprehending how customers think seems to have become very difficult, since it not considered reliable anymore to base considerations on their past behavior. Studying transactional data, using traditional market research and dividing clients into segments and demographic profiles is no sufficient because this information only let us know what customers are doing, without including any depth regarding the reason. KPMG research found that leading companies are solving this issue by combining advanced qualitative insight methodologies like ethnography and cognitive research and quantitative observations on customers, possible thanks to data;

- Focusing on having first-mover knowledge and experience of new technologies. Being dedicated to matching evolving customer needs and innovative digital technologies, anticipating their implementation compared to competitors. Each company differentiates itself from other ones by harnessing these technologies in different ways according to separate brands purposes in each organization, while continuing to try to minimize the time to market.

- Focusing on the so-called Six Pillars of customer experience. Firstly, personalization. It is essential to demonstrate how the company comprehends each customer's particular circumstances and adapt the customer experience accordingly. In order to make the experience seem more personal, common methods are using the names of the clients, knowing their preferences and tracking their past interactions. Secondly, the firm has to prove its integrity, which is shown by having always the same constant trustworthy organizational behavior. For example, trust-building events, in which firms have to react to unexpected situations in public, trust-building moments, meaning individual actions done by the firm's workers over time, and the company's consistency in delivering its promises help considerably in this matter.

Moreover, understanding, anticipating, satisfying and sometimes exceed customers' expectations is also a good step, as well as considering the importance of turning a bad experience in a great one, i.e. "Customer recovery". An honest apology and re-acting urgently to fix any inconvenience are both vital basics for successful resolution; things can go wrong even in huge companies with an excellent customer journey, so it is important to be prepared. Then, it is always good to remember that customers tend to look for instant gratification and do not like to waste too much time and effort. This is further supported by the fact that enabling them to reach their aims rapidly and effortlessly has been proved to increase their loyalty to the brand. Finally, understanding individual customers' circumstances often results in the formation of a deep and strong relationship between brands and clients. Using empathy, making customers think that firms comprehend their feelings and trying to help in solving specific issues leave a remarkable impression too.

- Delivering a superior and economical customer experience. Ensure a consistent outcome for the customer is vital. Customer experience excellence is a journey, not a destination, possible if the businesses really comprehend what customers need and are able to creatively connect innovative digital technology. *(J. J. Hernandez, D. Conway & T. Knight, 2018).*

Digitalization is able to transform the customer journey into a highly personalized experience. Moreover, it has empowered customers, who are able to create their own customer experiences depending on the technology used. For example, in the travel industry, where customers are able to choose and discard different components such as flight, hotel, car hire, taxi and so on. Or in the retail sector, if we think about customer configuration. Clients may visit a physical store for information and then purchase online. This process usually involves numerous entities, however, it seems seamless to the customers. We refer to this phenomenon as the digital democratization of the purchasing process, which is fragmenting a previously historically unchanging and predictable process. The leading firms are those that managed to connect their customers in exceptional and thrilling ways, by developing a network of ecosystem partners that let customers bundle services and products as they prefer. These firms realized that it is better not to do everything themselves and concentrated to form an integrated environment, where clients can build seamless journeys through the power of connected digital technology.

Particularly interesting is the Asian landscape, with an impressive number of internet users. In China, the world's largest internet market, internet users were 772.0 million in 2017 and 97.5 percent of

them used the internet on their mobile devices. The scale and speed of mobile adoption in China have altered how Chinese consumers expect to interact with companies in every sector. Consumers have become more connected than ever, and they are empowered by the convenience and accessibility that mobile technology offers. The progress and success of China's FinTech and e-commerce companies were fueled by this positive and highly profitable environment, further characterized by a younger population with incredible spending capabilities in the major cities. The money accumulated by old generations is concentrated in the hands of a single heir due to the one-child policy that had been in vigor for a long time. China's FinTech decided to put customers at the heart of their business models, setting the standard for customer experience in China and globally. In China mobile payments are widely accepted and normalized, Chinese consumers' trust in this system had a significant role in the increasing penetration and preference for mobile in the country. The top brands in the mainland are mobile payment companies: Alipay and WeChat Pay. They created ecosystems where clients can do financial transactions, book travel and hotels, make reservations and do a vast range of tasks such as booking doctors' appointments and claiming overseas tax refunds. They, basically, beyond financial services, because they deliver to their clients' lifestyle services within their apps, which greatly facilitate a lot of actions and quickly win over their approval due to convenience. *(J. J. Hernandez, D. Conway & T. Knight, 2018).*

CHAPTER III

3.1 Banking Industry

Nowadays, even banks are beginning to be perceived differently. The traditional view of credit institutions is losing importance in comparison to the need for a more interactive offer that gives the client the opportunity to have access to online personalized services, quicker processes and more functional options. Going to the branch becomes one of many nuisances. In order to respond to this increased need for change, the idea of the digital bank was born. The digital transformation in the banking industry, however, is not a simple transaction. It is not enough to simply introduce new technologies; even in this case, the decisive point is modifying the way in which the bank interacts with customers.

According to Sumit Kamra, a business analyst working for Happiest Mind, the most effective way to understand and bring the organization from traditional banking to digital banking is an Omni-Channel approach. While clients continue to change their channel usage patterns, banks and credit firms need to focus on delivering seamless customer experiences across various touch-points. This proposal is linked to the trend explained in Chapter I regarding how clients' expectations are becoming the same for all kinds of companies because they do not differentiate anymore. Consequently, individuals want their unstated needs as well as likes to be understood also by banks. This is the reason why it is necessary to rethink the traditional role of credit institutions, which are not prepared to satisfy these new needs. *(Sumit Kamra, 2014)*

In 2013 Tunde Olanrewaju, a principal at McKinsey, wrote an article in the Financial Times, in which he underlines how, in Europe, banks only permitted basic customer transactions through digital innovations. In particular, he emphasized that retail banks had digitized only 20 to 40 percent of their processes and 90 percent of European banks invested less than 0.5 percent of their total spending on digital. This data was disquieting because it was already predicted that, once reliable digital-banking alternatives were established, the customer would have adapted astonishingly fast and companies left behind, from the digital perspective, would be at a tremendous disadvantage. In fact, these same clients were already used digital channels in other industries for buying goods and services, such as books, music, groceries, flights and holidays.

Olanrewaju affirmed that one of the reasons for the slower transformation in banking compared to other sectors is that bank executives generally tend to interpret digital transformation incorrectly, often as stand-alone features like mobile apps or online charts with comparisons among products. The variations associated with the adoption of digital tools, regarding internal processes, staff

capabilities etc., which are needed to combine everything in a well-organized proposition, were typically overlooked. The author explains how even if the first step is reinforcing the bank's presence and strength online, the efforts should not finish at that first step. Moreover, apparently some banks stressed security and risk concerns as justification for their slow approach to the integration of digital practices, but these are feeble arguments considering how high-risk industries have already automated almost every aspect of their customer experience in the last years. For example, the airline industry, which has managed to improve customer service without compromising passengers' safety.

The author explains how European retail banks that pursue a full digital transformation can realize improvements in earnings before interest, taxes, depreciation, and amortization of more than 40 percent over the following five years. The impact of digital is centered on lowered cost base and loss provisions and not on an increase in revenue, which is why a focus beyond front-end investments is critical. There are cost-saving opportunities for every area of the bank, but the two main ones are the automation of processes and transferring front-end activity to digital channels. Automation reduces the cost of internal processes, thanks to the implementation of digital tools and the fact that customers and staff can operate autonomically, developing self-servicing capabilities. Moreover, transferring all activities traditionally done in branches into digital channels and using digital means to enhance frontline servicing (e.g. iPad forms instead of paper ones) should radically improve staff productivity and customer experiences. *(Tunde Olanrewaju, 2013)*

The typical consumer's banking relationship is characterized by payments. Therefore, determining a comprehensive strategy for digital banking that includes offering a strong payments plan in an imperative for banks that are enduring a digital transformation. The majority of the customer base nowadays has a smartphone and banks should be prepared to being present on digital channels to satisfy the rapidly growing part of consumers who prefer to conduct daily business on multiple devices online.

Many consumers have begun to use their smartphones to make payments. These transactions happen thanks to mobile apps, which are controlled by online-payments specialists and digital merchants, instead of banks. In order to remain competitive, banks must be able to satisfy the expectations of digital natives, by developing diverse innovative tools for customers. Making sure to seize the customers' most frequent transactions with the new mobile channel is the first step, but it is not sufficient. Developing a fully digital relationship with clients is the best strategy in the long run.

As we have said, payments are really important as a point of contact between customers and banks. If we think about it, we easily realize that the average customers interact with their bank each day in

order to make or receive payments for various reasons. Paying lunch with a debit card, paying at the supermarket, buying a financial product, checking a payment, paying a bill etc. are all moments in which clients are in contact with the institutions. It is understandable, then, why these moments in which clients interact with the bank for payments represent a marvelous opportunity for business if used as a platform to cross-sell other financial services.

It is essential to compete in the areas of mobile payments, i.e. any payment is done with a portable handheld device, and digital payments, i.e. done with a digital device such as a smartphone, tablet, computer etc. Banks have a significant advantage regarding mobile payments, since they are currently the only entities that possess enough ability to reach the scale needed for them. This is due to the fact that they start with having numerous deposit accounts and lending relationships, a long-term reputation for security and a strong infrastructure. Whereas, for digital-payments, they benefit as service providers if they properly manage to leverage their strengths against digital disruptors, in particular against non-bank entities such as large telecommunications companies or small and agile technology players. These companies have been successful in blurring the lines between media content, product merchandising, orders and payments. Their strength is in tailoring cross-functional offers to individuals and satisfying in real-time their needs. These entities are also not as constricted as banks, since they have to face fewer regulatory constraints. Moreover, non-bank players are characterized by continuous innovation, whose importance was explained in Chapter II, so they repeatedly launch upgrades, proving to be much more efficient, rapid and agile overall. For example, Adyen releases an updated payments software every two to three weeks. Whereas, PayPal gives permission to accept payments within one day, which compared to the time frame of almost a week of traditional banks is a remarkable and immediately observable benefit for consumers.

The bank must begin by concentrating on an evolution along the digital-banking continuum: starting from mobile payments, continuing by creating a unified strategy for multiple and different channels and arriving to offer a consolidated digital platform, capable of delivering all financial services. A transformation that necessarily involves the whole organization, not only front-end commercial activities but, primarily, back-end technology and operations. For example, POS payments, P2P transfers etc. would be the first step to offer digital-payments solutions, however, a “digital wallet” is preferable in order to continue to improve from this point of view. It would optimize transactions and offer suggestions on how to fund costs, track loyalty points and present personalized offers etc. Then, an additional improvement could be the introduction of a digital financial planner, which would help in managing monthly income, savings, investments and so on.

In any case, it is fundamental for banks to make sure that all its clients know the advantages of digital banking after the organization has undergone a digital transformation. Typically, in fact, the clients of a bank vary, from people that still use prevalently cash, people used to write checks and early adopters of technology. Some of these individuals will have to be guided to change their habits in how they behave in their everyday life, when they shop, pay their bills, manage their finances etc. Some of them could prove to be particularly resistant, however, banks should try to convert them to the advantages of digitalization. If entities like Google and Facebook manage to excel in this, there is no reason why banks should be able to follow their example. *(O. Denecker, S. Gulati & M. Niederkorn, 2014).*

It is certain that digitization presents huge promising improvements due to the automation of many banking processes. It is, however, important to understand how financial institutions can preserve their core operations and embrace new technologies simultaneously. Basically, we should try to explain in detail what the digital transformation means exactly.

For example, the role of branches is going to change. According to an interview done with Somesh Khannaas, McKinsey director, they are going to remain important for a multichannel representation of a bank, however in a different way. It would be more appropriate to see them as a destination for complex advice and problem resolution. Some organizations are experimenting with different kinds of branches. From large showcases to highly tech-enabled hub branches, surrounded by much smaller ones in different formats (ATM-only or with few financial consultors). Whereas, other institutions have decided to have only a few strategically located branches in each major city, which are supposed to support a very strong digital presence.

The person that usually drives digitalization changes from case to case. It depends on the choice of the CEO who sometimes picks the head of operations and technology, sometimes create a new figure called “chief digital officer” or sometimes assumes that it is the responsibility of the chief marketing officer as a natural extension of its role in the business. In reality, the role of the person involved is not important, what makes a difference in their character and propensity to visualize the future, identify the right objectives and inspire people in the organization to actually them. *(S. Khanna & S. London, 2014).*

There are four fundamental ways in which digitalization is capable of creating value for financial institutions. Firstly, digital innovative technologies increase banks’ connectivity with customers, employees and suppliers. Including online interactivity, payment solutions, mobile functionality and chances to boost brands in social media. Then, thanks to big data and advanced analytics, banks are

able to refine decision making. Thirdly, it creates the opportunity to automatize and digitize repetitive, low-value and low-risk works, as we will see in analyzing Citi's business case. Finally, digitization also fosters innovation of products and business models.

These are remarkable results, however, developing a digital agenda and successfully manage a digital transformation is complex. It requires investment, planning and coordination regarding decision making in the whole bank because it means rewriting the rules of how financial institutions compete. Incumbents that decide not to bother because they fail to realize the competitive advantage of banks and non-banks that embraced digitalization or that begin a digital transformation but fail to truly understand its complexity, risk of damaging irreparably their franchise, after cultivating it for generations. *(H. Broeders & S. Khanna, 2015).*

In conclusion, we observed how there is a difference between traditional banks simply offering their customers high-quality web and mobile sites/apps, where digital is only an additional feature, and banks with a fully integrated mobile experience, in which clients can use their smartphones, tablets etc. to do everything they want. From opening a new account, to make payments, solve credit-card billing disputes and so on, without going to a physical branch. The principal point important to remember is that, in order to build a digital-banking business, it is better to start by trying to identify clearly, from the beginning, the correct value drivers, instead of following the usual temptation of copying or replicating existing models, because results are not necessarily replicated. *(S. Barquin & Vinayak HV, 2016).*

We will proceed by analyzing the digital transformation of two business cases: DBS bank and Citigroup. The situation in Asia is particularly interesting because it is quite profitable from a digitalization point of view, in fact, since 2011, the implementation of digital-banking services has soared across Asia. In developed Asian markets, Internet banking is widely used and smartphone banking has grown rapidly since 2011. In emerging Asian markets, the trend is similarly dynamic. *(S. Barquin & Vinayak HV, 2015).*

With the rapid diffusion of e-commerce and global supply chains, payments are increasing and the desire for "instant" solutions is growing. However, speed and higher volumes also comport a higher risk of processing anomalous payments, such as ones due to fraudulent activities or operational errors. Thus, there is a growing necessity of real-time control of payment flows and enhanced monitoring tools, capable of helping detect and stop these anomalous payments before they are processed. Even if it seems an impossible task for humans on their own, thanks to the support of the currently more

advanced technologies introduced with the fourth industrial revolution that leverage artificial intelligence and machine learning to enhance treasury teams' efforts in banks, it is conceivable.

In the banking sector, various players are trying to develop in particular Artificial Intelligence and machine learning to harness big data and offer new services, improved customer experiences etc. Moreover, these technologies are fundamental in supporting the processing of transactions and identifying ways to help treasurers manage their funds flows and transactions more efficiently.

3.1.1 Business case: DBS Bank

DBS Bank was established in 1968 by the government and it has grown from being a Singapore bank to one of the largest banks by assets in Southeast Asia. DBS is a commercial bank headquartered and listed in Singapore. It provides a full range of services in consumer banking, wealth management and institutional banking. In order to remain competitive in the industry, DBS is reimagining banking and it is also committed to concentrating on sustainability as a purpose-driven bank. In the Annual Report 2018, DBS declared to have 551 billion SGD of total assets, a net profit of 5.63 billion SGD, over 200,000 institutional banking customers and over 26,000 employees. *(DBS Annual Report, 2018).*

Source: DBS Annual Report 2018

In May 2018, DBS Bank changed its traditional brand "Living, Breathing Asia" to "Live more, Bank less". This new motto reflects the belief that characterizes the bank, which is that in the digital era it is necessary to deliver a simple, seamless and invisible banking experience. The bank's priority in the previous years has, in fact, been reimagining banking, DBS wants to become the personification and embodiment of the banking of the future.

The digital transformation process started quite early compared to the rest of the industry. Nowadays, DBS has one of the most comprehensive digital transformation programs for a bank. Moreover, it is

important to underline how, in DBS, the digital transformation is supported by the entire organization. This is mainly visible in customer-facing roles, but also Marketing, Communications, Human Resources (HR) and Audit are involved. All of this was possible due to a large-scale culture change.

For example, HR has started to use artificial intelligence to help review resumes and pre-screen job applications in order to recruit. This resulted in the reduction of candidate screening time by 75%. Furthermore, in order to embed DBS in the customer journey, the bank has launched marketplaces on its website, selling cars, property and electricity. This initiative is used by the bank to reimagine the customer journey to assure that banking is entrenched in the lives of the customers. Other than creating online marketplaces, DBS also concluded several ecosystem partnerships. Partnerships such as with GOJEK, in Singapore, get access to exclusive promotional codes when using DBS/ POSB credit and debit cards to pay for their rides.

In 2009, Piyush Gupta was appointed Chief Executive Officer (CEO) of DBS after 27 years with Citigroup and, since then, he pushed toward a strategy centered on leveraging digital technology to appeal to the more tech-savvy Asian consumers though banking innovation. DBS spent 600 million SGD annually on technology, investing in internet and mobile banking platforms. In 2014, Gupta added an additional 200 million SGD investment over the next three years to continue to develop DBS digital capabilities. *(S. Kien, C. Soh, P. Weill & Y. Chong, 2015).*

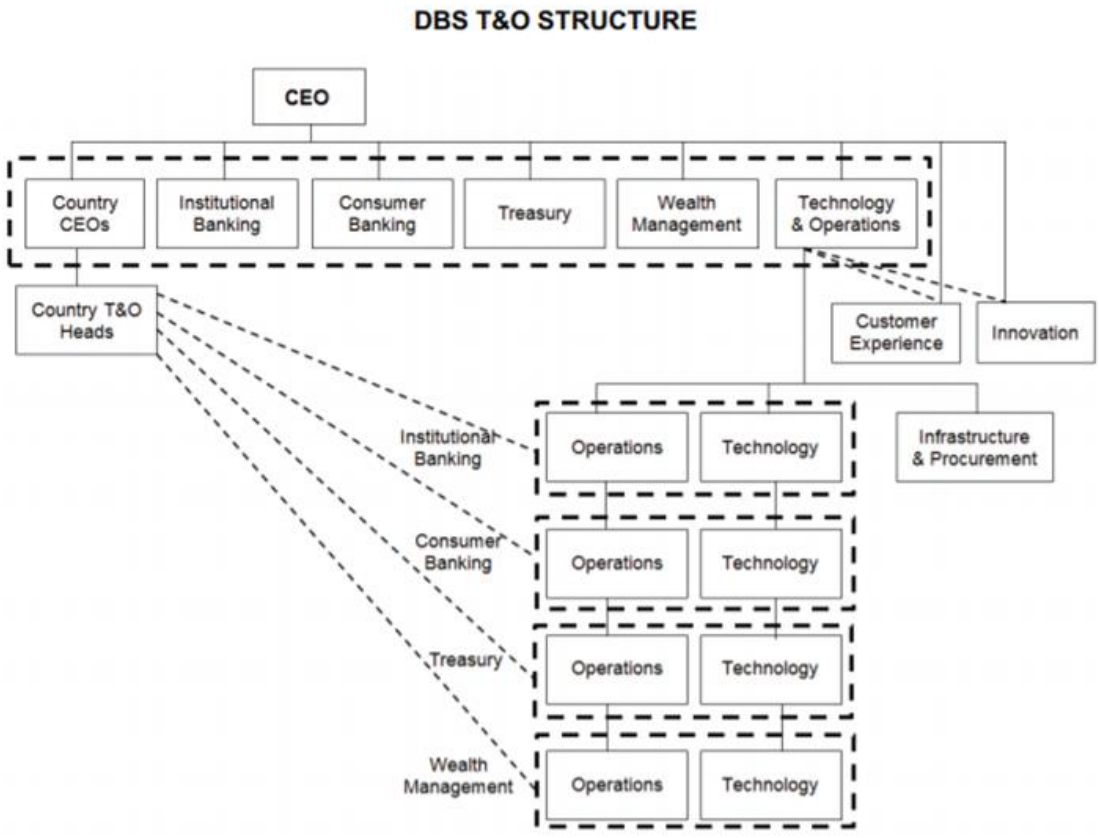
DBS bank's digital journey began when the CEO of DBS Bank, Piyush Gupta, joined the institution in 2009. Certainly, an instrumental figure for its digital transformation. It was in 2014, however, that the bank really started the journey to seriously develop in a digital institution, recognizing the risk due to the encroachment in the banking sector of emerging fin-techs, large tech giants and the start-ups. DS management reached the conclusion that it was necessary to digitize completely the bank, in order to remain competitive and satisfy the new expectations of modern consumers. Working with its legacy technology and put "lipstick on a pig" would not be sufficient, the transformation had to be revolutionary. Firstly, eliminating paper became a mantra in the organization and the mindset of focusing on digital solutions permeated the culture in the bank. It was necessary to dramatically rethink how financial services should be delivered to clients.

The bank contacted IDEO, a global design and innovation company, in order to consult an expert to properly analyze and correct the way in which they deployed products. In this way, DBS acknowledged seven critical skills that their executives should possess. Among these skills figured agile ways of working, digital technologies, journey thinking and understanding of data. DBS began to use two new metrics to identify opportunities: customer wait time and customer waste-time.

Determining how long it took to complete a goal, how long customers had to wait in line at a branch, how long it took them to complete a wire transfer etc. were important points, as well as assessing areas where customers retrieved data or paper documents, which could easily be automated or gathered electronically.

This logic continued also to guide other decisions. They divided clients into segments, differentiating between digital users and traditional users. According to their analysis, there was almost no correlation with age or income, a signal that the bank had to deal with a behavioral aspect, in line with broader market trends. Then, DBS identified the following strategies:

- Shifting to a customer-centric design;
- Making banking invisible;
- Eliminating "waste";
- Being respectful, easy to deal with, and dependable;
- Reducing the number of formalities, paperwork and processes. *(S. Greer, 2018).*



DBS bank T&O division structure (S. Kien, C. Soh, P. Weill & Y. Chong, 2015)

Firstly, the Technology Division and Operations Division were merged to form a new group called T&O, under the responsibility of David Gledhill. Gledhill reported directly to the CEO and was included as a key member in the planning of the bank's business strategy. This is particularly important because it underlines the importance of how the use of technology must add value properly, the T&O needs to be close to the heart of the business in order to do so. The T&O was aligned with the respective business lines and the geographical markets; in the teams, there were generally business analysts, project managers and system analysts. The figure shows the T&O structure, each country T&O heads reported to David Gledhill, as well as the numerous T&O heads of consumer banking, institutional banking, treasury and wealth management.

In 2010, Piyush decided to promote improvements for all the T&O projects, saving 60 million SGD in the first year. This success leads to the CEO deciding to continue, involving all the organization. Employees were also encouraged to contribute to this programme by proposing any idea. As a consequence, DBS bank achieved a reduction of over 240 million hours of customer wait time by 2013. The key had been making sure to link each project in the T&O Division to real and quantifiable outcomes, in order to ensure the correct integration and of the utilization of technology.

"Make sure that you are defining projects and initiatives in terms of solving a well-defined and clearly sponsored business problem as opposed to implementing a piece of technology, measured purely in terms of on time, on budget. Failure to do this will inevitably result in a division (separation) forming between IT and business teams, and the projects being seen as career suicides."

(Cit., Paul Cobban. Chief Operating Officer, T&O, DBS bank)

Collaboration is essential, everyone must follow the same aims in the business. Otherwise, it is fairly easy to concentrate on different aspects of each division. The risk of using and integrating incorrectly a new technology in the pre-existing business is considerable. Thus, it is essential to focus on this issue and verify that workers and business structure both adjust accordingly to attain the maximum possible benefit due to the innovation.

In the case of the DBS bank, in fact, investments in collaborative technology were of fundamental importance too. Tools such as video-telepresence conferencing systems, enterprise portals or unified communication infrastructure facilitated enormously coordination. The culture in the business must change and an effective way to promote this is by giving everyone the opportunity to express their opinion and actively participate in the change, feeling part of it. DBS bank had an internal portal

called “Tell Piyush” in 2010, which permitted to the staff in different regions to directly provide feedback and suggestions to the CEO. This internal portal represented an effective channel to oppose the effect of the rigidity of bureaucracy, typical of a business as large as DBS.

After establishing the T&O Division, the priority was also rationalizing and standardizing the T&O platforms. The technology platform had to be scalable, but also flexible in order to meet specific country requirements. Since Asian markets were diverse from a cultural and linguistic point of view as well as regarding the stages of development, it was decided to attempt to modernize the legacy system, favor a service-oriented architecture and integrate technologies in the enterprise by acquiring configurable enterprise systems.

Enterprise systems (ES) are large-scale enterprise software packages that support business processes, information flows, reporting and data analytics in complex organizations. It is a combination of computer hardware and software that a business uses to organize and run its operations. We have seen that to remain competitive in today’s digitally driven market, businesses should try to meet customers’ expectations. Facilitating access to information anytime and anywhere creates the possibility for workers and clients to work, shop, bank, and live flexibility on their own terms. Thus, many companies are trying to provide solutions with remote access; however, often they incur the problem of having to deal with the limitations of their back-end infrastructures.

Focusing on the back-end infrastructure is exactly what management did in DBS bank, driving all the innovations necessary to improve their architecture and allow digital instant fulfillment. In fact, regarding the billions of investment spent on digitizing the bank, only 10% was in the front-end apps. The remaining 90% was focused on the back-end infrastructure; only by improving the core is it possible to see significant results reflected on the front-end, thanks to seamless connection and connectivity. The first step was individuating the range of banking applications and how to handle the various operations in order to develop the enterprise architecture and focus on the back-end technology platforms. The platforms themselves were provided by external vendors, the key responsibility is being responsive to business demands and developing strong competency in technology integration.

Firstly, there was the introduction of a new core banking system called Finacle. It had standardized applications that included trade, accounting ledger, capital reporting, interfacing with internet banking etc. Plus, new functionalities in customer and liquidity management. Overall, this new operating platform permitted more flexibility in adapting to different regions and countries, offering different packaging features like rebates, tiered pricing and loyalty points.

Then, in 2011, DBS bank introduced a new wealth management platform as well. It was characterized by an integrated customer and retail banking, with private banking functionalities. It permitted to focus on each customer segment and the transition of clients from middle to high-end segments. Retail customers with growing assets were able to access the retail banking platform to manage their checking accounts, credit cards funds transfer, mortgages etc. as well as the wealth management one in private banking to manage the trading accounts, multi-currency deposits, investments in financial products, portfolio management etc. A seamless customer experience that, due to a strong mass affluent regional client base, resulted in the increase of DBS bank's wealth management income to increase from 506 million SGD in 2010 to 1.1 billion SGD in 2014.

In 2012, an internet and mobile platform for businesses was launched too, it was called IDEAL 3.0. It gave the opportunity to companies to manage both cash and trade finance transactions with straight-through processing and access to consolidated statements and forex functions. Different languages were incorporated and the platform could be integrated with the diverse ERP systems and the market's core banking technology of every business.

The aim was not just developing customer service excellence, but also digitally enable a new customer experience. It is crucial not to forget that the clients must benefit from these innovations, it is very dangerous if the management continues to push forward changes that are not appreciated by workers and customers.

"Digital banking goes beyond creating mobile apps or enabling transactions. It is about leveraging world-class technology to create a first-class customer experience. We have been very focused on executing against our IT strategy that allows us to be more nimble and innovative in the ways we engage our customers, including changing the way people think."

(Cit., David Gledhill. Head of group T&O, DBS bank).

DBS bank focused on data to identify how to serve customers better and align their priorities as well as decisions consequently. Thanks to data analytics a lot of observations were possible. For example, T&O analyzed the transaction statistics of its call centers, noticing that only 20000 out of 86000 touchpoints in a month registered information on the reason they were contacted by the clients.

DBS also managed to use analytics and sensors from its ATMs, which includes numerous features like the purchase of insurance and bill payments and are widely used; for example, the average

number of transactions for 1000 ATMs in Singapore was 7-8 times higher than the global average. Considering this vast range of information, DBS bank was able to extrapolate data to predict usage and customer withdrawal patterns for each machine, thus optimizing the bank's cash reloading schedule at non-peak times.

"Customer touchpoints such as ATMs – merely output channels previously – now became a customer sensor point for us, delivering real-time information that can be used to form a bigger and better picture of customers and their needs"

(Cit., Piyush Gupta. CEO, DBS bank)

Furthermore, the bank developed a voice analytics technology in 2012. Conversation streams were analyzed to understand clients' issues and optimize procedures at calls centers. Key phrases usually used in these communications by the clients to DBS operators in call centers were highlighted. In this way, the bank managed to identify which types of calls required longer handling times, which calls came repeatedly from the same person, which calls followed particular patterns etc. In some cases, it was possible to anticipate clients' complaints and address better their needs overall. As a consequence, customers' relations benefitted enormously. Complaints decreased by 17%compared to the previous year and compliments increased by 45%. There was an impact on the operating efficiency in the call centers too. The time required to solve clients' issues and answer their questions decreased by 5% thanks to this system.

In 2013, the bank organized a customer journey design laboratory in order to put DBS workers in customers' shoes and make them understand better the issues that they could encounter in various touchpoints. This had great results in comprehending their importance. An example of how observing touchpoints could be useful is given by an observation that the bank made regarding the time clients spent viewing their account balances at the ATMs, i.e. 15000 hours a month. The bank decided to launch, in 2013, SMS banking services to facilitate simple basic transactions for these customers. Thus, creating the possibility to check balances, pay card bills and transfer funds to their accounts, without having to use the internet to be online.

"What we do is we look at the journeys our customers are taking and then we try and get inside the mind of the customer, feel like we are the customer. We actually create a pretend customer that

represents our base. We give them a name and age and occupation, and then we take them through the journey as they apply for a mortgage or a credit card, and we try to understand what they are going through. We consider what they are thinking, what are their emotions, what is their experience, what they are concerned about and then try and improve that process so their journey is more joyful."

(Cit. Neal cross. Chie Innovation Officer, CIO, DBS bank).

DBS bank also elected to add other touch-points through cash point partnerships and self-service kiosks to offer alternative cash withdrawal options for customers, which did not have to necessarily go to the bank branches to do so. The branches themselves were changed to reflect the digital transformation of the bank. Clients were greeted by DBS ambassadors at the entrance, digital services such as iPads were provided in the waiting area, virtual queuing electric forms and a separate Quick Serve Counter for more rapid non-cash transactions were available. There were no cubicles, the majority of the bank is an open space. People stand up, conduct "agile" meetings, do Post-its on the walls and huddle together.

Particularly interesting additions were the Consultation Pods, which offered various banking services. This is the way in which digital technologies should be implemented, with the objective of making services as smooth and seamless as possible for the clients. Another example was the SMS "Q" Service that the bank launched in 2015. Customers could ask for a queue number and the estimated wait time prior to a branch visit. This solution significantly improved clients' amenability to speak with DBS representatives as a consequence, since the time lost waiting was significantly reduced with direct repercussions on their moods during meetings.

Mobility innovation is another aspect that requires due attention. Smartphones have opened numerous opportunities that banks can use to reach the customer more easily. MyPrivateBanking, a Swiss research firm, names DBS bank as the world's best bank for mobile apps strategy in 2013-2014. DBS bank began to experiment with 19 mobile apps that included functions like share trading, insurance and shopping. In particular, DBS introduced a mobile wallet for peer-to-peer fund transfers for smartphones called "DBS Paylah!" in 2014. It had 200000 users after six months. For retailers, DBS also developed a point-of-sale app to accept mobile payments in order to complement DBS Paylah!.

In 2013, DBS also introduced "HomeConnect", an app that lets customers check a property's valuation by pointing their phone at a building by accessing transaction prices in the area and providing also estimated monthly loan repayments. Moreover, using an app called "Quick Credit",

clients could also apply for unsecured loans on their smartphones and have instant updates. The app had an optical character recognition technology, which permitted to transmit the necessary documentation directly to the bank by submitting scanned documents. *(S. S. Kien, C. Soh, P. Weill & Y. Chong, 2015)*

Another important milestone was the introduction of "Digibank", a bank that existed only on the phone and that should have been capable of satisfying evolving customer experience expectations. Digibank was the first mobile-only bank in India. The project required the formation of an entirely separate team to build the offering and the purpose was testing if it was possible to create a mobile-only bank, completely paperless and branchless. DBS ran it with an agile methodology, emulating start-ups, with a separate P&L and a separate process for vendor procurement, which permitted it to make decisions rapidly and autonomously. After observing the moderate success of this project, DBS Bank included digibank also in the retail consumer business of the main bank and it became the main bank product focused on digital consumers. Launching Digibank took approximately 14 months, from February 2015 to April 2016, when it went live. DBS Bank then extended it to Singapore and Indonesia in 2016 and 2017.

In India, digibank had two main products: eWallet (deposit account) and DigiSavings. One of the key selling points of digibank is the account opening process; DBS focused on process reengineering, trying to reduce as much as possible customer waste and wait time. The result is that a new customer now needs only 90 seconds to create an eWallet account. Digibank also offered customers interesting capabilities. Firstly, the services were designed to help customers make informed financial decisions online, with intuitive user journeys and Digipay gave users the access to India's Unified Payment Interface (UPI) directly through the application. Basically, clients were able to send or receive money using a virtual "@DBS" address, without needing any account information. Whereas, for merchant payments, digibank supported Bharat QR, which let clients pay at any QR-enabled POS or website and, therefore, made it possible to easily pay or receive money.

Furthermore, digibank had a budget optimizer to help customers to budget, track expenses and analyze their own purchase patterns. This budget optimizer was able to understand customers' spending habits and reward them with appropriate marketing offers (such as restaurant discounts or coffee vouchers); it also looked at spending and it was able to send alerts regarding whether or not the consumers were above or below their normal cash flow. Moreover, digibank allowed customers to manage mutual fund investments, the features included automated alerts or automated monthly investments. Clients could purchase, track or sell investments directly, with the app. However, one of the more distinguishing features of Digibank India concerns open banking, in fact, the bank's

customers can manage also their accounts held in other institutions through the Digitalbank India app; they can see real-time balances and conduct transactions on their external accounts with the app. Plus, it is possible to pay for purchases on online portals like Amazon directly, from the checking account.

Finally, we should also consider how DBS used artificial intelligence technology. The AI foundation of digibank is KAI Virtual Assistant. Realizing that voice-enabled conversational Artificial Intelligence has the potential to revolutionize traditional financial services, DBS bank decided to integrate KAI from Kasisto into digibank's customer experience. This partnership between the bank and Kasisto resulted in the most comprehensive deployment of conversational AI in the finance industry. Used in different geographies, channels (mobile app, website, and Facebook Messenger etc.) and languages, KAI-powered assistant often is the first touchpoint for most interactions with clients and it is an expert in banking. Its conversations are accurate and contextual, it helps clients manage money, track expenses, analyze spending and improve their financial literacy. This user interface makes banking a more interactive and intuitive experience for customers, who simply have to send a text message to the virtual assistant in informal language and receive immediately an answer as if they have a personal banker available 24/7. The KAI platform has demonstrated to be already highly accurate, with a good performance, but it is still constantly growing with DBS continuing to add new features and capabilities.

KAI is closely linked with the broader digital transformation strategy of DBS Bank. Kasisto's KAI is certainly a noteworthy aspect of the bank's long-term digital and customer engagement strategy to make banking simpler, more convenient and seamlessly integrated into their clients' lives. Aims facilitated by a prospective future with conversational and voice-enabled banking. We have seen how digibank was launched only as a stand-alone offering in India at the beginning, this is an exemplary case of DBS innovation approach: "fail fast, learn fast". Many experiments are conducted to try rapidly various ideas, taking small and calculating risks to see if they produce the desired outcomes. In digibank case, in fact, it was only after the project demonstrated to have been independently successful that DBS bank brought it in-house to begin to use it as one of its main bank products they were offering and as an extremely cost-effective way to expand into new geographies. *(S. Greer, 2018).*

We have mentioned how DBS bank put a lot of importance on how to their company in a technology-literate reality. In an interview with Piyush Gupta, published by McKinsey Quarterly in 2017, the CEO explains that they had initially tried to use a traditional classroom sessions approach but the learning team reported to the management that it was not working properly. Because of this, they thought about a different idea and, in the end, they decided to run a series of "hackathons." It consisted

of making seven or eight DBS employees form a joint team with people that worked in a start-up company. There were 20 teams in total and they participated in a five-day hackathon process. The first day was devoted to understanding the technology and the skills necessary to build a human-centered design, then they had approximately three days to work together with start-up kits and help the teams code and create an app. DBS bank gave them mattresses, Ping-Pong tables and free-flowing beer, however, after 72 hours, they expected them to provide an app, which was showcased to a judging team on the final day.

People actually invented fairly good apps, but the significant aspect of this exercise was recognizing with this experience that they were able to do it. The first hackathons involved young people in their 20s, but by the third attempt, the bank started to make also 40 and 50-year-olds people participate, involving all employees that were not naturally comfortable with technology. The results were a renewed confidence and self-belief among employees, an astonishing consequence. The realization that everyone was able to do things differently and have a real impact was perpetuated. The CEO insists that to really change a company, it is necessary to give employees opportunities to experiment. By making this mandatory, it is possible to see a significant impact on the culture. In 2015, DBS bank ran 1000 hackathons and the majority of the senior leadership also participated.

Regarding how to measure success in the digital transformation process, Piyush Gupta highlighted how there is a measurable and visible revenue impact. It is due to reimagining the customer experience, which leads to customer stickiness and an increased share of the customer's wallet. Clients do not want mortgages, but they want to buy a house. They do not want an auto loan, but they want to buy a car. Following this logic, the CEO said that it would be preferable to hide the mortgage and the auto loan in the house and car buying processes, not making them weight too much on customers to get more business. How the clients perceive the overall process heavily influences their willingness to ask for financial services. Moreover, when a company is completely digitized, it can create products that would have been impossible previously. For example, DBS bank introduced a set of money-transfer products in Asia, which enabled us to transfer money in just three seconds.

Finally, regarding the possible threat in the future, Piyush Gupta underlined that his worries were focused mainly on platform companies, which in Asia and China are doing an extraordinary job and, with the support of regulators, are getting involved in the financial services sector. They represent a significant threat for incumbents, because these are not only technology companies with a technology culture, they have a large customer base too. The cost of customer acquisition for these platform companies is low and they are capable of doing everything a bank can do, from raising to lending and moving money. While, according to the CEO, fin-techs could mostly end up collaborating with

incumbent banks due to the high cost of customer acquisition, the same cannot be said for platform companies.

Piyush Gupta explained that one of the main challenges for banks is a regulatory issue. In most parts of the world, banks are restricted in the type of banking activities they can do, a consequence of being a fiduciary business. This protection represents tight barricades on what banks are permitted to do to remain competitive. Still, there are banks that managed to do something. For example, the CEO mentioned Ping An, which created an ecosystem of activities outside its core banking by owning a housing company and a car dealership. There are many areas where a bank could integrate its services with e-commerce and become a platform company according to the CEO. However, he stated that he did not know the regulatory barriers would ever be removed. *(J. Sengupta, 2017).*

3.1.2 Business case: Citigroup

Citigroup began to move toward a "back-to-innovation" strategy after the debt crisis in 2008. The bank adopted a "decentralized" approach to deal with the impact of Internet finance and FinTech. Basically, each sector in Citigroup can decide its own strategy and budget to respond to the challenges encountered against competitors. Moreover, Citibank has individualized seven innovation directions:

- data monetization;
- big data;
- mobile Internet;
- security and authentication;
- information technology;
- next-generation banking;
- financial services.

Citigroup digitalization strategy is based on three core supports. Firstly, it has a customer-centered approach, similarly to DBS bank. It is fundamental to never forget that clients must always been taken into consideration. Citigroup developed the Citibank Express system, for personal businesses. Using it, customers can directly do many matters that normally required their psychical presence in a traditional bank office. On the other hand, for corporate businesses, there are the "Citi Velocity" mobile trading platforms, which offer data streams, research, collaboration and real-time transactions.

Citigroup has also been actively trying to collaborate and communicate with clients and developing new digital competences, in order to satisfy specific customer needs and expand its business. An

example would be the collaboration with América Móvil, with whom Citi has developed a mobile payment platform called “Transfer in Mexico”, comparable to Alipay in China.

With the aim to improve planning in advance due to possible future disruptive innovations, Citigroup relies on two institutes for innovation: the Innovation Lab, which nurtures gradual innovation characterized by a boosted efficiency, and the Information Technology Center, formed by a group with IT and business experts. *(Z. Chen, Y. Li, Y. Wu & J. Luo, 2017)*

In an interview with McKinsey, the Head of Operations and Technology at Citigroup, Don Callahan, explained the efforts undertaken to have an as rapid as possible digital transition in the bank and how having access to the correct skills is fundamental, as well as the nimbleness to actually implement the required changes. Don Callahan recalled one of the famous statements of the legendary chairman at Citi Walter Wriston, who years ago stated that information about money had become almost as important as money itself. Callahan believes that nowadays, in the 21st century, this affirmation clearly reflects reality and information has indeed become as important as money.

In order to be agile and implement improvements with the due nimbleness, it is underlined even in this case how it is considered a priority to focus on the culture. In fact, this is what Citigroup is doing as well and Mr. Callahan is one of the figures responsible for spreading a new way of thinking at Citi. In order to achieve this objective, the bank has tried to encourage internally the development of innovative capabilities, from cloud computing to big data and analytics that empower automation and machine learning. Moreover, Citi is investing in a digital lab for start-up innovations and innovative apps for customer smartphones.

Regarding the more important risks in Citigroup digital transformation, Don Callahan declared that the most significant one is whether the industry will be capable of reacting appropriately in a timely fashion. The crux of the matter is the capability of thinking and executing rapidly, leaving behind the traditional approaches. Having agility means hiring experts in various subjects that collaborate and work together after having different life experiences. Therefore, product managers, developers etc. all coordinating their efforts and skills to achieve improvements, by generating ideas and implementing them properly. Swiftly substituting the ones that do not prove to be successful with new ones, continuously continuing to go forward and innovate.

As an example of agility at work, Don Callahan described the work lead by Stephen Bird, the CEO of Global Consumer Banking. Citigroup formed a “lean team” in Long Island City office, composed by 100 people that do not operate in a traditional manner but with nimbleness, remarkably similar to a creative team. Their purpose is focusing on how can become all-in on mobile, by integrating

feedback, ideate designs and led tests with clients. They experiment and use coding, conducting their job with speed, curiosity and an unprecedented level of execution.

Don Callahan stated in the interview that this method already showed promising results. On the consumer-banking side, Citi thought about a product offering for the Apple Watch. The Head of Operations and Technology recalled a phone call he received on the day in which IBM and Apple announced their intention to work together, the caller was from Citigroup consumer business side and he was wondering if the bank would have been the first to help and provide a financial-services app on the Apple Watch. Indeed, Citi collaborates with a senior team at Apple and IBM and managed to develop the first banking app for the watch in only 120 days. A wonderful case of how this mentality opens many satisfactory results.

Undertaking a digital transformation is essential to face the new competition of this century. Often, the challenges come from new, small and nimbler start-ups and not only from peer banks. Thus, it is a motivation factor in order to become stronger and faster and progress as an institution, which would otherwise remain unchanged and miss many interesting potential changes. In particular, Callahan stated that he thinks banks can learn a lot by observing start-ups and that there could be opportunities for job collaborations with them in the future. The blank slate that characterizes start-ups makes it possible for them to embrace any possibility afforded by the new technologies and bring rapidly the resulting innovations to market. A refreshing attitude, compared to traditional companies that are not used to welcome change and embrace new ideas at this rate, but that is creating a wave with enormously potential positive repercussions.

An important aspect that is important to highlight is the necessity for continuous innovation, whose crucial role has already been explained at the beginning of the previous chapter. Callahan underlines how Citigroup will also continue to change constantly, adapting to the constantly evolving innovating technologies possibilities. The bank already radically changed during its digital transformation, improving all its more noteworthy platforms globally, its core hardware and its architecture. Nevertheless, in the future, these efforts will have to be supplemented. For example, Citigroup management plans to explore the possibility of achieving true automation using robotics, machine to machine, cognitive etc. If a repeatable and fairly predictable work is identified, the idea of letting a "bot" be responsible for it would be feasible. The current workers that cover these roles would have the possibility to concentrate on more significant matters and more valuable functions, therefore, having a more central role, an effect on final results and better career-growth future prospective.

In particular, the Head of Operations and Technology mentioned that data should be used better in the whole industry, he defines it as the "lifeblood of an organization". Big data is probably going to continue to bring more and more added value, this is why it is fundamental to emphasize its role. Its utility, however, does not excuse any kind of misconduct and organizations should ensure that big data is used respecting both security and privacy appropriate guidelines.

Regarding how useful big data can be, Don Callahan described how they were used at Citigroup to analyze the supply chain of a big manufacturer. After receiving the data and the authorization to study it, they were able to inspect every phase of the supply chain in every country, its sub-supplier and its sub-sub-supplier. This greatly facilitated finding opportunities for synergies, for reducing costs or rationalization and for M&A. These insights are also useful to cultivate strategic ideas for customers and they expedite the dialogue between CEO and CFO.

The real problem in the implementation of all these technologies in a business is that each adoption of a digital solution also comports significant security risks. Regarding Citigroup, Callahan stated that as technologies advance and become more complicated, the abilities necessary to harm an organization that uses them are very hard to obtain. The risk remains, however, because there are always attackers with great abilities and their skills are evolving and increasing as well for sure.

In order to face this security risk, Citigroup has transformed his strategy focusing also on information security, forming an intelligence-lead model. Instead of trying to simply secure the gate or use firewalls, the bank tries to individuate the possible threat factors and to understand of where they will manifest, usually in different client sub-segments. Moreover, it is important that the collection of data, using and sharing it, must be done respecting customer expectations, law and regulation; Citigroup attention on these matters follow this logic as should all companies exposed to security risk and responsible for sensitive and private data.

Still, attracting the right range of people with the correct needed talents is the most important step in any digital transformation. Citigroup, for this purpose, works closely with universities all across the world. For example, Manhattan Community College. Among its 26,000 students, Citigroup selections the ones that demonstrate an affinity with computer science, with diverse backgrounds and from all over the world. Another example is Cornell University, with whom Citigroup has built a new tech campus in New York to support the study of information security. In any case, the central point of the interview with Don Callahan is that Citigroup intends to proceed and concentrate on procuring and employing people with the right skills and talents, with digital awareness and the capability to

think and act swiftly to change the culture at Citi and be able to improve its digital transformation. *(J. Kaplan & A. Mehta, 2016).*

Regarding Industry 4.0 technologies specifically, Citi is using a sophisticated real-time data analytics tools called Citi® Payment Outlier Detection, which radically changes compared to the traditional paradigm for detecting unusual payments. This service uses machine learning algorithms to check an organization's current payments compared to their recent payments' history, with the purpose of identifying transactions that are different from past trends. Citi® Payment Outlier Detection is able to do this comparison in real-time and immediately send alerts to an organization's designated payments investigator, who can then evaluate and reject or approve flagged outliers for further processing.

The automated outlier detection process starts with looking at an organization's payment history, generally over a six month period. Machine learning is used to identify and create payment patterns based on combinations of payment data like payees, beneficiaries, currencies and values etc. When the payments arrive, in this way the outlier detection engine is already prepared to flag anomalous payments and to tell operators the reason. This data analysis process is quite complex and generates a lot of patterns. The AI-based machine learning technology examines and processes similarly to the human brain, however, it is capable of doing it for a mega volume of data and reaching tremendous levels of complexity and speed, a performance impossible for human beings. The system is self-learning because it continuously trains itself by analyzing all possible combinations for every payment that passes through the engine and any new data it receives, for example, the actions taken on flagged outliers. Over time, detection accuracy will progressively increase and false-positive rates will decrease. *(Citi Annual Report, 2018)*

3.2 Automotive Industry

The automotive industry is affected by all innovative technologies too. For example, Artificial intelligence (AI) is not only useful in building autonomous cars. In fact, the industry is also working on Artificial Intelligence applications that extend to all sectors: engineering, production, supply chain, customer experience, mobility services and so on.

"Car companies are actively using AI in their autonomous driving efforts and this typically gets the most headlines. But every facet of this industry can benefit, including how cars are made and sold and to invent new customer experiences."

(Cit. Atif Rafiq, global chief information officer and chief digital officer, Volvo Car Group)

"Not only are AI technologies critical for enabling our autonomous vehicles, but they are playing an increasing role in transforming our customer and employee experiences. Supply chain risk identification, and in-vehicle predictive maintenance, are just a few of the ways Ford is already applying AI to improve our customer and business operations."

(Cit. Jeff Lemmer, vice president and CIO, Ford Motor Company)

Some of the numerous benefits due to Artificial Intelligence in the automotive industry are the control of the emissions and the improved efficiency of fuel for electric cars, it also reduces experimental R&D costs by predicting outcomes with simulations and test components, controls the quality of supplies and finished goods with automated visual inspection, decreases excess stock by forecasting orders, adds risk and crash avoidance elements to vehicles thanks to object detection, detects technical or emergency circumstance due to smart sensors inside cars, detects and responds to cybersecurity threats and so on. The implications of the adoption of Artificial Intelligence are remarkable in all areas. *(M. Winkler, R. Tolido, A. Thieullent & others, 2019).*

Additive manufacturing also has a fundamental role. It creates the possibility to accelerate design cycles and lower costs by producing prototypes without creating tools. Addictive manufacturing technologies accelerating the product design phase of new product development because traditionally firms had to experiment with several iterations before taking a final decision on the design. However, additive manufacturing technologies can produce multiple variations of a product with little additional cost, therefore they easily help auto companies improve their product designs with the support of physical models. Another reason why additive manufacturing is so useful is the fabrication of customized tools, which greatly improve productivity on the shop floor. Moreover, these technologies reduce tooling costs in product design too. *(C. Giff, B. Gangula & P. Illinda, 2014)*

Virtual Reality and Augmented Reality tools are also amply used, as well as other Industry 4.0 technologies. We shall now observe some business cases that give us a glimpse of all the different way in which innovations are being implemented in the industry and their consequent impact. From Nissan that is using Siemens product life cycle management (PLM) software to BMW augmented reality technologies and some applications of Artificial Intelligence. Supply Chain with Audi, Sales and Marketing with Volkswagen and connected driver experiences with Toyota.

3.2.1. Business Case: Nissan Motor

In order to have a competitive advantage in the automotive industry, Nissan Motors is strongly pursuing since 2001 a strategy focused on the V-3P: Value Up for Product, Process and Program Innovation. This aim is seen by the company as necessary to face the challenges that are characterizing the car industry. Nowadays, Nissan is focusing on its V-3P program by implementing the product lifecycle management technology from Siemens PLM Software, in particular, the I-deas™ and NX™ software for digital product development and the Teamcenter® software for digital lifecycle management.

NX and I-deas are useful for the company because it can be used to create a system of knowledge that the Nissan defines "Know-How CAD," which capture and re-use information, available to the entire team composed design engineers, suppliers etc. The two aspects of this system are process knowledge and product knowledge. Know-How CAD gives younger engineers access to historical data and ideas. In this way, the knowledge can straightforwardly be retrieved and used constantly to shorten timelines and streamline processes. Teams become more efficient and innovative and younger engineers are able to obtain the same results as more experienced engineers.

Moreover, I-deas and NX are software that contains the digital data necessary to form the basis for virtual validation, which is proving to be essential to shorten the development cycle at Nissan. Thanks to virtual validation, it is possible to identify problems in the first phases of the design process. Traditionally, those problems are not immediately identifiable and they are discovered only after creating a physical prototype; at that point of the design process, it is very expensive to correct them, even because any problem may have repercussions also on many other parts that compose vehicle, which would have to be changed too. On the other hand, it is now possible to run a virtual test with these new technologies and implement the required countermeasures before continuing. The company saves time, money and employees have the opportunity to study more design alternatives and identify with more precision the best solution.

With Teamcenter Nissan can also benefit from having a single source of accurate and up-to-date information. CAD data created with NX and I-deas, digital validation models and results, CAM files, bills of material, process planning data etc. is all collected in Teamcenter and available to employees in the entire organization, even to those who do not use the technical applications.

Nissan Motors is an exemplary case in which the product life cycle management (PLM) software has improved manufacturing capabilities. The software enables Nissan's production teams across the world to collaborate and share data and the virtual production process can verify design feasibility in

real-time, combining inputs from both the PLM software and designers in various facilities. Before the beginning of the V-3P program, Nissan the development cycle to bring a new vehicle design from styling freeze to the start of production (SOP) lasted 20 months. The time need for the vehicles that have been developed since then has been reduced to only 10.5 months. The quality of the vehicles has also improved substantially as proved by the reduction of design changes and the number of problems reported after a vehicle was released to the market. Finally, the V-3P program exceeded the return on investment that Nissan Motors originally expected. The PLM system has certainly had a significant impact on Nissan Motors supply chain and on its corporate strategy, it guarantees the quality of the company's products and it to get innovative automotive models to market faster. *(Siemens PLM Software, 2015)*

3.2.2 Business Case: BMW

BMW has introduced the use of augmented reality to improve its Customer Decision Journey with the BMW iVisualizer. The iVisualizer works thanks to Tango, an augmented-reality computing platform created by Google. Potential clients are able to enjoy showroom perspective directly from their own smartphones, explore and place anywhere their dream vehicle with an immersive customer experience option and share their actions on social media with friends.

BMW iVisualizer can be used directly in showrooms or at home, on tablets and smartphones, making possible a multi-channel sales approach that provides to the customers a seamlessly integrated experience. With this application of augmented reality technology, BMW offers a realistic and detailed purchasing experience, with a 360° perspective, thanks to Tango features: indoor navigation, 3D mapping, physical space measurement and environmental recognition.

BMW iVisualizer app lets clients create their own personal BMW simply by moving their fingers. They can select the exterior and interior of the vehicle according to their preferences, open the door, and switch on the light. They are also able to access the online configurator directly to arrange a test drive. Then, after designing their preferred vehicle configuration, customers have the opportunity to share it quite easily on social media channels, by e-mail or as a QR code.

Another interesting project at BMW is the use of Augmented Reality wearables. The technicians working in a BMW dealership have the opportunity to use three new systems: Technical Information System TIS 2.0, the Technical Support & Research Assistant TSARA and the new TSARAVision Smart Glasses. All of these technologies support technicians in gaining faster access to technical information and facilitate their job. *(G. Nica, 2019).*

3.2.3 Business Case: Audi

Audi is testing an AI-based system with smart cameras with image recognition software to test and identify tiny cracks in sheet metal and automate inspections. The system can potentially detect the finest of cracks using millions of images, automating visual quality inspection in the supply chain. The sample images are marked down to the pixel level to achieve the highest level of accuracy in detecting defects.

The company is also very interested in the role that artificial intelligence plays in automated and autonomous driving. This technology helps a car recognize its immediate surroundings among other features. For example, the new Audi A8 uses the method of "deep learning" for its image processing; similar to the learning process of a human mind. During the programming phase, the software is trained to identify and distinguish pertinent characteristics of objects, such as other vehicles.

Audi A8 is the first series-produced car explicitly designed for highly automated driving in specific situations. For example, Audi A8 can take control of the steering wheel and pedals in traffic jams. The problem is that, in order for automated and autonomous driving to be used on streets, the firm knows that it is necessary to build up customers' confidence in the reliability of these inventions and change the current legal framework. *(Audi Official Web-site)*

3.2.4 Business Case: Volkswagen

Volkswagen specialists are exploring possibilities to use deep learning in corporate processes and in the field of mobility services. For example, they are developing new procedures for optimizing traffic flow in cities or to make accurate predictions of vehicle sales. Advanced AI systems are also among the prerequisites for developments such as intelligent human-robot cooperation. The AI system can use context-based information, such as growth forecasts, economic sanctions and weather conditions. This solution creates several opportunities that sales planners may consider in future strategic decisions.

An interesting project at Volkswagen was the showroom of the future. It used artificial intelligence and virtual reality technology to understand customers' likes and preferences and recommend car models that meet their needs. In practice, it works by letting people sit on a chair, giving them a virtual reality headset and headphones, putting EEG sensors on their heads. These people are then exposed to differences imagines, everyday situations and colors. While their brain reacts to each image instinctively and spontaneously, the EEG sensors record all the reactions and compare those

to the adjectives linked to each Volkswagen model. In the end, the Car Finder formulates a recommendation.

"We were surprised by the number of people who wanted to know just how the system works. Visitors were interested in finding out what happens when they sit in the Car Finder. That's really great news for us. When we get talking we can explain the results using the reactions to the individual images. That way, people believe us when we say we haven't made it up."

(Cit. Stefan Aust, responsible for marketing communications at the IAA)

The Car Finder is a sales tool, but also an innovative way of reaching out to customers. It is an example of how Industry 4.0 technologies can be used to engage clients. After using it, even people that were not previously interested asked to see their Car Finder recommendation and this is an important signal. *(Volkswagen Official Web-site)*

3.2.5 Business Case: Toyota

With an initial investment of $100 million, Toyota invested in tech start-ups and entrepreneurs around the world, committed to autonomous mobility, data and robotics. Thus, in these years, Toyota has helped accelerate the arrival of critical new technologies to the market. One of the company's investments is in May Mobility, a company that is developing self-driving shuttles for areas where low-speed applications are acceptable, such as college campuses and central business districts.

Toyota's purpose is using artificial intelligence technology to make "cars an object of affection again" as soon as 2020. The firm is investing $1 billion in self-driving cars and AI between now and then to achieve it. For example, the investments in tech start-ups such as Perceptive Automata are driven by the hope to invent a technology that allows autonomous vehicles to have human-like intuition on the road.

Toyota has developed the so-called "Concept-i fully electric autonomous vehicles", nicknamed "Yui". These vehicles learn about their drivers by listening to their conversations, monitoring their social media activity and schedules, analyzing their facial expressions and driving habits to sense when they might be lethargic, stressed or to improve the drivers' comfort by adjusting lighting, music or the seats on its own. The full vision is creating "intelligent talking cars", Toyota imagines a vehicle that is equipped with AI and, thus, able to have conversations with its passengers. *(B. Marr, 2018)*

3.3 Airport & Airline Industry

Extraordinary advancements are becoming common in the aviation industry. Airports are becoming progressively adept at using technology to extend their appeal to passengers of different ages, abilities and cultural backgrounds. The purpose is trying to create a journey as smooth as possible. Innovative technologies are appearing in various airports. For example, in the Incheon International Airport in Seoul, South Korea, there is now a robot named Troika, made by LG. It assists travelers, the robot is capable of consuming tickets, scanning them, giving them back and escorting people to their gate. Whereas, in Singapore airport is planning to provide augmented reality glasses to the ground crew. These glasses would be able to give instructions to the staff while loading and unloading aircraft cargo. By scanning a virtual QR code displayed on baggage, crew members would instantly see the details of its weight, the order to follow to load it on the plan and its designated location. The glasses also have cameras, which would permit the control center staff to monitor everything in real-time. It seems that this implementation of AR technology could cut loading times from one hour to forty-five minutes, which would result in a benefit for passengers that would have to wait for less. The risk of flight delay would decrease.

Immersive entertainment systems are also being experimented in airports. In-flight entertainment experienced a change when the first movie was watched on a plane in 1921 and then, only in 1988, the first in-seat, in-flight entertainment system was tested. Currently, the new idea is using virtual reality in airport lounges and aircraft. Inflight virtual reality experience would provide passengers with a headset, loaded with immersive entertainment, including shopping, travel experiences, cinema and games. If the content is also customizable, it means that airports and airlines could create inimitable virtual reality experiences for their clients, helping their brand establish an innovative image. Moreover, considering that many people would use this tool for the first time, there is also a factor effect for the next couple of years at least. *(Frances Marcellin, 2018).*

Furthermore, individual airline companies are adopting Industry 4.0 technologies or planning to do so in the future, in order to improve their own services. We will discuss briefly, as examples, Assaia Apron Ai Solution, SkyLights VR Headsets and Singapore Airlines strategy in moving toward a digital transformation according to its published timeline.

3.3.1 Business Case: Assaia Apron AI

An interesting project is the one undertaken by Assaia, a Zurich and US-based tech specialist, which has used artificial intelligence (AI) technology to minimize delays and optimize airport turnarounds.

The company's Assaia Apron AI solution analyzes footage from cameras that survey the airport apron, expediting real-time predictive analysis that can support airlines in identifying the cause of aircrafts' lateness, permitting a consecutive execution of effective prevention measures. The necessity for this invention is due to the fact that the demand for air travel is growing, so airlines and airports require more robust technology to ensure that aircraft can arrive, pick up passengers and depart as quickly as possible. Assaia declared that its technology will help prevent accidents, ensure efficient usage of runways and boost revenues to its numerous clients, such as British Airways, Gatwick Airport, Swiss Port, EuroAirport, Toronto Pearson etc.

Apron AI solution is useful in various situations. For example, knowing when an aircraft ought to arrive with precision would enable companies to react immediately in case of lateness, instead of waiting until someone notices a plane did not arrive. Overall, Assaia Apron Ai solution is valuable for three aspects: it increases on-time performance, increases safety and decreases operational costs. By reducing delays, costs associated with them are reduced too. Furthermore, by optimizing turnarounds, it is possible to increase aircraft utilization and, thus, increase airlines' revenue. The information given with this application permits the optimization of gate planning, push back sequencing, runway sequencing and so on. While, traditionally, the aviation industry is uncoordinated because everybody works following schedules that have already been ruined by unexpected incidences, Assaia invention creates the condition to solve this issue.

Assaia chief customer officer Christiaan Hen explained in an article written by Saraogi that Nikolay Kobyshev and Max M. Diez invented the Apron AI solution by starting to organize workshops for companies to showcase technologies with computer vision and AI, in which they were both particularly killed, and to find a business application. Apparently, the head of innovation from Swiss Port participated in one of those workshops and commented that being able to produce real-time videos and insight about what is happening in an internal process of an aircraft would be incredibly valuable for the aviation industry. After talking about this point and contacting airports and airline companies to show how the technology worked, it became apparent that the enthusiasm for this application was undisputable.

Christiaan Hen also briefly commented on the trend of automation for airports. According to Assaia vision, airports are leaning towards full automation. The potential of the industry is considerable and, due to the fact that decision-making based on a lot of variables is a skill in which humans do not excel on their own, Artificial Intelligence is going to become even more important in the following ears, indispensable for many projects. Assaia has already begun to ideate new inventions in order not to

miss any opportunity and, for example, it is experimenting with how to use technology to validate visas and passports or in baggage handling. *(V. Saraogi, 2019).*

3.3.2 Business Case: SkyLights VR Headsets

SkyLights is currently the leading provider of immersive entertainment using virtual reality technology to airline managers that want to improve and differentiate their premium passenger customer experience. Founded in 2015, SkyLights has invested, piloted and deployed its Cinematic VR solution on thousands of flights and in lounges around the world.

Skylights offers to its clients a tool that let passengers have an immersive cinema experience, which boosts the brand, the innovation reputation and generates ancillary revenue for airlines firms that decide to adopt this technology. People can see 2D or 3D movies by using expressly designed portable glasses. The revenue generated by the rental of these glasses on-board in planes is shared between Skylights and each airline company.

The device is a comfortable wearable tool that creates an isolating effect for the users, who feels like they are in a private movie theater. Without being bothered constantly by the other people in the cabin, users tend to feel more contented. In order to satisfy infight requirements regarding comfort, size, battery, content protection and conditioning, Skylights designs its own hardware.

Among firms that have tried this virtual reality headset, there are Emirates (in their lounges in Dubai International Airport), Japan Airlines, Etihad Airways, SriLankan Airlines, Alaska Airlines, British Airways etc. The feedback seems to have been positive in each case and the technology has also proved to successfully reduce the fear related to the flight. The potential for a future diffusion exists, however it remains to be seen if this will remain prevalently a tool to offer to clients in premium or not. *(SkyLights Official Web-site)*

3.3.3 Business Case: Singapore Airlines

Singapore Airlines is known for its Customer Experience Management approach, based on constant analysis of big data assimilated form clients, in order to constantly improve and tailor the customer experience. Data is collected through multiple sources, such as internal operational data, real-time customer feedback and staff generated insights and the aim is achieving continuous improvement, by focusing on customer recovery and innovation.

Singapore Airlines declared it wants to be the world's leading digital airline. In 2017 the firm started a three-year Transformation Programme, working on a range of business initiatives and operational augmentations to remain competitive. For this purpose, Singapore airlines launched on 29 January 2019 a digital innovation lab, KrisLaba digital lab, where the company's experts are working in collaboration with partners in data science, cybersecurity, analytics, optimization, robotics and automation. The lab has been created to explore the possibilities of data analytics, Internet of Things, virtual and augmented reality and Artificial Intelligence across the front, middle and back-office. From achieving lower maintenance costs to decreasing aircraft delays, improving internal service standards and personalizing the end-to-end passenger travel experience. *(J. J. Hernandez, D. Conway & T. Knight, 2018).*

In the 2018 Annual Report, the company stated that 50 prototypes had already been developed out of 315 digitally-driven ideas received during that financial year 201872019. 10 prototypes had also progressed to the production stage and would be adopted into the firm's operations in the future. Technologies such as blockchain, mixed reality devices, artificial intelligence, data analytics etc. are explored by the KrisLab team as digital initiatives are being developed into viable prototypes. *(Singapore Airlines Annual Report, 2018)*

3.4 Healthcare Industry

In healthcare, it is particularly interesting to observe the impact of artificial intelligence and additive manufacturing. Experts believe that, in the future, artificial intelligence could support doctors in making diagnostic decisions and planning treatments. In addition, patients are expected to benefit from increasingly personalized approaches and better care.

Currently, medicine uses imaging techniques like ultrasound and computer tomography to have a detailed view of the inside of the human body. They can also gain precise information about a patient's condition thanks to blood tests, histological findings and genetic analyses. Yet, all this data is difficult to process at one for human beings, so it is increasingly difficult for doctors to retain an overview and suggest treatments in such circumstances. The elevate number of medical condition cases, the different causes of illnesses and all the treatments often overwhelm the human brain. Thanks to smart systems solutions it would be possible to reduce this problem and derive precise information about a patient's condition from large amounts of data. They would constantly learn from treatment results and improve.

For example, physicians that have to formulate cancer treatment are often flooded by data from different cases and the diagnostic depends on the interpretation of PET images (positron emission tomography), which requires a lot of time and is prone to error. In these cases, it is obvious that using computers to integrate and analyze patient data to reach smarter decisions would be a great benefit. An automatic evaluation system would support the medical experts by analyzing PET images and automatically produce reports or by completing similar tasks.

Siemens Healthineers has been working on machine learning since the 1990s. Thanks to Moore's law, computing power continues to increase exponentially and complex AI algorithms can now be inexpensively integrated into medical equipment. Huge amounts of data on patients are now produced and AI can learn and draw conclusions from it. Still, it is necessary to have leading medical experts that are disposed to collaborate and help process data, before proceeding with the training algorithms.

Machine learning shows particular potential in imaging. Deep learning id fundamental, it means that a computer program imitates the way in which human brains work. When analyzing images, these systems begin by recognizing the most important properties, such as corners or edges, then they detect more complex patterns and, ultimately, complete objects. For example, Siemens Healthineers has developed ALPHA (Automatic Landmarking and Parsing of Human Anatomy) is an algorithm that automatically recognizes anatomical structures.

As a more practical and detailed example, Siemens Healthineers is using artificial intelligence methods to plan heart operations. If a patient needs a new aortic valve, the software is capable of automatically extracting the aorta when it analyzes CT images of the chest, thus ignoring all the other parts of the human body. Then, the system combines individual CT layers to form a three-dimensional image of the aorta. This information enables doctors to take a better decision regarding the required replacement valve, before proceeding with invasive surgery. The information tells them where the valve should be placed, how big it should be and how it should be shaped, decreasing the possible margin of error that would complicate the operation pointlessly.

Other interesting Industry 4.0 technologies application could be drones that facilitate the transport of time-sensitive laboratory samples, like the attempt of Swiss Post or Convergent Modeling. Convergent Modeling lets designers combine facets, surfaces, and solids in one model without converting data and it imports scanned 3D data as facets. The technical aspects are difficult to comprehend for people that have not an adequate background and the specific characteristic are beyond the scope of this thesis. However, let's just say that it is a technology that greatly facilitates

a process known as reverse engineering, which is used when products have to be handheld, worn, or be “fitted” to a person or object.

For example, a nine-month-old baby’s life was saved in 2016 because a doctor used a 3D printed model of a human heart to prepare the required complex surgery. The baby suffered from a severe heart defect.

“He was taken to the hospital and was critically ill with heart failure and severe pneumonia. Since the boy was so young and small, it was difficult to develop the best surgery plan using just an ultrasound examination. If treatment had been delayed, the baby’s chance of dying before his first birthday would have been as high as eighty percent”

(Cit. Zhang Xueqin, director of the pediatric cardiac surgery center at the People’s Hospital of Jilin and the baby’s surgeon)

Leaving aside the technical explanations, it is important to know that these advancements in technology are making amazing things possible, which would have been unimaginable previously. In healthcare, it has important effects on the possibilities regarding the construction of implant, prosthetic and similar products. *(C. Buck, 2018).*

CHAPTER IV

4.1 The changing nature of work

Technological advances, particularly the implementation of automation technologies, are transforming how people work. New research from the McKinsey Global Institute on the future of work focuses on how the growing implementation and diffusion of automation and artificial intelligence technologies are likely to affect women in the workforce. For this research ten countries were examined, six mature economies and four emerging economies, chosen because they account for approximately half of the world's population and because they are representative of an extensive range of demographic profiles, stages of economic development and progress toward gender parity. The institute observed differences in patterns of impact in the period up to 2030 in these ten countries.

According to this study, in the automation age, women face new challenges, overlapped on established ones. Navigating the technological transitions properly could give women the possibility to gain access to more productive and better-paid positions. However, failing to adapt rapidly to the change and take advantage of this opportunity could result in worsening of existing challenges. The experts at McKinsey have concluded by saying that, in order to capture job opportunities, millions of women would have to make major work transitions by 2030.

Men and women tend to cluster in different occupations in both mature and emerging economies, and this shapes how each is likely to be affected by automation. For example, more than seventy percent of workers in healthcare and social assistance are usually women, whereas less than twenty-five percent of women are machine operators and craft workers. Due to technological disruptions, both women and men could face job displacement. Entirely new professions will be created and companies will require people to cover them. The problem is that, according to McKinsey research, roughly sixty percent of new US professions emerged in male-dominated fields. Nevertheless, the composition of potential job losses and gains for men and women depends on the sector and, as we have seen, all industries are being involved in technological disruption and benefits. In mature economies, only jobs requiring a college or advanced degree may be subjected to a net growth in demand. Whereas, in emerging economies, women working with little education may have difficulty securing work in other sectors.

One thing is certain, this wave of technological advances in companies is going to change the nature of work. Both women and men could find themselves in a situation in which it would be preferable to rapidly change their occupation. It is important that both groups are given the opportunity to obtain the right set of skills needed, though. Otherwise, the level of gender equality could be affected and

one of the possibilities is the worsening of gender inequality as a consequence of a badly handled transition period. *(Madgavkar, Manyika, Krishnan & Others, 2019)*

4.2 Sustainability and Industry 4.0

In conclusion, there is another reason why Industry 4.0 technologies should be considered by companies and it concerns natural resources. The demand for renewable and non-renewable resources is continuously growing as the level of consumption increases, which is due to population growth and an increase of the economic well-being of the majority of the world. Therefore, the issue of resource scarcity is emerging, because it is dubious whether this economic growth can be sustained in a world with finite natural resources. The diminishing amount of natural resources can be an issue especially for manufacturing companies with global supply chains, which may have increased prices in the future for resources and supply uncertainty. Human beings have always been creative in finding solutions to their problems and the issue of scarce natural resources is definitely one. The development of the new technologies introduced by Industry 4.0 may allow us to economize on scarce resources or to use resources that were previously uneconomical. It is, however, important to focus on this aspect and not only on the resulting competitive advantages possible thanks to improved efficiency and flexibility after their implementation.

Precisely, environmental pollution and shrinking resources continue to be more and more pressing matters for industrial businesses. Moreover, manufacturing industries have also to consider environmental regulations set by governments and price volatility due to the scarcity of resources. A solution to combine economic growth and environmental protection could be creating a circular economy. It means realizing a closed-loop material flow in the whole economic system. Thanks to Industry 4.0, this solution is particularly feasible and trying to create a sustainable, eco-friendly and resource-saving manufacturing system is possible and advisable, considering the global situation.

The environmental contributions due to Industry 4.0 are possible thanks to the impact on the allocation of resources. In fact, as we have seen, its implementation makes it possible to realize more efficiently products, materials, energy and water etc. on the basis of intelligent cross-linked value creation modules. Moreover, Industry 4.0 holds a great opportunity for realizing sustainable industrial value creation on all three sustainability dimensions: economic, social and environmental.

The opportunities for sustainable manufacturing from a macro perspective are two. Firstly, the new evolving business models are driven by the use of big data. Sustainable business models significantly create positive impacts or reduce previous negative impacts on the environment or society.

Furthermore, they can contribute to solving an environmental or social problem. Secondly, the cross-linking of value creation networks in Industry 4.0 offers new occasions for realizing closed-loop product life cycles and industrial symbiosis. It favors the efficient coordination of the product, material, energy and water flows during the product life cycles and between various factories. Closed-loop product life-cycles reuse products, even thanks to remanufacturing. Industrial symbiosis describes the trading and exchanging of products, materials, energy, water etc., it is basically cross-companies collaboration.

Information has a fundamental importance to guarantee that businesses all over the world are able to make the correct decisions, eliminating waste and using resources effectively. Industry 4.0 technologies are capable of providing this valuable information regarding all matters, such as energy use, underutilized assets and material flows.

For example, we have seen how Industry 4.0 makes it possible to observe processes in real-time. Thanks to the interconnection of machines, products and humans, it is possible to react rapidly and efficiently to different situations during production. Everything gets traceable, so also the consumption of resources becomes more transparent in these advanced manufacturing processes. Companies can assess exactly the amount of resources required for each production phase and excess resource consumption can be identified immediately and optimized or stopped. Furthermore, thanks to the use of "smart materials", equipped with sensors and actuator technology, resources can be observed not only during the production process, but also throughout the whole life cycle of the product they are incorporated in. The observation of the state and location of valuable materials like rare metals used in electronic parts will reduce waste and will increase the reuse of these scarce resources.

Without going into too many details, let's just highlight that smart products and Industry 4.0 technologies are able to generate significant economic, environmental and social benefits and therefore are able to contribute to strive towards a Circular Economy. This means that companies could capture the value of their untapped waste streams and turn them into wealth. Developing an economic system relying on these concepts would imply a new area of growth and development, a great opportunity to redefine the current relationship between economy and resources. Shaping a future socially, environmentally and economically sustainable should be a priority and it is just another reason for striving to innovate as much as possible and to implement correctly the innovative technologies introduced by the fourth industrial revolution, relishing in all the resulting benefits. *(T. Stock & G. Seliger, 2016)*

CONCLUSION

After analyzing various industries and discussing the several areas of a company in which it is possible to implement Industry 4.0 technologies, it is evident that their impact on businesses is considerable. As stated at the beginning of this dissertation, we demonstrated how these technologies improve considerably companies' performances, increase revenue by attracting more clients and decreasing costs, thus increasing the final profits of the business.

In conclusion, it is essential to underline again that the reasons why it is important to consider implementing Industry 4.0 are several. In the digital era, it is not conceivable to maintain a competitive advantage in the long run by not adapting and striving for continuous innovation. New techniques and inventions are constantly introduced to the market and competitors may rapidly be able to surpass those firms that refuse to acknowledge these changes.

Moreover, Industry 4.0 technologies have the potential of being a solution for realizing economic, social and environmental sustainable industrial value creation, which is a significant aspect considering how the scarcity of natural resources is becoming an increasingly serious issue in the world. Companies in various industries risk facing problems from this point of view, so anticipating future aggravations, it would be preferable to act in advance and create conditions that solve the situation, such as the creation of a circular economy, with the support of the innovative technologies introduced by the fourth industrial revolution. All industrial revolutions drastically changed our society and the fourth one offers promising alternatives that may affect not only corporate strategies but the future itself.

REFERENCES

Amazon Petition Letter for Exemption to the FAA (2019). Retrieved from https://www.aviationtoday.com/wp-content/uploads/2019/08/amazon_-_exemption_rulemaking.pdf

Amazon Report (2018). Retrieved from https://ir.aboutamazon.com/static-files/0f9e36b1-7e1e-4b52-be17-145dc9d8b5ec

Audi Official Web-site. https://www.audi-mediacenter.com/en/audi-ai-9130

B. Chakravorti, A. Bhalla & R. S. Chaturvedi (2017). *"60 Countries' Digital Competitiveness, indexed"*, article published by Harvard Business Review. Retrieved from https://hbr.org/2017/07/60-countries-digital-competitiveness-indexed

B. Marr (2018). "*The Amazing Ways Toyota Is Using Artificial Intelligence, Big Data & Robots*", article published by Forbes. Retrieved from https://www.forbes.com/sites/bernardmarr/2018/11/09/the-amazing-ways-toyota-is-using-artificial-intelligence-big-data-robots/#4e41b0133863

C. Buck (2018). "*Spearheading Improved Patient Diagnostics and Treatments*", published by Siemens. Retrieved from https://new.siemens.com/global/en/company/stories/research-technologies/artificial-intelligence/artificial-intelligence-ai-in-health-sector.html

C. Giff, B. Gangula & P. Illinda (2014). "*3D opportunity in the automotive industry Additive manufacturing hits the road*", published by Deloitte University Press. Retrieved from https://www2.deloitte.com/content/dam/insights/us/articles/additive-manufacturing-3d-opportunity-in-automotive/DUP_707-3D-Opportunity-Auto-Industry_MASTER.pdf

Citi Annual Report (2018). Retrieved from https://www.citigroup.com/citi/investor/quarterly/2019/ar18_en.pdf

D. Geradin (2015). *"Uber and the Rule of Law: Should Spontaneous Liberalization Be Applauded or Criticized?",* published by Competition Policy International. Retrieved from https://www.competitionpolicyinternational.com/wp-content/uploads/2016/03/Uber-and-the-Rule-of-Law.pdf

D. Gish, A. Mussomeli & S. Laaper (2016). *"The rise of the digital supply network. Industry 4.0 enables the digital transformation of supply chains",* published by Deloitte University Press. Retrieved from https://www2.deloitte.com/content/dam/insights/us/articles/3465_Digital-supply-network/DUP_Digital-supply-network.pdf

D. S. González & A. G. Álvarez (2018). *"AM Manufacturing Feasibility Study & Technology Demonstration. EDA AM State of the Art & Strategic Report",* published by the Fundación Prodintec and the European Defence Agency. Retrieved on https://eda.europa.eu/docs/default-source/projects/eda-am-study-and-strategic-report_v6.pdf

D. Schallmo, C. Williams & L. Boardman (2017). "*Digital Transformation of business models – best practice, enablers and roadmap"*, published by the International Journal of Innovation Management. Retrieved from https://www.researchgate.net/publication/322467178_History_of_Digital_Transformation

DBS Annual Report (2018). Retrieved on https://www.dbs.com/iwov-resources/images/investors/annual-report/dbs-annual-report-2018.pdf?pid=sg-group-pweb-investors-pdf-best-bank-in-the-world

F. Marcellin (2018). "*Airports tap into virtual reality for passenger entertainment*", published by Airport Industry review. Retrieved from https://airport.nridigital.com/air_yearbook_2018/airports_tap_into_virtual_reality_for_passenger_entertainment

G. Nica (2019). "*BMW Technicians Now Have Augmented Reality Smart Glasses to Rely on*", article published by BMW on company official web-site. Retrieved from https://www.bmwblog.com/2019/06/11/bmw-technicians-now-have-augmented-reality-smart-glasses-to-rely-on/

H. Broeders & S. Khanna (2015). "*Strategic choices for banks in the digital age*", published by McKinsey. Retrieved from https://www.mckinsey.com/industries/financial-services/our-insights/strategic-choices-for-banks-in-the-digital-age

H. Gimpel & M. Röglinger (2015). *"Digital Transformation: Changes and chances",* published by the Fraunhofer Institute for Applied Information Technology FIT. Retrieved from https://www.fim-rc.de/wp-content/uploads/Fraunhofer-Studie_Digitale-Transformation.pdf

J. J. Hernandez, D. Conway & T. Knight (2018). *"Tomorrow's experience, today. Harnessing a customer first approach in a changing world"*, published by KPMG. Retrieved from https://assets.kpmg/content/dam/kpmg/it/pdf/2018/06/tomorrows-experience-today-harnessing-a-customer-first-approach.pdf

J. Kaplan & A. Mehta (2016). "*Rewiring Citi for the digital age*", published by McKinsey Digital in McKinsey Quarterly. Interview with Don Callahan, Head of Operations and Technology at Citigroup. Retrieved on https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/rewiring-citi-for-the-digital-age#

J. Manyika, G. Pinkus & S. Ramaswamy (2016). *"The Most Digital Companies Are Leaving All the Rest Behind"*, article published by Harvard Business Review. Retrieved from https://hbr.org/2016/01/the-most-digital-companies-are-leaving-all-the-rest-behind

J. N. Kok, E. J. W. Boers, W. A. Kosters, P. van der Putten & M. Poel (2016*). "Artificial Intelligence: definition, trends, techniques and cases"*, published by EOLSS - Encyclopedia of Life Support Systems. Retrieved from https://www.eolss.net/Sample-Chapters/C15/E6-44.pdf

J. Sengupta (2017). *The digital reinvention of an Asian bank,* interview with Piyush Gupta, CEO of DBS, published by McKinsey Quarterly. Retrieved from https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/the-digital-reinvention-of-an-asian-bank

J. Wilke (2019). "*A drone program taking flight. Amazon moves closer to its goal of a drone delivery solution that scales to meet the needs of customers*", article published on Amazon Official Website. Retrieved from https://blog.aboutamazon.com/transportation/a-drone-program-taking-flight

K. Alicke, J. Rachor & A. Seyfert (2016). "*Supply Chain 4.0 – the next-generation digital supply chain*", published by McKinsey. Retrieved from https://www.mckinsey.com/business-functions/operations/our-insights/supply-chain-40--the-next-generation-digital-supply-chain

L. Damiani, M. Demartini, G. Guizzi, R. Revetria & F. Tonelli (2018). "*Augmented and virtual reality application in industrial systems: A qualitative review towards the industry 4.0 era*", published by Elsevier, International Federation of Automatic Control IFAC. Retrieved from https://www.sciencedirect.com/science/article/pii/S2405896318315131

L. DePillis & I. Sherman (2019). "*Amazon's extraordinary 25-year evolution*", article published by CNN Business. Retrieved from https://edition.cnn.com/interactive/2018/10/business/amazon-history-timeline/index.html

L. Probst, B. Pedersen & L. Dakkak-Arnoux PwC (2017). "*Augmented and Virtual Reality*", published by The Digital Transformation Monitor for the European Commission. Retrieved from https://ec.europa.eu/growth/tools-databases/dem/monitor/sites/default/files/DTM_AR_VR%20-%20vf.pdf

M. Coyle (2019). "*New robots, new jobs. Innovation is opening up new career paths in Amazon warehouses"*, article published on Amazon Official Website. Retrieved from https://blog.aboutamazon.com/operations/new-robots-new-jobs

M. H. Ismail, M. Khater & M. Zaki (2017). *"Digital Business Transformation and Strategy: What Do We Know So Far?"*, published by Cambridge Service Alliance. Retrieved from https://cambridgeservicealliance.eng.cam.ac.uk/resources/Downloads/Monthly%20Papers/2017NovPaper_Mariam.pdf

M. Hirt, A. Dawson and J. Scanlan (2016). *"The economic essential of digital strategy",* article published by McKinsey Quarterly. Retrieved from https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/the-economic-essentials-of-digital-strategy

M. Winkler, R. Tolido, A. Thieullent & others (2019). "*Accelerating automotive's AI transformation: How driving AI enterprise-wide can turbo-charge organizational value*", Capgemini Research Institute. Retrieved from https://www.capgemini.com/wp-content/uploads/2019/03/Ai-in-automotive-research-report.pdf

Madgavkar, Manyika, Krishnan & Others (2019). "*The future of women at work. Transitions in the age of automation,* published by McKinsey Global Institute -MGI. Retrieved from *https://www.mckinsey.com/~/media/mckinsey/featured%20insights/gender%20equality/the%20future%20of%20women%20at%20work%20transitions%20in%20the%20age%20of%20automation/mgi-the-future-of-women-at-work-full-report-june%202019.ashx*

N. Monahan & B. Griggs (2019). "*Why 2.7 million Americans still get Netflix DVDs in the mail*", published by CNN Business. Retrieved from https://edition.cnn.com/2019/04/04/media/netflix-dvd-subscription-mail-trnd/index.html

N. Sharkey (2012). *"Alan Turing: The experiment that shaped artificial intelligence"*, article published by BBC and retrieved from https://www.bbc.com/news/technology-18475646

O. Denecker, S. Gulati & M. Niederkorn (2014). *"The digital battle that banks must win"*, published by McKinsey. Retrieved from https://www.mckinsey.com/industries/financial-services/our-insights/the-digital-battle-that-banks-must-win

P. Gandhi, S. Khanna & S. Ramaswamy (2016). *"Which Industries Are the Most Digital (and Why)?",* article published by Harvard Business Review. Retrieved from https://hbr.org/2016/04/a-chart-that-shows-which-industries-are-the-most-digital-and-why?referral=03759&cm_vc=rr_item_page.bottom

R. Brooks & M. Chui (2014). *"Robots mean business: A conversation with Rodney Brooks,* published by McKinsey. Retrieved from https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/robots-mean-business-a-conversation-with-rodney-brooks

R. Singh (2006). "*Introduction to Basic Manufacturing Processes and Workshop Technology"*. Published by New Age International (P) Ltd., Publishers. Retrieved on http://103.135.169.82:81/fdScript/RootOfEBooks/MED/Introduction%20to%20Basic%20Manufacturing%20Processes%20and%20Workshop%20Technology.pdf

S. Barquin & Vinayak HV (2015). "*Capitalizing on Asia's digital-banking boom*", published by McKinsey. Retrieved from https://www.mckinsey.com/industries/financial-services/our-insights/capitalizing-on-asias-digital-banking-boom

S. Barquin & Vinayak HV (2016). "*Building a digital-banking business",* published by McKinsey. Retrieved from https://www.mckinsey.com/industries/financial-services/our-insights/building-a-digital-banking-business

S. Greer (2018). *"DBS bank: launching an AI-enabled digital bank",* published by Celent, a division of Oliver Wyman. Retrieved from https://www.edgeverve.com/wp-content/uploads/2018/12/DBS-A-revolutionary-new-way-to-bank.pdf

S. Khanna & S. London (2014). "*The bank of the future*", published by McKinsey. Retrieved from https://www.mckinsey.com/industries/financial-services/our-insights/the-bank-of-the-future

S. Reddy & W. Reinartz (2017*). "Digital Transformation and Value Creation: Sea Change Ahead"*, published by De Gruyter. Retrieved from https://www.degruyter.com/downloadpdf/j/gfkmir.2017.9.issue-1/gfkmir-2017-0002/gfkmir-2017-0002.pdf

S. S. Kien, C. Soh, P. Weill & Y. Chong (2015*). "Rewriting the enterprise for digital innovation: the case of DBS bank*", published by The Asian Business Case Centre, Nanyang Technology University. Retrieved from https://www.myassignmenthelp.net/file/case-study-dbs-bank.pdf

S. Scott (2019). "*Meet Scout*", article published on Amazon Official Website. Retrieved from https://blog.aboutamazon.com/transportation/meet-scout

S. Scott (2019). "*What's next for Amazon Scout?"*, article published on Amazon Official Website. Retrieved from https://blog.aboutamazon.com/transportation/whats-next-for-amazon-scout

S. Shalev-Shwartz & S. Ben-David (2014). *"Understanding Machine Learning: From Theory to Algorithms"*, published by Cambridge University Press. Retrieved from

http://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/understanding-machine-learning-theory-algorithms.pdf

Siemens (2016). *"PLM Overview Video for Beginners"*, video retrieved from https://www.youtube.com/watch?v=ePZheUvsH0w

Siemens PLM Software (2015). "*Nissan Motor"*. Retrieved from https://www.industry.siemens.com/verticals/global/en/automotive-manufacturing/Documents/PDF/CS_Nissan-Motor.pdf

Siemens PLM Software (2017). *"Transforming the Digital Enterprise".* Retrieved from https://www.plm.automation.siemens.com/media/global/en/corporate-brochure-10737_tcm27-24902.pdf

Singapore Airline Annual Report (2018). Retrieved from https://www.singaporeair.com/saar5/pdf/Investor-Relations/Annual-Report/annualreport1819.pdf

SkyLights Official Web-site. http://www.skylights.aero/

S. Kamra (2014). "*Digital Transformation in banking – the future of banking"*, published by Happiest Minds. Retrieved from https://www.happiestminds.com/whitepapers/digital-transformation-in-banking.pdf

T. Davis & J. Higgins (2013). "*A Blockbuster Failure: How an Outdated Business Model Destroyed a Giant*", published by Trace, Tennessee Research and Creative Exchange. Bankruptcy Case Studies, chapter 11. Retrieved from http://trace.tennessee.edu/utk_studlawbankruptcy/11

T. Pereiraa, J. Kennedyb & J. Potgieter (2019). *"A comparison of traditional manufacturing vs additive manufacturing, the best method for the job",* published by Elsevier. Retrieved on https://www.sciencedirect.com/science/article/pii/S2351978919300332

T. Stock & G. Seliger (2016). "*Opportunities of Sustainable Manufacturing in Industry 4.0*", published by Elsevier

T. Olanrewaju (2013). "*The rise of the digital bank"*, article originally published in the Financial Times. Retrieved from https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/the-rise-of-the-digital-bank

V. Saraogi (2019). "Assaia: Using AI to speed-up airport turnarounds", published by Airport Industry Review. Retrieved from https://airport.nridigital.com/air_sep19/assaia_using_ai_to_speed-up_airport_turnarounds

Volkswagen Official Web-site. https://www.volkswagen-newsroom.com/en

World Bank (2019). *World Development Report 2019: The Changing Nature of Work.* Washington, DC: World Bank. doi:10.1596/978-1-4648-1328-3. License: Creative Commons Attribution *CC BY 3.0 IGO*. Retrieved from *http://documents.worldbank.org/curated/en/816281518818814423/pdf/2019-WDR-Report.pdf*

Z. Chen, Y. Li, Y. Wu & J. Luo (2017). *"The transition from traditional banking to mobile internet finance: an organizational innovation perspective - a comparative study of Citibank and ICBC",* published by SpringerOpen, Financial Innovation. Retrieved from *https://rdcu.be/bMGWX*

SUMMARY

Maintaining a competitive advantage in this century requires striving for continuous innovation and undertaking a digital transformation. Moreover, due to the fourth industrial revolution, there has been a wave of innovative technologies that are permeating the economy and causing significant changes. All the previous industrial revolutions have had a momentous impact on society and the current one, commonly referred to as Industry 4.0, promises to do the same. Thus, it is becoming increasingly necessary to implement Industry 4.0 technologies in companies, because they have proven to be able to improve considerably firms' performances in various industries. These technologies are numerous and touch every aspect of an organization. Value chain, supply chain, including operations, transportation, production, designing and so on, and clients' perception of brands. The overall effect is so tangible that it is inevitable that Industry 4.0 has a direct impact on corporate strategies themselves.

In the first chapter of this thesis, the topic is introduced. Presenting the competitive landscape of this century is the first step, it is immediately underlined how the most valuable companies in the world are ones like Apple, Microsoft, Facebook, Amazon, Alibaba and so on. All firms with a clear digital strategy and a distinct technological advantage. Consequently, it is evident that pursuing a digital strategy should be taken into serious consideration by the management in companies that wish to reinforce their position in their industry, instead of risking of being surpassed by new entrants or by other incumbents that have decided to reinvent their business.

Deciding to undertake a digital transformation means having to implement appropriately the technologies in the organization. It is not sufficient to simply buy the latest technological assets. In order to benefit from digital advances, it is necessary to focus on how these technologies are used (usage) and on how the digital tools are integrated into employees' everyday tasks (labor). Digital usage indicates the form of transactions, customer and supplier interactions and internal business processes, whereas digital labor means having a digitally empowered workforce. Both indispensable aspects on which firms should concentrate.

The dissertation continues by explaining in detail what digital transformation and Industry 4.0 are. Firstly, the growing penetration of digital technologies in our society and the phenomenon of how digital products and services seeped inexorably in the everyday life of every individual in our society are mentioned. Due to its scale, businesses are forced to concede that business rules have changed because people's behavior is unwaveringly determined to be influenced and altered by the use of

technology and firms do not hesitate to employ new technologies to conquest or conserve a competitive advantage in their industry.

The term Digital Transformation is used to describe a managed adaptation of technologies that companies commence due to this disturbance in the global market, caused by the unstoppable progressing of digitalization. A properly executed digital transformation assures a sustainable value creation, however, this implicates that current business models must be re-evaluated because they may be prone to become obsolete in the future digital economy. In fact, companies might have to completely modify their own business models to anticipate the disruptive ones of potential future competitors and use digital innovations to prosper in the digital era.

The thesis briefly describes classic examples of digital disruption, such as Uber, Spotify and Airbnb. Obviously, however, digital disruption includes various kinds of changes and we should not take into consideration only the more eye-catching cases. For example, let's think about the trends in the automotive industry regarding the study and creation of driverless cars or electric cars. The diffusion and success of electric cars would eliminate the need to depend on traditional fuels and there would be tremendous consequences on the current supply chain in the automotive sector. The petrol stations, the tankers, the tanker's drivers would all be entities that would be affected by this disruption. Generally, speaking, therefore, it is palpable why the issue should be taken seriously by companies in all sectors.

In the text, it is analyzed which are the most glaring elements that may result in a potential disruption and how the management should react to protect a business. In order to do so, a framework developed by McKinsey is used to guide management in the creation of a proper digital strategy. The introduction in the company of digital technology is necessary because it exposes sources of supply that were previously impossible or uneconomic to provide. Digitization also removes distortions in demand, giving customers more complete information and creating a situation in which it is necessary to unbundle aspects of products and services, formerly combined or kept separate by necessity, convenience or to increase profits. The key, in order not to remain exposed to disruption in these regards, is lowering transaction costs by reducing information asymmetry.

Depending on the different degrees of change in the nature of supply and demand, different situations can be distinguished. For a modest degree of change, "New markets making" that refers to finding new ways of connecting supply and demand, whereas "Unconstrained supply" indicates circumstances similar to the case of YouTube, a platform open to updates from all kind of users and with an unlimited supply of videos. Then, "Undistort demand" indicates how nowadays it is feasible

to determine a perfect matching of the products to the demand. Nowadays, it is possible to discover new demand, it is conceivable to unbundle it, tailor it to different clients and price products and services more accurately. This means that firms should try to avoid stickiness and simplify their entire distribution process, prioritizing immediateness and ease.

For an extreme degree of change, on the other hand, there are the "reimagining of business systems", the "hyper-scale platforms" or the "creation of new value propositions". "Reimagine business systems" means fundamentally changing the cost structure in the supply-side by automating, virtualizing, disintermediating or becoming much more accurate and predictive. Whereas, "Hyperscale platforms" means creating an entirely new value chain and new ecosystems and "Create new value propositions" means using digital technology to improve the value to the customer. In fact, it is possible to enrich the product with information, make the product social or transform it into a service.

A successful digital transformation should start by clarifying the long-term objectives of the firm. It is necessary to evaluate the change readiness of the entire company, classify probable problems, vulnerabilities, opportunities and the related risks. Secondly, it is imperative to ensure that the new digital technologies are integrated with the core values and business goals of the company. The entire organization must be united by a common and clear purpose and all stakeholders should be perfectly informed regarding the strategic plans of the firm, to ensure success. Thus, internal communication regarding all these aspects is of fundamental importance and must be done with attention and responsibility, in order to ensure that the organization is continuously evolving with the technologies employed.

Technological decisions are also decisive, the role that these tools play in achieving strategic goals must be evident. For example, the technologies may have an enabling role for new business opportunities or a purely supportive one to realize business requirements. The firm's attitude towards these innovative technologies and its capacity of exploiting them must be carefully considered. Companies generally tend to either adopt well-known and widely-used technologies, effectively acting as unpretentious market followers, or become market leaders by introducing new revolutionary technology solutions. The difference is due to how much the firms are investing in developing their skills in hypothesizing ways in which digital technologies would be able to impact their business.

Variations in the interaction between firm and customers must also be taken into consideration from a strategic point of view. Examining eventual benefits in the customer journey, whether it provides an enriched customer experience thanks to new digital technologies, is recommendable. All the

customer touch-points should be evaluated and monitored in order to deliver an integrated experience to clients. A seamless experience for customers across various digital and physical, platforms, communicating the same image, brand, communications etc. on all channels. Investments in R&D can also offer aid to companies in developing digitized solutions to anticipate customer needs, instead of limiting to respond to existing ones. Digital innovation should be perceived as an integral part of the firm overall strategy. New opportunities such as agile and new flexible working initiatives should determine a constant digital transformation.

Another important point is the company's culture, which must be managed properly. Simply imposing new technologies on employees can be daunting and unproductive. Rather than overwhelming employees and produce a counterproductive effect, it is better to guide them in adapting rapidly to change from the beginning. The culture inside the firm often proves to be one of the biggest challenges in a digital transformation due to the resistance of many individuals, but it is a critical success factor in technology-induced business transformations. The workforce is essential for the proper utilization of digital tools and for the reputation of the organization.

Moreover, management must try to hire people with the necessary skills and abilities. Identifying immediately the skills required and secure individuals with the proper background through internal training or external talent acquisition is paramount. Also, the right internal governance and external collaborations through partnerships or acquisitions are essential. Internally, firms have to take multiple structural choices to support the execution of their digital transformation strategy and to decide whether new operations should be assimilated into existing structures or separated in new units. Externally, companies can gather the needed know-how with takeovers, in the form of mergers or acquisitions, or with fostered partnerships. Alternatively, it is also possible to resort to external sourcing.

Finally, strategic decisions should also focus on methods to improve operations. Thanks to the use of new data, tools with predictive capabilities etc. it is possible to obtain important insights and optimize the firm's supply chain and the company's interaction with customers. Operational agility, quality and efficiency can be increased as well. Thanks to the fourth industrial revolution, those solutions are becoming increasingly common and the opportunities are several, often only limited by the company's imagination and its willingness to face considerable changes.

The term Industry 4.0 indicates the diffusion of the use of new technologies that "blur the lines between physical and digital worlds". It is a consequence of three factors. Firstly, the cost of technologies swiftly declined in the last decades, which means that nowadays companies need less

money to invest in digital technologies and, thus, the number of companies capable of undertaking a similar investment and benefit from it is significantly higher. In general, the whole innovative process is more easily accessible to firms interested in the effort. Secondly, computing power and technological capabilities increased enormously. In particular, between 1992 and 2002, computing power grew at an average of 52 percent per year. This led to a noteworthy increase in the amount of data that firms could gather, store and analyze. Furthermore, these two advances, lower costs and improved power and capabilities, had exponential consequences. In fact, people were able to combine information technology (IT) and operations technology (OT).

Industry 4.0 will lead to the opportunity to reach a higher level of efficiency and change traditional production relationships among suppliers, producers, and customers. In this dissertation, we focus on some technology trends form the building blocks of Industry 4.0, which are big data and analytics, autonomous robots, simulation, horizontal and vertical system integration, the industrial internet of things, additive manufacturing, artificial intelligence, virtual and augmented reality.

Big data and analytics, in an Industry 4.0 context, means the collection and comprehensive evaluation of data from many different sources, from production equipment and systems to enterprise, customer-management systems; they support real-time decision making. Autonomous robots, on the other hand, indicates an advanced model compared to the ones introduced by the previous industrial revolution. Advanced robots are capable of interacting with each other and work beside humans without issues, learning from them. Thirdly, simulations permit to control real-time data, by mirroring the physical world in a virtual model, including machines, products, and humans. Consequently, the operators can test and optimize everything immediately the next product in line in the virtual world, before deciding what to do in reality after observing the outcomes. Thus, machine set-up times would lower and the overall achievable quality would increase.

Moreover, with horizontal and vertical system integration, in industry 4.0, universal data-integration networks evolve and allow completely automated value chains. Thus, companies, departments, functions and capabilities become much more unified and interconnected. Whereas, the phenomenon indicated with the term “industrial internet of things” indicates the opportunity to enrich devices, even unfinished products, with embedded computing. Imagine a reality in which there are connections between all devices across the home, the car and the office etc. Leading firms are thinking about how this possible connectivity and the resulting inundation of data should be handled. Field devices could communicate and interact with one another and with more centralized controllers and real-time responses would be possible, thus decentralizing analytics and decision making.

Other important technologies connected to Industry 4.0 are additive manufacturing, artificial intelligence, virtual and augmented reality. These are the ones explained in more detail in chapter one. Additive Manufacturing, better known by the term "3D printing", consists of using revolutionary technology to create complex shapes, building them up layer by layer. Vastly different compared to traditional manufacturing techniques, where materials are either removed through machining, drilling or grinding techniques or cast into molds. In the dissertation, various additive technologies are explained in-depth, in order to comprehend properly their impact when utilized.

The study continues by briefly introducing artificial intelligence and advanced robotics. The first chapter is then concluded by introducing virtual reality and augmented reality technologies. Virtual reality consists of using a computer to visually simulate an artificial environment where users can interact with objects and be fully immersed. Whereas, augmented reality creates in real-time a digital overlay of information over physical elements. The capacity for immersion with Augmented Reality is lower compared to virtual, however, it is in some cases preferable. In many professional contexts, in fact, it would not be advisable to employ Virtual Reality because users should not be completely isolated from the real environment.

In the second chapter, after having previously described the substantial repercussions of digitalization and Industry 4.0 on businesses, we focus on how it is not sufficient to reinvent a business only once. Not even being a digital disruptor protects businesses from being disrupted by other new entrants or competitors in the future. The only way to avoid being overcome is by respecting a strategy centered on continuous innovation. The same is true for the implementation of Industry 4.0 technologies. As we have mentioned, their adaptation has a significant impact on the companies' corporates strategies, on their efficiency in production, development, transportation and so on, as well as in the customer experiences that they are able to offer to their clients. Attracting more clients increase revenues and technologies decrease costs, so profits increase. However, paying attention to every innovation or, better yet, trying to lead the innovation is the best way to maintain always an advantage.

Implementing only once an innovative technology and then returning to stagnancy, means embracing the high possibility of being surpassed in any case by more attentive competitors. This is the reason why leading successful companies like Amazon continue to invest in innovative solutions by taking risks. While, on the other hand, there are Netflix, which is now delving into advanced hyper-personalization thanks to interactive technology but that has lost its initial momentous success and is now risking to be overcome, and Blockbuster, which lost its dominance in the media entertainment industry after failing to focus and take seriously its competitors.

We proceed by briefly mentioning how incumbents sometimes react aggressively to digital disruption in some industries and try to use legal measures and regulatory influence to respond to the challenges and threats it represents, by blocking the innovation and having it declared illegal. Then, after observing that such a measure is not feasible in many cases, the dissertation analyzes the specific impact of Industry 4.0 in the Supply Chain and in the Customer Experience that firms offer to their clients.

Supply Chain 4.0 is faster, more flexible, more granular, more accurate and more efficient. New product distribution methods based on advanced forecasting approaches reduce considerably the delivery time. In the future, it is feasible to imagine "predictive shipping", whose patent is already owned by Amazon. The idea is that products would be shipped before specific orders by customers. Individual orders would later be matched with the shipment that was already transporting that order towards the customer region, rerouting the good to the precise destination requested by the client. Thus, the delivery is more rapid because the product ordered is already near its final destination.

Due to real-time planning, a flexible reaction depending on changes in demand or supply is possible. Planning becomes a continuous process, which is able to react dynamically to changes or limitations, such as real-time production capacity feedback from machines. The increased flexibility also makes it possible for the firm to reroute shipments during the delivery processes, as described above. Among the new business models, there is also the Supply Chain seen as a Service. Instead of having resources and capabilities in-house, some companies could decide to pay for a supply chain service. The specialization and focus of service providers would allow the creation of economies of scale and economies of scope.

Since customers tend to prefer more and more individualized goods, micro-segmentation and mass customization ideas seem to be the most suitable solution. Managing customers in more granular clusters and having an extensive spectrum of appropriate goods to offer would be the best way to respond to the growing demand for individualized products. In fact, this method would allow customers to choose among numerous "logistics menus" according to their preferences. Moreover, there are many new transport concepts, such as drone deliveries. These new methods allow firms to be efficient in handling single and high-value dense packages.

New performance management systems are able to assure real-time, end-to-end transparency throughout the entire supply chain. It is possible to share synthesized top-level KPIs like the overall service level, but also very granular process data, like the exact position of trucks in the network. An opportunity to make available joint information for all levels of seniority and functions in the supply

chain of a business. In this way, by integrating all the data, all stakeholders are able to make decisions knowing simultaneously the same facts. Performance management systems will be able to "learn" to automatically recognize risks and they will adjust supply chain parameters accordingly in a closed-loop learning approach.

Finally, due to the automation of physical tasks and planning, it is possible for the business to be more efficient. Robots handle boxes and similar items automatically in the warehouse process, by receiving them, unloading them, packing them and shipping them. Then, autonomous trucks transport goods in the network.

As a company that is continuously trying to improve its supply chain, Amazon is a perfect example for Supply Chain 4.0 and it is, in fact, analyzed as such. The firm is always looking at the future and making long-term plans and, nowadays, its constant attempts to improve have naturally pushed it into experimenting with the implementation of various Industry 4.0 technologies. Good examples are Amazon Scout, the experiments regarding drone deliveries and the implementation of advanced robots.

Amazon Scout is an innovative and fully-electric delivery system ideated to safely get packages to clients using autonomous delivery devices, an invention that I being tested in the USA. On the other hand, autonomous drone technology represents the company's attempt to offer its clients even faster deliveries compared to the one-day service that they are able to assure currently. Customers are always looking for better services and more convenient options, therefore, Amazon constantly tries to improve its already impressive delivering system, which permitted its success for all these years.

Finally, the kinds of robots at Amazon are palletizers, robo-stows and drive units. Palletizers are robotic arms with grippers that are capable of recognizing and grabbing totes from conveyor belts and load them on pallets for shipping or stowing. The robo-stow is another type of robotic arm, which lifts pallets of inventory to different levels in fulfillment centers or puts them on drive units. The drive unit itself is a robot that transports packages around facilities. All the projects have been successful so far and the company is planning to expand them in the future.

The chapter continues with an explanation of the Digital Supply Network (DSN). Its entire process encompasses the movement and transformation of raw materials into finished products, the transportation of those products and their distribution to the end-user. The entities involved are producers, vendors, warehouses, transportation companies, distribution centers and retailers. With Digital Supply Networks we refer to digital supply chains that combine all the information collected from different sources and locations to improve the production and distribution of the firm's products.

Practically, the technologies create a virtual world that reflects the physical world and generate an integrated and holistic view of the entire supply network in real-time. Consequently, this allows DSNs to cover a fundamental role in the strategic planning and decision making processes of the company.

After analyzing the passage from a traditional supply chain to digital supply networks in detail, the following paragraph provides an example to clarify the concept further: Siemens Product Life-cycle Management (PLM) Software. Instead of making employees use different systems and making them waste too much time to look for information or entering data in multiple platforms because of their inefficiency, this is a single software able to connect people with data and applications in real-time. It is explained properly, from Teamcenter, which is the platform that facilitates collaboration, to the way in which the system transforms design. All benefits are listed, like the ones due to the dynamic "digital twin" of the product, which provides the opportunity of predicting the performance of the product through simulations.

Finally, the second chapter finishes by underlining the importance of focusing on clients and introducing the impact of Industry 4.0 technologies on customer experience. CEOs need to constantly continue to concentrate on customers and this is the reason why it is so important to make sure that each company is able to provide new experiences, especially since competitors unceasingly raise customer expectations.

In the third chapter, we observe different industries in order to highlight how the diffusion of Industry 4.0 technologies has been pervasive. Firstly, we speak about the banking sector, analyzing the business cases of DBS and Citigroup. For example, regarding DBS, we see how the bank has applied artificial intelligence technology in order to enrich digibank. KAI Virtual Assistant is a voice-enabled conversational Artificial Intelligence that has the potential to revolutionize traditional financial services. KAI-powered assistant is often the first touch-point for most interactions with clients and it is an expert in banking. Its conversations are accurate and contextual, it helps clients manage money, track expenses, analyze spending and improve their financial literacy. This user interface makes banking a more interactive and intuitive experience for customers, who simply have to send a text message to the virtual assistant in informal language and receive immediately an answer as if they have a personal banker available 24/7. The KAI platform has demonstrated to be already highly accurate, with a good performance, but it is still constantly growing and DBS is continuing to add new features and capabilities. KAI is closely linked with the broader digital transformation strategy of DBS Bank; in fact, Kasisto's KAI is certainly a noteworthy aspect of the bank's long-term digital and customer engagement strategy to make banking simpler, more convenient and seamlessly integrated in their clients' lives.

On the other hand, we have Citi's sophisticated real-time data analytics tool called Citi® Payment Outlier Detection, which radically changes compared to the traditional paradigm for detecting unusual payments. This service uses machine learning algorithms to check an organization's current payments compared to their recent payments' history, with the purpose of identifying transactions that are different from past trends. Citi® Payment Outlier Detection is able to do this comparison in real-time and immediately send alerts to an organization's designated payments investigator, who can then evaluate and reject or approve flagged outliers for further processing.

Then, the thesis continues by focusing on the automotive industry. We analyze different applications of Artificial intelligence in all sectors: engineering, production, supply chain, customer experience, mobility services and so on. Then, we consider the role of additive manufacturing, which creates the possibility to accelerate design cycles and lower costs by producing prototypes more easily. Finally, we introduce how the applications of Virtual Reality and Augmented Reality tools in the automotive industry are common too.

In the business cases presented, there is Nissan, which is using Siemens product life cycle management (PLM) software. The second one is BMW, with augmented-reality in its Customer Decision Journey. BMW iVisualizer is an augmented-reality computing platform that works thanks to Tango, created by Google. It can be used directly in showrooms or at home, on tablets and smartphones, making possible a multi-channel sales approach that provides to the customers a seamlessly integrated experience. With this application of augmented reality technology, BMW offers a realistic and detailed purchasing experience, with a 360° perspective, thanks to Tango features: indoor navigation, 3D mapping, physical space measurement and environmental recognition. Potential clients are able to enjoy showroom perspective directly from their own smartphones, explore and place anywhere their dream vehicle with an immersive customer experience option and share their actions on social-media with friends.

BMW iVisualizer app lets clients create their own personal BMW simply by moving their fingers. They can select the exterior and interior of the vehicle according to their preferences, open the door, and switch on the light. They are also able to access the online configurator directly to arrange a test drive. Then, after designing their preferred vehicle configuration, customers have the opportunity to share it quite easily on social media channels, by e-mail or as a QR code.

Another interesting project at BMW is the use of Augmented Reality wearables. The technicians working in a BMW dealership have the opportunity to use three new systems: Technical Information System TIS 2.0, the Technical Support & Research Assistant TSARA and the new TSARAVision

Smart Glasses. All of these technologies support technicians in gaining faster access to technical information and facilitate their job.

The third business case regarding the automotive industry is Audi, which is testing an AI-based system with smart cameras and an image recognition software to test and identify tiny cracks in sheet metal and automate inspections. The system can potentially detect the finest of cracks using millions of images, automating visual quality inspection in the supply chain. The sample images are marked down to the pixel level to achieve the highest level of accuracy in detecting defects.

The company is also very interested in the role that artificial intelligence plays in automated and autonomous driving. This technology helps a car recognize its immediate surroundings among other features. For example, the new Audi A8 uses the method of "deep learning" for its image processing; similar to the learning process of a human mind. During the programming phase, the software is trained to identify and distinguish pertinent characteristics of objects, such as other vehicles.

Audi A8 is the first series-produced car explicitly designed for highly automated driving in specific situations. For example, Audi A8 can take control of the steering wheel and pedals in traffic jams. The problem is that, in order for automated and autonomous driving to be used on streets, the firm knows that it is necessary to build up customers' confidence in the reliability of these inventions and change the current legal framework.

Then, there is the example of Volkswagen, where specialists are exploring possibilities to use deep learning in corporate processes and in the field of mobility services. For example, they are developing new procedures for optimizing traffic flow in cities or to make accurate predictions of vehicle sales. Advanced AI systems are also among the prerequisites for developments such as intelligent human-robot cooperation. The AI system can use context-based information, such as growth forecasts, economic sanctions and weather conditions. This solution creates several opportunities that sales planners may consider in future strategic decisions.

The dissertation also mentions the Volkswagen showroom of the future. It used artificial intelligence and virtual reality technology to understand customers' likes and preferences and recommend car models that meet their needs. In practice, it works by letting people sit on a chair, giving them a virtual reality headset and headphones, putting EEG sensors on their heads. These people are then exposed to differences imagines, everyday situations and colors. While their brain reacts to each image instinctively and spontaneously, the EEG sensors record all the reactions and compare those to the adjectives linked to each Volkswagen model. At the end, the Car Finder formulates a recommendation, an innovative way of reaching out to customers and engaging them.

The final business case for the automotive industry is Toyota. The company's purpose in using artificial intelligence technology is particularly interesting, because it is trying to make “cars an object of affection again”. Toyota has developed the so-called “Concept-i fully electric autonomous vehicles”, nicknamed “Yui”. These vehicles learn about their drivers by listening to their conversations, monitoring their social media activity and schedules, analyzing their facial expressions and driving habits to sense when they might be lethargic, stressed or to improve the drivers’ comfort by adjusting lighting, music or the seats on its own. However, the most fascinating project is Toyota's vision for the future: creating “intelligent talking cars”. Toyota imagines a vehicle that is equipped with AI and, thus, able to have conversations with its passengers.

The chapter then proceeds with the Airport and Airline industry. Both robots, capable of consuming tickets, scanning them, giving them back and escorting people to their gate, and augmented reality glasses are being used in airports. For example, the glasses are in some cases given to workers, who receive instructions while loading and unloading aircraft cargo.

Immersive entertainment systems are also being experimented both in airport lounges and on planes. We discuss briefly, as examples, the offer of SkyLights VR Headsets. Then, the business case of Singapore Airlines and its strategy in moving toward a digital transformation according to its published timeline is presented and, finally, we describe also Assaia Apron Ai Solution. The latter is an interesting project undertaken by a Zurich and US-based tech specialist, Assaia, which has used artificial intelligence (AI) technology to minimize delays and optimize airport turnarounds.

Finally, the third chapter finishes with a description of the impact of Industry 4.0 on the healthcare industry. In fact, in the future, it seems that artificial intelligence could support doctors in making diagnostic decisions and planning treatments. Currently, medicine uses imaging techniques like ultrasound and computer tomography to have a detailed view of the inside of the human body. Blood tests, histological findings and genetic analyses generate a lot of data, which is difficult to process at once for human beings. The elevate number of medical condition cases, the different causes of illnesses and all the treatments often overwhelm the human brain. Thanks to smart systems solutions it would be possible to reduce this problem and derive precise information about a patient’s condition from large amounts of data. They would constantly learn from treatment results and improve. The paragraph goes on analyzing examples such as the effect of the support of Industry 4.0 in case of cancer treatment, Siemens Healthineers and the consequences of the application of Convergent Modeling. Certainly, the advances in technology are making amazing things possible, which would have been unimaginable previously.

In the last chapter, the fourth, we conclude by highlighting the consequences of the fourth industrial revolution and its impact on corporate strategies on the nature of work. It is necessary for people to adapt and develop the type of skills that are needed in the new working environment. Industry 4.0 creates new jobs and new opportunities, however, it also causes alterations that may have consequences on the distribution of work and social issues.

Lastly, we underline how Industry 4.0 technologies are fundamentally important because companies not only need them in order to maintain a competitive advantage. In fact, firms should also begin to consider that there are growing concerns regarding natural resources. The demand for renewable and non-renewable resources is continuously growing as the level of consumption increases, which is due to population growth and an increase in the economic well-being of the majority of the world. Therefore, the issue of resource scarcity is emerging, because it is dubious whether this economic growth can be sustained in a world with finite natural resources. The diminishing amount of natural resources can be an issue especially for manufacturing companies with global supply chains, which may have increased prices in the future for resources and supply uncertainty.

Human beings have always been creative in finding solutions to their problems and the issue of scarce natural resources is definitely one. The development of the new technologies introduced by Industry 4.0 may allow us to economize on scarce resources or to use resources that were previously uneconomical. For example, a solution to combine economic growth and environmental protection could be creating a circular economy, thus realizing a closed-loop material flow in the whole economic system. Thanks to Industry 4.0, this solution is feasible and trying to create a sustainable, eco-friendly and resource-saving manufacturing system is possible and advisable, considering the global situation.

Industry 4.0 technologies obviously offer multiple improvements. Their implementation makes it possible to use more efficiently materials, energy and water etc. and offers the opportunity of realizing sustainable industrial value creation on all three sustainability dimensions: economic, social and environmental.