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Industry 4.0 and the impact on the Supply Chain: A study on Sales trends for the Fashion & Luxury Sector

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Summary

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1. Introduction

Throughout history, society has always been run by the continuous necessity and request of data and information. The typical idea that passes through people's mind is "the more you know, the more you rule". Nowadays, this has never been so true.

From companies to politics, everyone who has more information and data than others, gains a stronger and higher position in a peculiar hierarchical pyramid, in which the most powerful people compose the upper summit. Moreover, the more sensible the information is, the stronger is their ability to obtain a competitive advantage against the other.

However, a question arises immediately as a ringing bell: *Is this a bad thing?*

To answer this question, we have to understand that the world's economy is led by the capitalistic view, in which the main purpose of a company is its profit's maximization that could be reinvested in other activities capable of generating extra earnings. This view is based on a personal *laissez-faire* concept, with the aim of leaving to the private companies the possibility to decide the prices of their specific goods and the quantity that are going to be sold on the market. Theoretically, this should be capable of generating an efficient market where the power is mainly divided between both sides: the supply and the demand.

Nevertheless, as every firm is competing in a specific market, in which are present *n* other companies, the importance of being efficient and enough differentiated arises with the number of competitors present in the same market. For such reasons, the importance of being able to obtain information and data from the competitors, from the market (that creates the demand) and from the company itself, ascends.

The main problem with this organizational and strategical need relies on the difficultness in the creation of a strong and reliable ability capable of capturing, stocking and analyzing both data and information. The specific results emerged from the previous activities should be used by the company's top management to develop a strategy that will sustain an increase in earnings and profits during the future years. However, developing such a difficult capability is not as easy, and the major problem relies in the time needed to obtain it (there is even the possibility that once a company obtains this ability, the technology used has already became obsolete or that other competitors previously developed the same ability).

Therefore, we must understand that for a company there are many different, great and opposite forces that create an everyday challenge for Management. One of the most important problems relies on the continuous shifts and changes in consumers' needs and tastes and with them even the changes in technologies. We do not have to think of technologies only as the devices used by the customers (television, telephones, computer, smartphones, etc.), but even of all the machines employed in the production of goods and services (machinery, calculators, software, robots, etc.). These technologies are improving in such a faster manner that nowadays they are capable of generating an incredible amount of data and information. The data comes from both internal and external sources to the company: a large number of players (workers, shareholders, customers, clients, suppliers, etc.) and factors constitute the company's micro and macro environments.

How should a company collect and exploit these amounts of data and information to gain a competitive advantage against the competitors? How will this improvement in technologies affect the manager's ability to create efficient strategies for all the company's supply chain?

In the past two centuries, the challenges imposed by the market have been positively faced by three different industrial revolutions. Now companies are facing a new wave of revolution, that does not deal with energetic or meccanization needs and does not deal with steam or petroleum. This revolution is the so-called "Industry 4.0", completely built around the necessity of taking advantage of data and information. The object has switched from material to immaterial, but this does not reflect a worsening in its value or in its quality, as the importance of data has increased thanks to the costs and the difficulties in obtaining the capabilities to analyze and extrapolate information that should be able to help the management in implementing functional strategies.

Furthermore, the final customers behaviors and tastes are changing quicker than in the past, making it more difficult for the companies to develop a sustainable and efficient strategy based on a modern customer experience. Moreover, the actual sales' trend shows us that in upcoming years there will be an increase in the utilization of online shopping websites, thus companies must deal with this phenomenon in order to maintain a strong position in the market and to be competitive.

How should a company face the problem related to these trends, in order to survive the competition imposed by the market?

The previews questions lay the basis of the main topic of this paper, in which we are going to answer them by deeply analyzing the effect that the Revolution 4.0 is bringing to the whole economic system.

The analysis will start by presenting the characteristics and the principles of this Revolution, by analyzing each single pillar that characterizes it. We will move from a brief historical introduction to the study of big data, ending the first chapter with a cost and benefit analysis for the implementation of this revolution.

Moving forward, in the second chapter we are going to go into depth of the study by moving through the analysis of the impact that the Industry 4.0 Revolution is bringing to the supply chain. We will understand how all the activities that constitute the production chain, from the suppliers step to the final customers step, are being affected by the new 4.0 approaches, where data and information are changing the rules of the game. Moreover, we are going to see how the supply chain is modifying itself using the data originated both from inside and outside the company, understanding what is a "smart factory" and how it could improve the firm's performances.

The last chapter will even go deeper in the analysis by analyzing the sales function and all the 4.0 factors that are completely changing it. To better understand how much the data and information approach is hitting this function, the analysis will be focused prevalently on the Fashion & Luxury sector. Starting the presentation with its history and its main characteristics, the analysis will move to the sector's main players and the future trend's estimations. Then, after the previews introduction, the analysis will enter into the core of the topic, which is to understand how the 4.0 Revolution is affecting the sales function in the Fashion & Luxury sector. First, it is important to understand the differences between the two main distribution channels, retail and online, from both points of view (company and customer). This lays the foundations for the next step that draws attention to the future trend and the impact made by data and information. We will discovery which are the recent trends exploited by the most profitable companies in the sector; trends that are developed to create a new customer experience capable of generating a strong sense of necessity in the final customer and that should also generate an increase in the earnings by beating the competitors by the differentiation strategy. To conclude the study, we will discover if now a company should develop its distribution channel mainly basing it on a retail strategy or on an online strategy.

At the end of this paper, this journey across the 4.0 Revolution will help the reader to understand better the 4.0 main characteristic and pillars, starting from the influences made by data and information to the whole supply chain and by moving forward to focus on the impacts made by this change on the sales function. By discovering the main drivers from both the customers and the company points of views, we will comprehend how a company should develop its own strategy in

order to create a lasting customer experience, capable of overtaking the competitors, gain profits and increase the market share.

2. The “Industry 4.0” Revolution

In the last years, we all have been listening about a new Industrial Revolution that is rapidly changing the market’s rules imposed in the past. The companies’ needs of remaining into the principal player’s group of their industry is growing day by day. However, being competitive through the implementation of an efficient strategy based on the utilization of data and information is very expensive. For these reasons, many countries are trying to create functional economic policies that allow company to obtain different fiscal benefits for the money invested in the development of 4.0 business structures.

In parallel with these costs, one of the biggest problem that arises during the 4.0 Industry implantation is related with the increase in the needs of high skilled labor. In fact, this Revolution relies on a raise in the industrial digital meccanization, reducing the firm’s needs of blue-collar employees and, at the same time, increasing the demand for high-skilled engineers. Many labor unions and politicians are talking about a heavy increase in the public expenses for welfare, thanks to the implementation of this Revolution. *However, is this true? Which are the main features that characterize the “Industry 4.0” as one of the greatest Revolution in the economic world? Which are the benefits that this Revolution could bring to a company (related to the expenses for the implementation)? Which are the overall benefits that could bring to the whole economy?*

This chapter will analyze and answer all the previous questions by entering into the “Industry 4.0” world. First, it will be easier to start from a brief presentation of its history and its main characteristic.

2.1. The “Industry 4.0” main Characteristics

During the last three centuries, the economic world have been shocked by three different Industrial Revolution. The First Industrial Revolution started in the England of the eighteen century, where the exploitation of **steam**, generated using coal (that was heavily extracted as a primary resource in that period), initiate a new wave of developments and discoveries. This feature pushed every single manufacturing sector into a period in which the transformation the “ancient” natural and animal power into the “new” mechanical power was the main objective for the firms.

Later, after more or less a hundred of years, the discovery of the electrical power lead the economic world into the Second Industrial Revolution. It is well recognized that the main protagonist of this

period has been the electricity. Nicola Tesla, in 1882, discovered the alternating current and afterward, during the next decades, this power was brought to every single home and factory (reducing to zero the problems related with the transportation of coal for generating energy). This Second Revolution brought to an increase in the number of new firms and changed the human habits thanks to the advent of the bulb (capable of extending the length of the day even after the sunset, stimulating the origin of new sectors). Moreover, thanks to the possibility to work 24 hours a day, this was the period in which were laid the foundations for the creation of large factories with thousands of employees and was adopted a new organizational technique: the **assembly line**, implemented and standardized by Henry Ford in 1913, for the production of the Model T.

In just a century, the industrial world changed completely as never before. Even if they could seem very different, these two different Revolutions have been very related the one with the other, as the first laid the basis for the second's improvements. They have been able to have such a great impact on all the society as nothing before, changing the habits of millions of people and creating new industrial realities and sectors. This because the two Revolutions brought improvements related principally to the primary and secondary sectors, where engineers developed new ideas for transportation, production, medicine, agriculture, and, last but not least, communication.

Why leaving communication as the last sector in the previous list?

Before the nineteenth century, communication was already one of the most important sector, fundamental for merchants and politicians, in order to always being informed. However, communication had one very big problem, which for that time was insuperable: Time. For a normal person, being able to maintain many different communication routes was very expensive and difficult. These difficulties came from the dangers linked with the distances needed to bring the information between two different people. Imagine how many problems there were in keeping connected people between Europe and America, during the seventeenth century, when the only way was through sending a letter via ship and the probability of facing acts of piracy or finding a storm was extremely high.

Nevertheless, we already said that the Second Industrial Revolution was a florid period for inventions and where there was a problem, sooner or later, there will even be the solution. Firstly, the telegraph and later the telephone reduced both the cost and the risk of non-receiving the information. During the first decades of the twentieth century, thanks to the laying of submarine cables, the communication's accessibility improved exponentially (especially in the long

distances), and the possibility for the firms to set new subsidiaries in other countries increased, starting a phase of great economic expansion.

These facts, with in addition two World War (this could sound strange, but wars are capable of developing devices that can be redesign for daily life utilization) laid the basis for a period of economic growth. This is when the Third Industrial Revolution begun. In the ’70s of the twentieth century, the world was completely transformed by the introduction of computers that gave a further acceleration in both technical and scientifically innovation’s processes. From this moment, there have been an unstoppable increase in the accessibility of new devices capable of being connected together and, for the same reason, of connecting different users simultaneously. The companies’ main objective changed again and became the **automation**, with the aim of reducing the human participation, with the aim of limiting it to the control of the processes (and no more being a part of the production processes).

Moreover, this third Revolution had the capabilities to create one of the most important creation in the human history. During the ’90s, the advent of the internet pushed forward the economy in a way never seen before. From this moment ahead, every single person and company in the world could connect into a network in which the difficulties in exchanging information are set to zero. This is the moment since the firm’s power is no more just related to the number of patents owned or in the number of plants built, but even to the quantity of information that is capable of obtaining and stocking. The industries’ competition war has moved from the classical one to a new and more sophisticated data battleground, in which firms are fighting for obtaining the highest percentage of customer share. This laid the basis for the last Revolution, the one that we are going to analyze with this paper, the “Industry 4.0”.

How this battle for data changed the shape of the economic world? Why the importance of utilizing data has increased in this exponential and peculiar way?

We saw that every Industrial Revolution has had unique core features, fundamental for the progresses of the periods. The First Industrial Revolutions based its main feature on the importance of creating energy for the production and

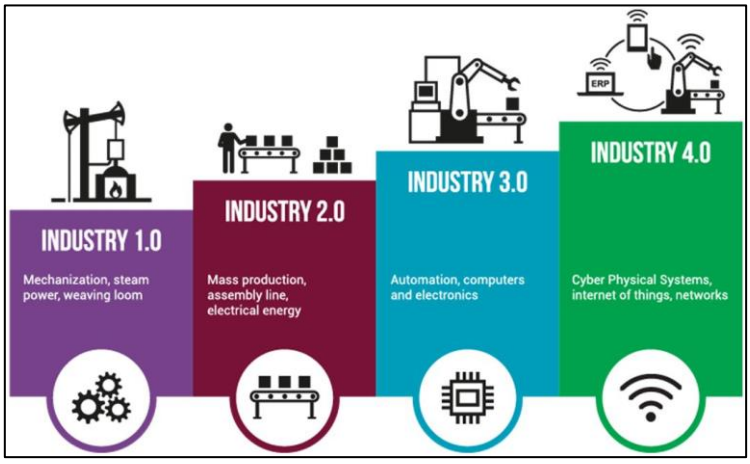

Figure 1 - Industrial Revolutions historical process

exploited with the steam machine, replacing the human power with the mechanical power. While, the Second Industrial Revolution, following the path created by the first, based its main characteristic on the mass production and the assembly line, reducing the time needed for transforming the raw materials into final products and increase margins. Here is easy comprehendible how these two Revolutions are strictly linked together, in fact, the synergies crated in the years from all the agents of the first one where the basis for the improvements created by the agents of the second.

While, the Third Industrial Revolution changed completely the "game" by starting to exploit the needs related to communication and automation. This last characteristic is the most important one for understanding why this Revolution laid the foundation for the Industry 4.0. In fact, in the last 25 years there have been an exponential increase in the development of the new technological devices, such as computers, smartphones, tablets, machines and even new software, capable of linking every single person and of creating a strong sense of need in order to be always connected with the everyday world. Moreover, even the firms have switched to the more classical "paper" to the more sophisticated software (from the basic Excel to huge application created for making the orders, managing the production, editing the budgeting, etc.). This firms' tendency is related to the innate need of increasing the efficiency level, pushing all the competitors in the adaptation of these new techniques, thanks to a reduction in the possible mistakes executable by the employees, a decrease in the total amount of time needed for the coordination between people and an increase in the money saved.

In the years, all these phenomena have started to create huge amount of data and increase the total quantity of information. This is exactly where somebody understood the possibilities and the advantages that the data exploitation could have brought into a company and into the everyday world. This is where the Industry 4.0 begun.

The very first time in which the world started hearing about the "Industry 4.0", was in 2011 during a conference in Hannover, where Henning Kagermann, Wolf-Dieter Lukas and Wolfgang Wahlster firstly introduced the concept of "Zukunftsprojekt Industrie 4.0". The aim of this project was to revive and modernize the German productive system, in order to develop a strong manufactory industry and retaking it to the world's summits, through huge investments on infrastructures, education, energetic systems, research laboratories and companies.

The achievement of these objectives became fundamental, thanks to the players involved in this Revolution: Companies, State and Workers. This is the first time in which all the possible players

are totally involved in the change, this imply that for successfully achieving it, everybody must play its own role in order to proceed in the development of a coordinated and functional strategy.

Therefore, this Revolution faces a wide range of new technologies that, at the same time, it combines physical, digital and biological spheres. This means that, the 4.0 Revolution is the first one in the human history that will not just affect the economic world, but even how people live, with the aim of maximizing the human well-being.

The new technologies are impacting all the disciplines, economies and industries, and even challenge our ideas about what it means to be human. Nowadays, the different technologies are having a multiple potential: they are continuing to connect billions of people to the web (in many different ways) and they are drastically improving the efficiencies of the different business and organizations. Finally yet importantly, they are regenerating the natural environment through a better asset management, with the prospective of undoing all the damages caused by the previous three Industrial Revolutions.

What is the 4.0 Revolution? Why it is becoming one of the greatest and most important change in human history?

Synthetizing the words of the Professor Klaus Schwab, Founder and Executive Chairman of the World Economic Forum (WEF), the 4.0 Revolution is totally different compared to the previous ones and it is exponentially transforming, more or less, every single sector in every country[1]. It is easily comprehensible how these words are true: in fact, the telephone took several years to reach at least the 50% of the US population, while the cellular took just 5 years[2].

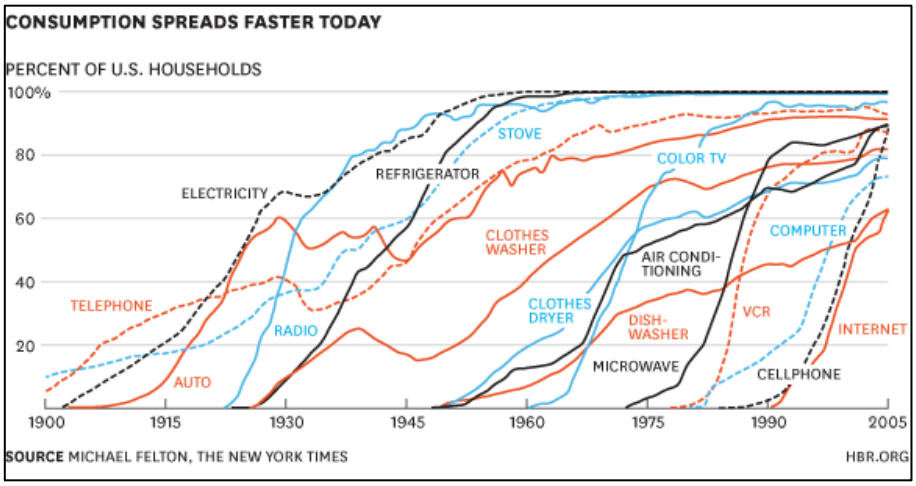

Figure 2 - U.S. Consumption Spreads for domestic devices, 1900-2005

The previous chart shows perfectly the differences in the time needed for a new technological device to enter into the market and is capable to help us in understanding that the last technological releases have a sharper

[1] "Compared to the previous industrial revolutions, the fourth is evolving exponentially, transforming more or less every sector, in all countries", Klaus Schwab (The Fourth Industrial Revolution).

[2] "The Pace of Technology Adoption is Speeding Up", Rita Gunther McGrath (Harvard Business Review).

curve. This is an important information as tells us that the devices, capable of communicate each other and keeping people connected, have had a greater impact on the final consumer, meaning that nowadays people's communicational needs are being satisfied in a shorter period.

In the previous part, where we saw the main differences between the Industrial Revolutions, we only spoke about the importance of knowing Data and to ability to communicate it, which is a field in which Industry 4.0 became important. In effect, nowadays the internet accessibility grew at a level in which every single last generation device (smartphone, tablet, pc, television, fridge, cars, alarm system, etc.) could both generate a network between them, through Wi-Fi or Bluetooth, and connect to the web, creating a link between this simple and basic network and the rest of the world.

Communication and **Information**, these are the two most important word in the 4.0 Revolution, combined with all the improvements reached in the last years on the net. Thanks to accessibility of the different information and the improvements in the communication capabilities, the technology adoption is rapidly increasing.

Nevertheless, all the previous features are perfectly referable to the economical world, as here, communication and information become as important as gold. Time and cost savings are the most important capabilities that a firm must obtain to maintain its competitive level in the years, as the competition is sharply increasing in every industry. The phenomenon related to the firms' technological acquisition and implementation increase with the number of competitors present in the same sector. In fact, competition pushes innovation through the easy access to new digital platforms for activities as R&D, Production, Sales and Distribution, making easier for competitors to overtake the market's historical players, improving quality, velocity and costs[3].

In conclusion, it seems that in this 4.0 Revolution, only the firms that consider Data and Information as a fundamental and strategic asset are the ones that will survive the competition and thrive. In fact, with the massive growth in Big Data and the Internet of Things (IoT), plus the evolving methods for analyzing data, the importance of Data across every aspect of business will only increase in the future.

[3] "Innovation comes from an agile and revolutionary competitions that, thanks to access to global digital platforms for research, development, marketing, sales and distribution activities, is able to surpass all the historical players, increasing quality, speed and value guaranteed costs", Klaus Schwab (The Fourth Industrial Revolution).

2.2. Principles

As seen in the previous chapter, exploiting this 4.0 wave is became important and fundamental for everybody, as it could concern and affect every single aspect of the person's life. Thanks to their ability in obtaining Data, companies are the first players completely interested in the development of strategies than involves this Revolution. Effectively, we have to imagine a process in which human is not considered just the classical "final consumer" (so, as the one from witch the firm obtains its earnings), but even as a source of information that must be used to develop a functional strategy. Therefore, even if the final customer is the last steps of this chain, he occupies one of the most important roles, as he generates the greatest source of information about every single aspect of the consumers' world. However, even if he is acquiring more power day by day, unlike in the previous revolution, he remains in a sort of peculiar "passivity" (that is reducing, of course). In fact, the industries are the only ones capable of exploiting all the information given by the consumers, creating strategies capable of influencing the same customers' behaviors.

For these reasons, we can easily consider the firms as the main player between State and Customers. The only ones that, just by organizing themselves, are capable of bringing to the real life the 4.0 Revolution.

Which are the main pillars of this Revolution?

We saw that every Industrial Revolution has had its own particular and unique characteristics, and the 4.0 one has Communication as its main feature. In the last decades all the communication infrastructures has faced great improvements, both in terms of fastening and security, decreasing the time needed to the user for surfing and reducing the "distance" between them and the company. Moreover, people are increasing the usage of their device, surfing and inserting information about themselves on the net. Companies such as Amazon, Google, Facebook and others (these can be easily included in the group of the most profitable companies that are exploit the 4.0 Revolution), are obtaining data without doing nothing: they just wait the user to search, buy or posting something. This is way communication has now became the main tool for many firms that have set up their core business on internet and even on the normal retail strategy.

However, this revolution has even led to a reduction in the time and cost needed to implement a firm internal net, in which all the devices and machines are linked together and are capable of exchanging information.

According to the Boston Consulting Group[4], the main pillars of the Industry 4.0 are nine:

1. **Big Data and Analytics:** These are the most important driver of this Revolution. Big data are extremely large sets of different data that may be stored and analyzed by the companies in order to obtain information about patterns, trends and association related to consumer habits. That is why communication capabilities and infrastructures are becoming fundamental for every kind of firm: data could solve firm's problems related to improvements on the development of strategies and helping the top management to analyze both the suppliers and the customers segments.

   There are two main difficulties the companies must face in order to exploit Big Data in a positive and functional manner:

   - **Collection and Storage:** Depending on the firm's core business, the collection and the storage of the data could be either easy or difficult. These two activities relies on the core business of the company, the more is related to the internet, the more is easier to obtain data.

     Nevertheless, we have to ask ourselves "Which data should a company obtain?" instead of "How many data should a company obtain?". For a company is yes fundamental the quantity of data obtained, as the more data you have the more information you can analyze, however is more important the quality of data obtained. In fact, this is where firms must decide where to focus their core business, exactly deciding about the quality of the data.
   - **Analysis:** This is the most difficult activity for every kind of business. Here is where the top management decides which are the fundamental data for supporting the development of the company's strategy. In fact, if we combine quantity with quality, analyst must face many terabytes of data. For this reason, by moving inside this jungle made by information and numbers, the understating of which data should be used and deciding how to use those data, has become the most complex ability that the analyst must develop. The importance of this skill is growing day by day, as nowadays companies are trying to build their strategies and set their competitive advantages through the analysis of data, in order to better comprehend how the firm's micro and macro environments are composed. Fundamental is even

[4] "Embracing Industry 4.0 and Rediscovering Growth" – Boston Consulting Group (BCG).

becoming the presence of a new manager capable of managing this difficult function and obtaining advantages for the firm: the Chief Data Officer (CDO).

We will go deeper in the analysis of the Big Data later, in the next chapters.

2. **Autonomous Robots:** The Autonomous Robots are robots capable of performing activities and tasks, for which they have been created, with a high degree of autonomy. Moreover, these robots are capable of interacting with the others, sharing the activities and increasing the cost-savings levels for the firm. In addition, these robots are programmed for working, side by side, with humans and learn the activities from them.

   The improvements made in the engineering, physics and artificial intelligence fields, have set the basis for a huge increase in the requests and in the acquisition of new generation's robots for upgrading the firm's production chain. Their objective is to reduce the time spent in human interactions and indecisions with the obtainment of long-term cost savings.

   The criteria used in the development of the Autonomous Robots are:

   - **Self-maintenance:** Robot's ability of monitoring, through sensor (thermal, optical, etc.), and launching auto-checks for understating if there are any kind of problems. Moreover, the new generations of Autonomous Robots are capable of self-docking to charge their batteries.
   - **Sensing the Environment:** Robot's ability of analyzing the environment around them and exploit the information obtained for the adjustment of the tasks, for reducing risks of interrupting the production chain or the battle-necks.
   - **Task Performance:** Robot's capability of programming the tasks in a specific order based on the information obtained from the environment. The future developments are designed on a skill called "Conditional Tasks", that is a functional logic built on the condition of proceeding the execution of the task if evaluated as "true" and to skip the ones evaluated as "false". Here, the objective is to avoid the proliferation of too many plans and reduce the time spent in the calculation of the activities.
   - **Autonomous Navigation:** The localization capability is the one that permits the robot to manage the previous skill. This is the field that is improving faster, as there are many machines that must exploit this technology in order to execute their tasks effectively, both indoor and outdoor.

   This Autonomous Robots are directly linked with the next generation devices, as these kind of robots could be applied in every field. Both for the ones applied inside the firms, which

are the ones used in the logistic or the ones directly responsible in the production, to the ones sold directly to the consumers. In fact, the 4.0 Revolution has improved previous machines used by people every day. The range is very wide: the machines and the tools used in the kitchen (fridge, oven, utensils, etc.), the ones used for cleaning the house (vacuum robots), for surveillance, for the maintenance of the garden (robotic lawnmower), to the autonomous navigation systems used for driverless cars.

The increment in the development of machines with applied autonomous robotics is strictly linked with the continuous increase in the firm's demand for customer data, and from these kind of machine companies are now capable of obtaining tons of different information.

3. **Simulations:** Simulations are used by the companies to comprehend which is the best possible way to implement the strategy decided by the top management. These analysis are made through computers calculations capable of testing and optimizing the machine settings in a virtual simulation before the physical changeover. The objective is two minimize the time needed during the production chain and to increment the cost savings for the company.

   Firms uses computer software as "AnLogic", "SimScale", "Simul8" and many others to exploit this useful tool. These software work by inserting all the production facilities (with their constraints in terms of quantity processed per hour, time needed for the process, etc.), they order them in different chains and calculate the different possibilities and variables by exploiting the simulations, finding the best way to organize the whole processes.

4. **Horizontal and Vertical System Integration:** Industry 4.0 is changing the way firms are inserted in the microenvironment. In fact, the spaces between the company and its suppliers and customers are reducing as never before.

   In the past, companies where trying to reduce the cost of raw materials by analyzing the market and choosing the best possible supplier capable of balancing the business's quality-cost standards. At the same time, they were doing the equivalent activities with the customers (above all for the wholesalers), but by balancing the price-quantity standards. The new managerial strategies suggest that the company must leave this outdated policy and adopt the new Horizontal and Vertical System Integration. This strategy allows company to switch from the old isolation, to an implementation of an innovative network that embrace every single player of the supply chain. The advantages coming from the

integration of this system is the construction of a cyber-physical net capable of increasing the level of automation, flexibility and operational efficiency into production processes[5].

The differences in the two kinds of integration are:

- **Horizontal Integration:** The Horizontal Integration creates a functional net for both the firms that have different production facilities and the one that share their activities on the entire supply chain. In fact, Industry 4.0 promotes integration across plant-level Manufacturing Execution System (MES), where facility data (inventory levels, unexpected delays, etc.) are shared across the entire enterprise and even across all the supply chain. There is even the possibility that the systems can automatically reorganize the production by shifting the chain among the facilities to respond quicker and efficiently to the production variables.

  Moreover, with the horizontal integration there is an increase in the data transparency and in the levels of automated collaboration across the upstream supply and logistic chains, with the information sharing about production processes, as well as for the downstream chain that brings the finished products to the market.

- **Vertical Integration:** The Vertical Integration is capable of creating an internal net that links the production fields with the upper R&D, quality assurance, product management, IT, sales and marketing. The information flows are transparent and constant through the net, in order that both strategical and tactical decisions can be data-driven.

  The advantages coming from this integration are related to the firm's capability of responding quicker and more appropriately with the shifts imposed by the market's changes.

Therefore, the final objective of the firms should be to create a more cohesive and cross-company data integration, where the networks evolve and enable the value chains to become always more automated.

5. **The Industrial Internet of Things (IoT):** Thanks to the decrease in the costs of technology, many new devices are now created with Wi-Fi capabilities and different sensors into them. Moreover, a more widely available Internet and a decrease in the cost of

[5] "Horizontal and Vertical Integration, as a requirement for Cyber-Physical System in the context of Industry 4.0" – Konstantin Chukalov (2017).

connection is making the penetration of these new devices to skyrocketing. These are the main reasons for whom the IoT phenomenon is booming[6].

It is possible to describe the Internet of Things as the extension of the Internet connectivity into physical devices. This means that every single object around us is already or could be connected to the net in the future. Analysts have calculated that by 2020 there will be more than 26 billion connected devices (there are estimations talking about more than 100 billion devices)[7]. This shows that the Internet of Things is not just a normal phenomenon, but is a trend that is reshaping the world, in a way in which all the devices are not just connected to the net, but they are even capable of being connected together.

The implications of this phenomenon are countless: imagine then every single device around you, especially the ones that you personally own, are capable of exchanging every single information they have about you (working calendar, personal heath, food tastes, habits, etc.), in order to support you in all your activities and to facilitate you daily routines. Moreover, this could be transposed to a broader scale, creating the "Smart Cities", which are the exact same thing but with all the devices, utilized in the city (transportation, traffic, waste management, water distribution, smart lighting, etc.), linked together[8].

The lives of millions of people is going to change thanks to these enormous improvements in the field. Every single human being will be surrounded by personal devices capable of transmitting information about what he is doing to other public devices that could manage and analyze the data coming from thousands of different other people.

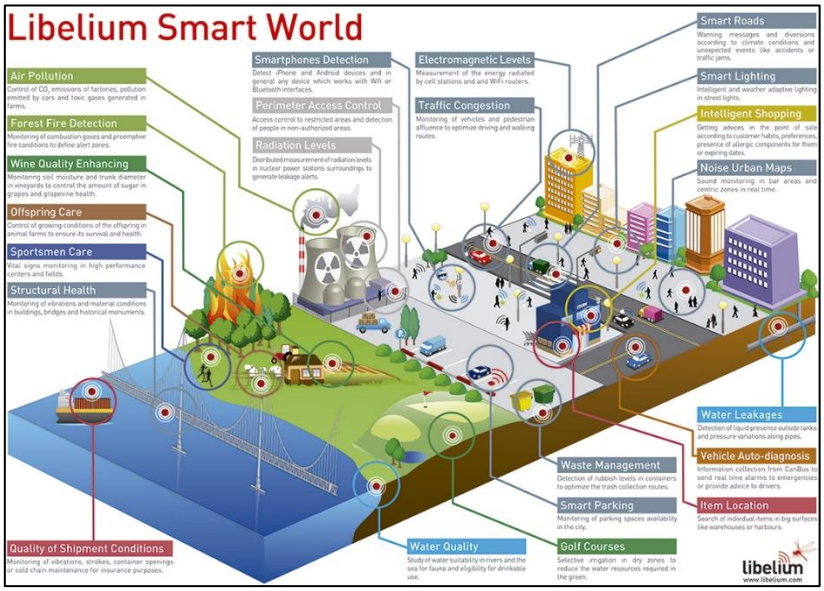

Figure 3 - The Libelium Smart World

[6] "A Simple Explanation of the Internet of Things" – Jacob Morgan (Forbes).

[7] "Internet of Things: the Gartner Perspective" – Gartner.

[8] "Libelium Smart World" – Libelium.

Currently, the applications' fields of the Internet of Things (IoT) are:

- **Consumer Applications:** This is the greatest portion of the IoT devices, thanks to the high demand and the more affordable cost. These devices can be clustered into the sequent groups: connected vehicles, home automation (the so-called "Smart Home"), wearable technology (inserted in the Internet of Wearable Thing, IoWT) and the connected health (capable of monitoring the user's vital parameters).

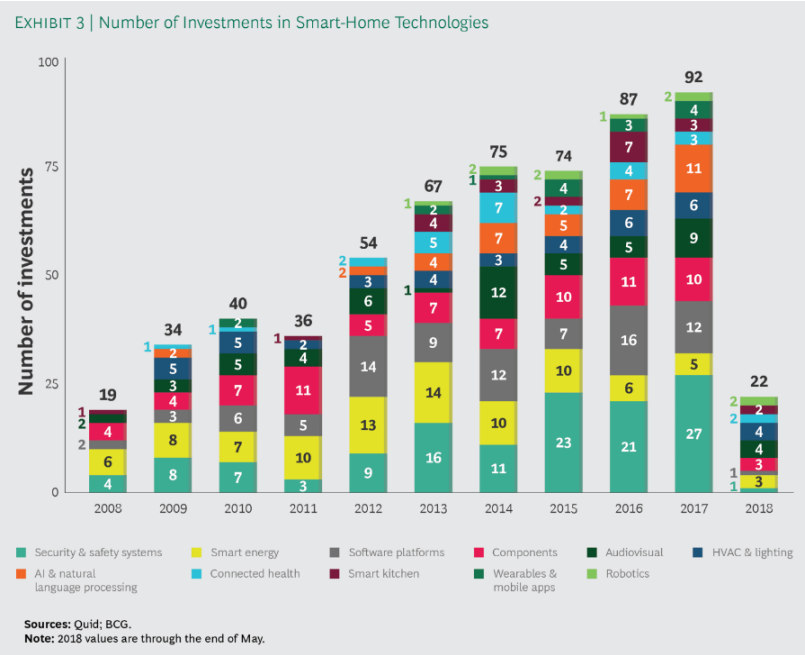

Figure 4 - Total amount of Investment in Smart-Home Technologies, 2008-2018

We can consider "Smart Home" as real phenomena. The previous graph shows that the total amount of the investment made in Smart Home segment has always incremented in the last years, with the "Security & Safety Systems" category capable of absorbing a big part of the investments[9]. This trend shows that people will is to protect their home and to purchase devices that apply touchscreens or voice command technology (for example the Amazon vocal assistant "Alexa").

- **Commercial Applications:** The main applications on the commercial field are related to Medical and Healthcare and Transportation.

  The Medical and Health application of the IoT (the "Smart Healthcare") has the objective do digitalize the healthcare system, by connecting the available medical resources with the medical services. The increment in the investment made on this

[9] "Mapping the Smart-Home Market" – Sonny Ali and Zia Yusuf (2018), Boston Consulting Group.

sector is strictly related to the increase in the demand of wearable technologies (IoWT). In fact, smartphones and smartwatches are now capable of monitoring the vital parameters (heartbeat, blood pressure, etc.), making possible for the doctors to have an immediate clinical picture of the patient. A study conduct by Goldman Sachs in 2015, reported that the IoWT devices can save, just for the United States of America, more than $300 billion annually, by both increasing the revenues and, above all, reducing the costs of the analysis[10].

Furthermore, the Internet of Thigs (IoT) is capable of improving the actual transportation level by creating a dynamic interaction between the vehicle, the infrastructure and the driver. The most importance advances are related to smart traffic control, smart parking, logistics and fleet management (vehicle tracking) and vehicle control (for increasing the level of safety).

- **Industrial Application:** This is where the Internet of Things is growing faster, thanks to the increase in the demand of new technological requirements linked with the current shift from the classical management methods to new ones. To better comprehend how quick this field is growing, in 2012 the worldwide expenditure for the Internet of Industrial Things (IIoT) were $20 billion dollar, the expected expenditures for the 2020 are $500 billion and the optimistic predictions for the 2030 are $15 trillion[11].

  The final objective is not just connectivity and acquisition of data, but is to lay the foundation and to design the par for future developments. For these reasons, new machines require some standard features, such as the autonomous navigation and RFID (Radio Frequency Identification). In fact, the will of the management is to increase their operational efficiency, trying to become the early adopters in a specific industry, in order to exploit all the advantages of being the first-movers.

10 "How the Internet of Things can Save the American Healthcare System $305 billion annually" – Goldman Sacks Report (2015).

11 "Driving Unconventional Growth through the Industrial Internet of Things" – Accenture Technology (2015).

Studies have shown that the adoption of devices and machines, cable of exploiting the IIoT, can boost the production levels up to 30% and decrease to more than 70% the breakdowns (with the reduction of the repairing cost by more than 30%)[12].

The most common machine for the Industrial IoT are related to R&D (computers and calculators), production (robots, cutters, lasers, etc.) and logistic.

Therefore, the Internet of Things is reshaping the economical world, by simplifying the way people do their normal or working activities.

However, among all of the, there is one player that obtains the higher benefits from the 4.0 Revolution: firms. In fact, a company produce its devices to sell them to the final customer in the market, increasing both its earnings and profits (as with the implementation of the "Smart Factory" the cost of production per unit decreases). Then, when the final customers use the company's devices, the firm obtains data and information from the user, fundamental for future development of the same devices.

Therefore, we can easily understand how enterprises obtains benefits from two different points of view:

- **Earnings and Profits:** By selling their final products, they obtain earnings and, by implementing IoT machinery, they gain higher profits (by reducing the costs). This can be observed in the long term, as firms must invest part of their liquidity in order to implement a functional production chain, capable of decreasing effectively the cost per unit.
- **Data and Information:** The devices sold on the market send back to the motherhouse data and user's information. Firms group all these information and use them to develop and improve their products.

This process is continuous, and the more a company obtains data and earnings, the more it will improve its own products. This is a very helpful example that let us understand better how important is, nowadays, the exploitation of data for companies.

6. **Cybersecurity:** Is the devices and machines capability to protect their systems from thefts and damages for both hardware and software. In the last years, this field has grown in importance thank to the increase in the wireless network and in the "Smart" devices. The

[12] "Driving Unconventional Growth through the Industrial Internet of Things" – Accenture Technology (2015).

objective is to create protection's protocols capable of defeating the dangers occurring to the industrial systems and manufacturing lines.

This increase in the security levels' needs has become even more fundamental with the firms' implementation of managerial structures that enable a vertical and horizontal integration. In fact, the exchange of sensible information between the net of the chain could be either interrupted or violated by intruders, resulting in a downtime of the production and incurring in losses.

Moreover, consumer could face the same security problems on their devices. With the increase in the demand for "Smart Home" devices, there have been a parallel growth in the demand for cybersecurity. Consumers want the company to prevent devices' breaches and to avoid data theft. In fact, the Internet of Things provides great opportunities for misuse for vandals and thieves that, with the increase IoT of application, will be able to threaten personal data in a greater way affecting the users more than with the classical "Credit Card theft".

7. **The Cloud:** The Cloud Computing is an on-demand availability of computer system resources. This tool is used, above all, for data storage and computing power, with the aim of increasing the device capabilities and the customer experience.

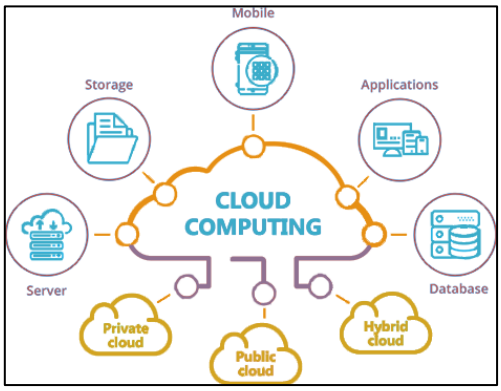

Figure 5 - The Cloud Computing structure

The structure of the Cloud begins with a series of Database, Servers (called bare-metal servers) and Applications that create the substrate for all the devices that exploit them.

The main characteristics of this tool are:

- **Increment of the companies' agility and productivity:** Companies could increase both their agility and productivity by sharing the activities on the cloud, helping people to work simultaneously on the same operations.
- **Multitenancy:** Cloud's ability of sharing costs and resources between all the users, as there is just one central location and all the capital expenditures related to the implementation and improvements (from the costs related to server's acquisition to

the ones related to the engineers' recruitment) are divided among the users. Thus, enabling the economies of scale.

- **Lower barrier to entry:** The costs share enable the new entrants (Startup) to become operative, profitable and competitive in lower time.
- **Device and Location Independence:** Allows companies to enter into the systems by browsing directly to internet and to avoid wastes of the physical spaces by utilizing them for the implantation of bare-metal servers.

The main limitation of the Cloud relies on the users' needs of data security that are related on the importance of protecting the company's most sensible data from cyber-attacks. Engineers are continuously finding new ways to encrypt data and to conceal them from thieves.

Moreover, many companies are adopting a new Cloud strategy called "Community Cloud", which is merely the construction of a common server farm, dividing all the costs and inserting data that are accessible to each other. This is exploited, above all, from the companies that are inserted in a specific industry cluster or from the companies belonging to the same supply chain. Therefore, its objective is to develop a new specific kind of vertical and horizontal integration, where data are easily shared among all the participants.

8. **Additive Manufacturing:** The last trend in firm's manufacturing and R&D functions is related to the "Addictive Manufacturing". This is an innovative process of creating three-dimensional objects and models exploiting 3D printers. The process is divided into three steps: firstly, an operator design the object on a computer three-dimensional software (the most utilized is the CAD), then he send the file to the 3D printer that produces the object through the utilization of polymer ink. At the end of the process, the operator proceed with the finishing part, where he smooths and improve through chemical products the object.

   The advantages coming by the utilization of this technique are mainly linked with the cost reduction in the production of models and with the increase both in the efficiency and in the possibility to create products with a higher level of sophistication.
9. **Augmented Reality (AR):** The Augmented Reality is just at its initial phase and is based on systems that supports a variety of services, such as selecting parts in the warehouses or sending repairing instructions on mobile devices. This tool is exploited through different instruments, as display, eyeglass, contact lenses, handheld and tracking instruments. These instruments enables more human-to-computer and human-to-human interactions than with

the conventional interfacing. Compared to Virtual Reality (VR), the Augmented Reality does not replace the natural environment with a simulated one, but it simply supplement the reality. The main advantages coming from the exploitation of this modern tool are:

- **Learning and Instruction:** The Augmented Reality is capable of improving the environmental learning. This can be utilized for training the employees, especially the ones that operate in the most complex processes of the supply chain, or even for the designers or engineers in the R&D function.
- **Communication and Interaction:** The Augmented Reality's ability of making communication more interactive is a fundamental and very useful tool for companies with works in different offices dislocated all over the planet. This tool improves communication through the addition of digital elements, such as images or graphs, in support to the normal verbal communication.
- **Business Improvements:** It enables business developers to observe the product design before sending it into production. Moreover, as said before, Augmented Reality can improve the communication also inside the company, for example by enabling the engineers in the remote support of a direct production worker (giving visual instruction through eyeglass). This reduces costs and improves the collaborative levels inside the organization.

These are the nine Industry 4.0 main pillars that firms must exploit in order to maintain high level of profitability and beat the industry competition.

Therefore, we can easily notice the presence of a common thread among all these tools and devices: companies are now able of obtaining data and information in the easiest way possible, both from the customer and from the company itself. This is the real reason why Industry 4.0 is changing as never before the complete economical world, because nowadays the management quality analysis passes through the ability of exploiting data and the implementation of a functional strategy. Every single device is capable of advantaging the consumer but, at the same time, to capture information from him, creating a sort of user's profile in which are inserted all the data obtain by the device. Moreover, even if people know that tech giants are using their personal information for increasing their profits, they still do not want to change or shift to more secure companies: this is the so-called

"Privacy Paradox"[13]. People consciously insert information about their life into the net, but at the same time, they ask for more privacy, knowing that the best way to have more privacy is by not inserting personal information on the net.

However, now the analysis will go deeper into the Big Data world and we will understand how they drive the management in the strategy's implementation.

2.3. Big Data and their Analysis

Previously we saw that Big Data are one of the nine pillars of the Industry 4.0 and that, nowadays, are considered the main driver of this Revolution. The main activities for the companies relies in obtaining and analyzing these data.

How is possible to define and identify the Big Data?

Data and information are commonly classed as Big Data exclusively if they satisfy at least one of these four main factors, the so-called **Five V's**[14]:

1. **Volume:** That refers to the huge amounts of data generated every single second. In fact, we have to understand that firms no longer operate with small quantities of data, but with petabytes (10^{15} bytes) and zettabytes (10^{21} bytes) of data. Moreover, these are too large to be stored in the traditional ways and too complex to analyze using the traditional database technologies.
2. **Velocity:** That refers to both to the speed at which new data are generated and to the speed at which data move around. This is important as in the past, companies were storing information to be used in a successive period, instead, today, there have been created software capable of analyzing data simultaneously. This, in order to not lose the quality and the functionality of the data.
3. **Variety:** That refers to the different types of data firm can work with. In the past, the only data capable of being stocked and analyzed where the ones that where fitting into tables or databases. However, Big Data are different as the types of data are changing, the outdated way of storing them does not work anymore.

13 "The Privacy Paradox: why do people keep using tech firms that abuse their data?" – John Naughton, The Guardian (2019).

14 "The Five V's of Big Data" – Anil Jain, IBM (2016).

4. **Veracity:** That refers to the messiness or trustworthiness of the data. This means that data are no longer ordered in a specific and normal way. Imagine how difficult could be working on the social network data, where there are photos, abbreviations, slang or post with inaccurate hashtags.
5. **Value:** That refers to the data's ability of generating value for the enterprise. Being able to work with vast volumes and many different varieties of data become useless if they does not lead to any real business value.

   Therefore, this is considered the most important among the Five V's as the most important data's capability for the firm is their ability in generating value for the company.

The more we proceed in the development of new technologies, the more we will be able to analyze and obtain more reliable information from greater amount of data. The only problem relies on the fact that even the data are changing too, making the whole process more complex than ever.

We have always to remember that the smartest companies are the ones that create a system capable of collecting or generating data automatically. These data could come from users of a specific product or machines and from the manufacturing line. Therefore, we must not forget that there are specific companies, such as Experian, Amazon or IBM, that sell valuable data to third parties. Consequently, firms can obtain different data from different methods.

How should the market classify and group the Big Data?

We just saw that data can be obtained we different methods and can come from different places. For these reasons, the market classifies the data in these four groups:

1. **Structured Data:** These are any data or information that could be located into a fixed place with a defined file or record (typically on databases). To simplify the concept, this data are the ones that can be organized into rows and columns and managed easily through simple programming languages, as the Structured Query Language (SQL).

   The most common example of Structure Data includes customer data, sales data, record of the transaction, financial information, number of visitor on web pages or every other data coming from the machineries of the production line (time records, temperatures, percentages of errors, etc.).

   These are the most used data, as are easily obtainable and analyzable, however, these data represent, at least, just the 20% of the available data in the world, making them exploitable, more or less, by all companies. The downsides of these data relies precisely on this

motivation, with in addition the fact that they are simple and less rich in insight than others kind of data are.

The advantages relies on the facts that are very cheap to obtain and use, are easily storable and they are easy to analyze. These data can be queried and used in different way even by not-analysts employees.

2. **Unstructured Data:** These are the remaining 80% of the world's data. The Unstructured Data are aby kind of data that could not be located into traditional structure or databases. The main examples of Unstructured Data are the e-mail conversation, website text, social network's posts, photo, video and audio recordings. In the past, these data where rejected because they were not insertable into spreadsheets or were printed and stored in document folders.

   These data have become very important with the latest improvements on the storage field and with the advances in analytical tools. The downsides of these data are that are very complex to store and, above all, the analysis requires specific and peculiar software, that increase the whole cost level for the company.

   Although, the advantages are incredibly high. Differently from the Structured Data, the crucial advantage relies on the picture wider picture that these data can provide. In fact, the first ones tell us *who, what, where* and *when*, while the Unstructured Data help us in understanding *why*.

3. **Internal Data:** The Internal Data refers to the all the information that a business owns or the ones that potentially could obtains. These data can be either Structured (transactions records, sales data, financial information, etc.) or Unstructured (employees interview, customer service calls recordings, etc.). The advantages of these data rely on the lower costs associate with data (as are internally generated), they are easily storable as the company can choose the method of obtaining them, and they are private, in the sense that nobody else could exploit them. The most important feature is that the real value of the Internal Data relies on the fact that they can be tailored to the business or to the industry necessities, making them very useful for the company. Fundamental is to always combine Structured with Unstructured Data in order to obtain a wider overview of the market.

   On the downsides, is the fact that for obtaining and maintaining these data, in particular the personal ones, sometimes are required legal permissions, and, moreover, the exclusive

utilization of these data, that without the combination with the external ones, do not provide enough information to meet the strategic goal.

4. **External Data:** The External Data refers to all the information that exist outside the organization. These data either could be publicly available or owned by third parties. Moreover, as for the internal data, these could be either Structured or Unstructured. The most common External Data are the internet resource engines, the weather data, the government's census and the economic data.

   The main downside of these data relies on the fact that the company will never own the data and for exploiting them, they have to pay for their access, increasing the risk for the company. In fact, if a company buys fundamental data from third parties, the operation will be riskier as there would be the possibility that this supplier could fail, so, companies must balance the cost and the risk to find the right path. While, the main advantage remain the fact that just the bigger company (as Facebook or Amazon) have the capabilities, the infrastructure and the budget to manage these huge amount of information, giving the possibilities to small firm to have access to these data without having to implement such structures (as this would be impossible due to high costs). Furthermore, external data are richer in insights than the internal ones, and for this reason the combination of the two gives the best possible market's picture to the company.

To summarize the previous concepts and to better understand how companies can exploit these data, we can say that the companies can obtain data either internally or externally.

After having identified the data needs, a company should understand if this need could be answered through an internal generation of information and if it has the capability to obtain them. If yes, the firm could gain information from its systems, products, customers and employees. In fact, the firm could gather data from every kind of app, software or digital process, and by questioning the user and capturing the answer. Crucially, a company should create the capability to obtain data in every single aspect of the product or service (for example through sensors), in order to link continuously the consumer to the motherhouse.

Although, if the company needs a specific kind of data that could not achieve through internal structures, it can obtain them through the market, as the market of selling and trading data is rapidly rising. Moreover, there is an incredible amount of valuable data collected and shared by the different governments, scientific organizations and not-for-profit companies. For example, the

census could be very useful for companies, as it gives useful information about the population, the geographic data, and the education data.

How could companies analyze Big Data and transform them into insights?

In the process of data utilization, the company has to decide which are the fundamental data necessary for the firm's correct and functional strategy implementation. After they have found the perfect data, their next step is to identify how to transform these data into useful insights. This process is done through **Analytics**, which summarize the concepts of collecting, processing and analyzing data for the generation of insights capable of improving the way firms do their businesses[15]. Therefore, the objective is to study historical data in order to find a wider picture of the industry, discovering which are the specific trends of the future years and creating a new firm's knowledge capable of improving operational performances, monetize data and reach the strategic goals decided by the top management (or by the majority shareholdings). The key point is to better understand more about the industry in which the firm operates and transforms the data collected into the most important of the Five V's, that is **Value**.

In the past, as said before, the Data Analytics was done through the use of spreadsheets and simple databases, or utilizing the SQL technology. This was simple but truly efficient, as every single company, even with a simple structure implementation, was able to store data and exploit theme when necessary. However, the world's data production has increased is such a rapid way that, nowadays, every two days we are creating the exact amount of data as we did from the beginning of time until 2003, generating billion's data about post, likes, impression, transaction, track, movements and many others. The only way to deal with these huge amounts of data is the Cloud Computing. The companies' capability of storing and analyzing data increased sensitively with the exploitation of this tool, creating a real technology advantage in the field.

These facts, with in addition the analytical power generated by the Cloud, have developed many new techniques and tools for analyzing data, that business are using today to meet their goals. The most used tools, for both Structured and Unstructured Data, are:

- **Text Analytics:** Is a process capable of extracting value from large quantities of unstructured text Data. This is a useful tool for the companies that can help them in

[15] "Data Analytics: IT Definitions" – Gartner.

obtaining information about all the not used text data. This is done through the document categorization, clusterization or summarization.

- **Sentiment Analytics:** Is a process, known also as Opinion Mining, which aims to extract subjects' information, opinions and sentiments from test, video, picture and recordings. This is a very difficult tool as the implementation is very expensive and software are going to analyze the people's voice tone, facial expressions, text abilities and others. The objective is to answer the firm's questions about how a product is going on the market or what does the stakeholder thinks about them.
- **Image and Video Analytics:** Is a process, similar to the previous one, where the software analyze and obtain insights from social network, medical, industrial pictures and videos. Their main purpose is to build a storage of data about people's faces that increases the firm's ability and competitive advantage in facial recognition.
- **Data Mining:** Is an analytic process designed to explore very large business data sets with the final objective of finding commercially relevant information and patterns that can improve firm's performances. The final goal is the prediction's ability, which can give suggestions about future trends that firms should follow in order to improve their market positions. This one of the most difficult tool as the analytical model, fundamental for the data's exploration, requires high development times and is very capital intensive.
- **Business Experiment:** Is a technique used by companies to test the validity of their choices in every single aspect of the firm, from the strategic hypothesis to marketing approaches. By inserting all the hypothesis and by designing the experiment, the firm will obtain information capable of answering their questions about if or not apply that single strategy.
- **Statistical Analytics:** Are all the processes that analyze data through statistical techniques. The most common one are the Correlation Analysis, the Regression and the Scenario Analysis.
- **Forecasting Analytics:** Is the process of analyzing series of data in order to obtain information about future trends or events.
- **Neural Network Analytics:** This is one of the most advanced and complex analytical tool, as it is a computer program modelled on human brain. It can process a great amount of information, as humans do, in order to find patterns about how people think or behave. This tool become very useful when a firm owns a very large set of data and wants to forecast the future. However, not as in the previous ways, but by extrapolating the forecast

directly from the way people think. The only disadvantage of this tool relies on the fact that is very expensive, as it requires a great number of engineers and physiologists for the implementation.

- **Meta Analytics:** Is the final tool that exploits all the previous methods, and others, identifying patterns and trends. Summarizing the concept, this a tool that combines all the previous results giving the best possible market picture to the company.

These are the most exploited and common methods for exploiting Data Analytics. Moreover, the very last advance in this field is called **Machine Deep Learning**, that relies is capability in developing software capable of deciding the best course by themselves, basing the decision on the past actions, and without any human interaction. Exploiting the cognitive computing, this software understands how people think and behave.

Therefore, we can say that there are many different ways of analyzing data for obtaining information capable of helping a company. However, the best possible solution for the normal company is to decide a budget for these analysis and not to focus on just one method but balancing the information coming from different tools (especially two or more that analyze different inputs).

How does Big Data creates Value for the company?

We said that the Data analysis is the way in which a company obtains useful information, capable of improving its strategic ability of increasing its performances. However, how should the process of data analysis transforms into **Value** creation for the company?

Data and Data Analytics has become one of the main key business asset and the ability of transforming insights in money is the one searched by the companies. At the same time, experts suggest not to focus the whole company in obtaining as much data they can in the hope that one day they will become useful, but to focus on just the ones that the management reputes fundamental for the strategy implementation. However, nowadays has emerged a figure that works by collecting the more data it cans, and is called “data broker”.

Therefore, even if at a first sight it seems that the only source of value relies on the firm’s ability of exploiting data for increasing both earnings and profits. However, we have to understand that now companies are being bought and sold for the data they own or for their ability in analyzing data.

For these reasons, there are three other aspects for the monetization of data, which are:

- **Data as Core Business Asset:** This aspect affects the companies that works with great amount of data. In fact, collecting, owning and being able of obtaining insights from data is a way of increasing also the enterprise value for the external investors, for possible buyers and for the stocking exchange. The more data you can manage, the more valued will be the company.

  To better understand this concept, we have to think about the Microsoft acquisition of LinkedIn, for the incredible amount of $26.2 billion dollars[16]. LinkedIn is a peculiar social network that links its users with the companies that are willing to search new employees. Therefore, there core business of this company is to create a business-employed service by collecting data from both players. At that time, they were having CV and working information of more than 430 million users and companies, making the company very desirable for the tech giants as they could merge its data with their.

  This is way data are fundamental even for increasing the company asset's value, because investors are looking at the left part of the balance sheets, searching for high intangible capabilities.
- **Ability to Work with Data:** Data brings an enormous value to the enterprise, but if the company is capable of analyze them and obtain useful insights, its value will increase even more. In fact, data become especially valuable when a company is able to combine the collection with sophisticated systems, app and algorithm that extract insights from data. An example on this aspect could be the Facebook acquisition of Face.com for its capability in facial recognition.

  The main advantage is that even a small firm, by just analyzing a small quantity of right data instead of amassing incredibly huge amount of data, will boost their overall value of the company and become more attractive for the investors.
- **Selling Data to Customers or Interested Parties:** Another way in which data could create extra value for the enterprise is relate to the possibility of selling the access of their data or collaborating with interested parties that need their data. Therefore, companies must analyze widely and transversely the market in order to understand if there are any enterprises that may need their data and start to commerce with them.

[16] "Microsoft to Acquire LinkedIn" – Microsoft News Center (2016).

The common example is related to the Smart Healthcare, in fact, as said previously, the market is booming and the companies that are producing devices capable of obtaining real-time users data are even capable of selling them to other firms. After the release of the Apple watch, Apple collaborated with IBM Healthcare for sharing the information captured by the Apple's devices, giving to IBM insights for the development of health-related apps[17]. The downside of this aspect is related to the user's privacy, as, depending on the country' regulation level, company must ask the customer for the utilization of personal data. However, for the "Privacy Paradox", the more a company has higher reputation, the more users are willing to give permission for the access of their personal data[18]. Moreover, exploiting the previous example, this is also referable to the market: who is going to deny the access of its personal data if those data could save its life by discovering potential disease before the normal times?

Therefore, the key aspect that the companies should apply in the correct implementation of the data strategy is to create a system where data are generated automatically by users, company or other companies. This will requires minimal effort in collecting data and the firm can spend more time in deciding how to develop the analytics part. Proceeding in this way, firms will obtain higher revenues and increase in asset value.

Now, it is very understandable why Big Data, as the main driver of the Industry 4.0, became such important for the companies. We have just to check between the most valuable Fortune 500 companies to prove what we just saw. In fact, already in the past years the trend was to invest massively on data or to build the core business model on data. In 2016, among the Top 5 companies, we had four that were doing this: Apple, Facebook, Alphabet and Microsoft[19]. These companies are all fighting each other for obtaining the higher amount of data and increase their profitability, but, at the same time, they operate in different sectors, so without damaging the other competitors. Nevertheless, these firms are united together in their ability of collecting data and analyze them.

17 "IBM launches new Health unit, teams up with Apple, J&J, Medtronic" – Bill Rigby, Reuters (2015).
18 "The Privacy Paradox and the Marketer's Dilemma" – Jessica Taylor, Forbes Communications Council (2018).
19 "Fortune Global 500" – Fortune (2016).

By the end, it seems that the future prospective shows that the data-based companies will continue squeezing the traditional markets and firms, unless even in the other market there will be a Data-Driven revolution.
This makes the Industry 4.0 a circular and irreversible process of development, which will reshape every sector and how humans behave.

2.4. Impact Areas within the Companies

We saw that the Industry 4.0 is affecting many different markets and even different players. However, now we are going to focus directly on the firm's strategic aspects and areas that are now facing a great wave of change with the implementation of some of the pillars presented previously (in particular the Big Data, as are the main ones and are the driver of the other pillar).
There are millions of companies around the world, each with its core business and strategy. The ones that are competing in the same industry must gain a competitive advantage in order to beat the competition. This is where data enter into the battleground.

Which are the impact areas touched by the Industry 4.0?
To answer this question, firms must decide which kind of data they need for their businesses. In order to be useful, data must address a specific business need, help the company to reach the top management objectives or generate value for the company, as we saw previously. Therefore, a company should never build a strategy on the data in possession, but vice versa. In fact, data must help the company in reaching its goals and not build the strategy. Why data, instead of other features, are the main driver of the industrial changes? Simply because only data analytics can answer management's question about their company and, exactly for this reason, is the first step of the possible 4.0 Revolution that could begin inside of a firm.
After having implemented the strategy, based on its core business, a company must choose which the right data are. To do this, is important to understand how the company would want to exploit these data, and usually they will need different kind of data to answer different needs. In fact, as we have seen in Chapter 2.3, there are different kind of data that could be very useful for a function and totally useless for another one. For example, sensors data are extremely useful for improving the manufacturing function (reducing costs and promoting efficiencies), while, at the same time, they could not able to give any insight about the possible customer demand for a new product.

Data can help the company, by affecting the way it operates and how it is managed, in a countless number of methods, which can be grouped into three big categories:

1. **Improving the Business Decisions:** Data are becoming fundamental for firms' decision-making processes. Moreover, data should be inserted at the center of these processes, as they are capable of providing precious insights that can answer the top managers' questions about the company.

   The step after the decision of the strategy, in order to obtain the highest possible outcome from the answers, regards the managerial decision of questioning themselves on these four organization's areas:

   - **Customers, Market and Competition:** This is the field where managers can identifying the questions that will help them in building a complete and detailed picture of the firm's consumers, market and competitors. The key business question in this area could be: Who are our customer? How can we segment them? How satisfied are our customers? How our brand is perceived compared with those owned by our competitors? Do we establish a long or short relation with our customers? Which marketing or sales channels strategy is more effective?

     These questions are mainly related to the organization's sales and marketing function. In fact, managers must exploit data in this field for obtaining precious information for developing successful sales or marketing campaigns. For example, marketing channel analytics could answer the managers' questions about which should be the most profitable marketing channel to be exploited for a positive campaign. In fact, Data Analytics is the most important tool for mapping the customers and the markets, giving to the managers the necessary information for completing the implementation of the strategy.

   - **Finance:** The final objective for the managers here is to answer to all the questions related to the finance and its implications. Obtaining information about the main financial key drivers is fundamental to predict the possible future cash flows and share-price performances. The key business question in this area could be: What are our most and least profitable products? Which are our sales, revenues and profits trends? Which are our greatest cost-savings opportunity?

     These questions, combined with the previous ones, can complete the company's customers profiles, for example, by segmenting them into groups based on their

buying habits. These could improve the firm's ability in becoming more profitable by focusing prevalently on the most important clients and, moreover, by going deeper in the analysis, managers can also understand which are the main zones in which the firm's is obtaining higher profits, in order to improve the future strategies implementations.

- **Internal Operations:** Here managers can obtain a wider picture of the whole supply chain players, from the suppliers to the distribution. Moreover, they can better understand the efficiency level of the company's production chain, by analyzing the internal systems and competencies. The key business question in this area could be: How can we optimize the supply chain? Are our machine fully exploited? What are our capacity bottlenecks? How can we improve the efficiency of our operations?

  To answer these questions, managers should implement a Project and Program Analytics System capable of giving the right insights for future improvements of the supply chain. This can give to the managers the necessary tools to understand if things are not going in the right way and reprogram the processes, by taking the right corrective actions.

  This field is the most complex one among these as it could have many different facets, and for this reason, we are going to deeper its analysis on the next chapter.
- **Employees:** The manager decision-making passes even through the labor quality, as checking the employees "health" is fundamental for the company. Employees are one of the most important enterprises' asset and being able to exploit them in the best way possible is a key point for a profits increase. The key business question in this area could be: How engaged are our employees? How efficiently do we employ them? How productive they are? Which are the best recruitment channels? Which are their risk of leaving the company?

  By exploiting the Employee Analytics, through interviews and surveys, managers can answer all the previous questions and even understand how the company could became more attractive for new employees in order to gain new external experience and increase the value of this fundamental asset.

2. **Improving the Business Operation:** This field is strictly connected to the previous internal operation decision making. This area is one of the most important for the company, as is could be mainly related to the core business. Being capable of exploiting the Industry 4.0

main drivers and, of course, data are the central objective of the management. In fact, the supply chain is where the firm can improve its profitability, by both decreasing costs and increasing the efficacy levels.

The economic world has moved, in the years, from a human-to-human interaction level to a machine-to-machine level. Thanks to the Internet of Things (IoT), now the machines employed in the production chain are connected together and can exchange information. This ability, in addition with the implementation of production sensor, are decreasing the difficulties in obtaining synthetic and useful data from the machines. Moreover, the Machine Deep Learning are simplifying the process as never before.

It is possible to improve the business operations through these two systems:

- **Optimizing the Operational Processes:** Data analytics and planning can optimize the way firms run their operational processes. Managers can should analyze systematically at every single aspect of the operations in order to improve the processes and maximize the possibilities of reaching the fixed goals.

  The main processes touched by data analytics are: Manufacturing (monitoring machinery, reduce downtimes, prevent bottlenecks, etc.), Warehousing and Distribution (reduce delivery times, create automatic stock control, etc.), Business Processes (customer and employees fraud) and Sales-Marketing (increase customer loyalty).
- **Improve the Customer Offering:** Data Analytics can also help firms in improving their customer offer by offering better products or services. This data exploitation can add value in two different ways: the first by obviously increasing the revenues and the other relies on the increase in the customer loyalty (with the increase in the brand value).

This is a very wide field in which the Industry 4.0 has toke its roots and, as it is the core topic of this paper, will be analyzed deeper in the Chapter 3 and the sequent. In which we will better comprehend how the Data and the IoT are changing the way firms are exploiting the supply chain and the operations, in general with the final aim of streamlining the whole process, increase the efficiency and increment the profitability.

3. **Exploiting the Data as an Asset:** Firms, as seen in the previous Chapter, can exploit Data to increment the value of the company in three different ways: increasing the enterprise

value for its ability in collecting data, for its capability of collecting and analyzing data or the core business of selling analyzed data to interested parties.

These are the three main areas where Industry 4.0 and the Data Analysis are capable of increasing both the firms' value and the capability of becoming even more profitable. The important part is that companies must comprehend how to balance the Industry 4.0 impacts, weighting the processes and creating a project capable of radically transform the company in a 4.0 firm.

2.5. Organizational Resources for an Efficient Development

To obtain the desired effects in the Industry 4.0 implementation, firms have just one last steps to do. We saw the pillars of this Revolution, what are the Big Data and why they are the main driver of the revolution, we understood how companies should develop the analytics process, how to transform data into insights and insights into value, and, finally, which are the main areas that benefit from this Revolution. Therefore, the last notion we are missing in the picture is related to the organizational resources needed for the perfect implantation of the 4.0 Revolution.

As all the information (internal, external, structured or unstructured) utilizable by the company are data, the firm must reassemble the organizational resources in order to answer the needs of these two groups:

1. **Technological and Data Infrastructure:** This is the first moment of the process in which firms transforms the concepts into physical things. The aim here is to create a solid infrastructure capable of answering the managerial strategies.

   Working with a great amount of Data and Information, for a company, is very difficult and expensive. In fact, there are very high costs related to the infrastructure (hardware and software), the storage and the group of IT engineers needed for maintaining efficient the whole process. Luckily, the revolution has produced new players that can provide part of all the previous services to the companies, making possible even for the small realities to work exploit these tools.

   We have seen that, to become useful, data must be transformed into insights, and, to obtain this result, firms must implement an infrastructure that includes the sequent elements:

   - **Data Collection:** Is how the company obtains their data. There are many ways to obtain them, however sourcing new data could require new and high infrastructure investments. Nevertheless, nowadays companies have developed many

sophisticated tool (that costs less and obtain more data) connected with the Internet of Things (IoT) world. Depending on the specific data needs, the companies can exploit: Sensors (that could be inserted more or less everywhere), Apps, Smart TV, Smart Home devices, website cookies and many others.

There is even the possibility to skip this step by accessing to external data sources.

- **Storing Data:** After having collected the data, firms must create a storage system. There are several options, from the dated hard disk to warehouse and data lakes. The choice is mainly left to the spending capability of the enterprise, as the more they could spend, the more they can implement an internal storage system.

  The most advanced storage technique is the Cloud Computing that, as said in the Chapter 2.3, is capable of improving the firm's storage by lowering the cost and improving the security level of the data.
- **Processing the Data:** We already encountered this element previously, when we talked about the diverse possibilities that companies can exploit for the data analytics. However, firms can decide if develop internal software or taking advantage from open-source technology available in the market (software developed by Amazon, IBM, Microsoft and others).
- **Providing Data Access:** The final element relies on the firm need of transmitting the insights extrapolated in the previous step and transmit it to all the employees that need them. The market can provide Data Hubs, where companies insert their data and make them available to every single employee in the enterprise (imposing some permission requirements).

All the previous elements can be both developed internally or exploited external resources. Moreover, firms can even decide to just focus on part of these elements and acquire the access for the utilization of external software and applications. These choice relies in the firm strategy, as from this is reflected the willing of implementing the structure. For example, if the top management thinks that the data must not be shared with other parties, the firm must use its liquidity to implement the whole elements. However, at the same time this could be a risky strategy, as such great capital expenditure without right economical returns, can lead in high losses, bringing the company to the failure.

2. **Data Competencies:** Data Competence is the second vital requirement for the insights creation. In fact, companies must develop skills capable of deciding which data are fundamental for achieving their goals.

   Firms can decide between investing money in the formation of part of their employees or hiring talents that can bring their past experiences into the company. The advantage here is that is not necessary to form all the employees, but just the right ones (at least one or two for single function) and later divide all function into groups in order to let them explain "on the field" what they have learnt.

   Five skills are evaluated as fundamental for the right creation of internal competencies through all the hierarchical processes:

   - **Business Skills:** Ability of understanding the business processes, the objectives and the core metrics that are capable of creating competitive advantage against the other competitors. Moreover, this is the skill exploited by the managers, which are the ones that set the strategy for the entire company.
   - **Analytics Skills:** Ability of understanding which are the best possible patterns and the capability of choosing the best possible way of analyzing data in order to gain functional insights needed by the top management.
   - **Computer Science:** Capability of connecting the physical to the metaphysical. This skill require employees that are capable of combining machine learning with the creation of algorithms.
   - **Statistics and Mathematic:** These two skills are fundamental for the enterprises that work with great amount of data. In fact, sometimes can be difficult to find the right patterns to extract insights from the data, and these abilities can help the company in revealing information that probably would never be found.
   - **Creativity:** Is the emerging skill required by companies. Big Data are difficult to deal with, so employees that are capable of coming up with new and innovative way of working with data are very desirable.

   It is recommended to hire employees that already have some of the previous skills and, possibly, that have past working experience for tech companies.

These are the two group of competences that firms must deal with if they want to achieve the management's prefixed goals. However, before taking their strategic decisions, companies must balance the cost expenditures with the desired benefits. The implementation of all the previous

competencies require high investments and lot of time. This kind of choice is recommendable exclusively to those companies whom want to focus their core business in the Data Analytics (and have higher liquidity capacity).

Therefore, it is fundamental to understand which are the real needs of the company by analyzing the whole process to find where and if there are any gaps that can be transformed into competitive advantages.

2.6. Industry 4.0 Trends

The Industry 4.0 is the greatest economic revolution of all time as it is involving all the possible players: Companies, People and State. Every one of them is sponsoring this shift. In fact, it is possible to divide these three macro-groups according to their activity: companies are the main driver, People are willing to obtain all the advantages coming from the 4.0 Revolution.

What is the State doing for encouraging companies to proceed in the 4.0 implementation?

The State is the second most important player as it gives advantages to the firms who are willing to start the implementation of the Industry 4.0 and enter in the group of those firms that achieved this objective. For example, the Italian Government, in 2016, has implemented the "Piano Nazionale Industria 4.0", that is a national plan that has the aim of unlocking private investment for more than 10 billion of euro, increase in the access of the broadband connection and development of a new educational plan.

Moreover, the state support relies in the possibilities, for the firms that wants to substitute part of their r production plan, to exploit iper-depreciation (250%, for the development of new technologies), super-depreciation (140%, for the acquisition of new technologies). More facilitation on demanding bank loans, facilitation for innovative startups and a state guarantee fund (guaranteeing the 80% for the investments lower than 2.5 million euro)[20].

These kind of initiatives have been taken by many governments around the world, as developing a new industrial economy, based on the Industry 4.0 drivers. In fact, being capable of creating a functional economic framework, is the base for remaining competitive among all the different other states, as the completion existing between companies is the same that exists between Countries.

[20] "Piano Nazionale Industria 4.0" – Ministero dello Sviluppo Economico (2016).

Which are the trends in the implementation of the Industry 4.0?

According to the PricewaterhouseCoopers company reports, around the world the 4.0 phenomenon is rising year by year. In fact, in 2016, one third of the interviewed companies where rating their digitalization level as high, and this number will increase from 33% to 72% until the 2021[21].

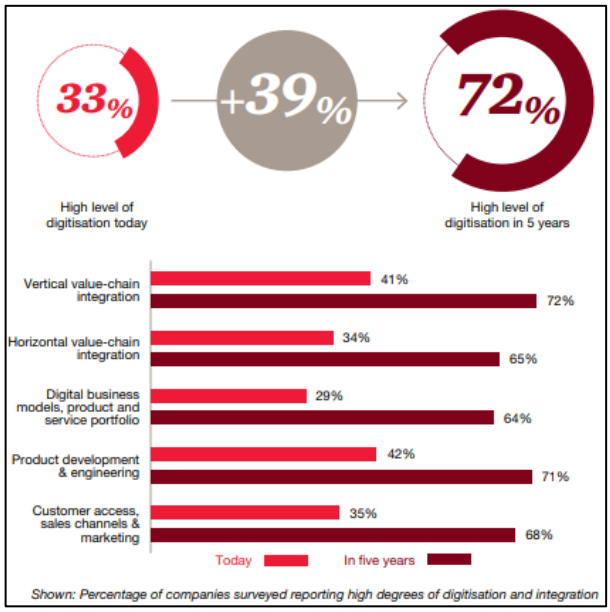

Figure 6 - Companies expect to more than double their level of digitization by 2020

Moreover, this worldwide rush is nourished by the fact that the first movers are the only companies that are capable of obtaining higher success in the implementation of the Industry 4.0, combining reduction in costs with an increase in the revenues (they are 27% more successful than the average).

We said that the final aim for the companies is to combine cost reduction, increase in revenues and efficiency improvements. However, this is correlated with huge costs for implementation. The PwC survey[22] discovered that, yearly, the capital expenditures, for the investments in Industry 4.0 applications, amounts to $907 billion dollar. In addition, these investments are reflected in the increase in revenues for $493 billion (making the expected ROI period about 1.9 years).

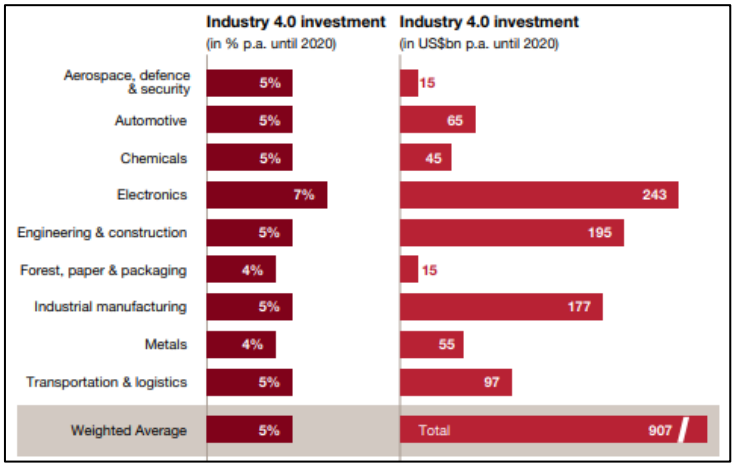

Figure 7 - Companies in every industry sector are planning substantial investments

[21] "Industry 4.0: Companies worldwide are investing over $US 900 billion per year until 2020" – PwC Belarus (2016).

[22] "Industry 4.0: Building the Digital Enterprise" – 2016 Global Industry 4.0 Survey, PwC (2016). This report surveyed over 2,000 companies, form nine different industry sectors and in 26 countries.

Moreover, the expected ROI declared by the companies (calculate internally) is about two year from the capital expenditure date. For these reasons, company are directly facing the advantages coming from the implementation and the average is willing to invest 5% p.a., of the total company investment, for digital operations solution (the 20% of the interviewed are willing to invest more than 10% p.a.).

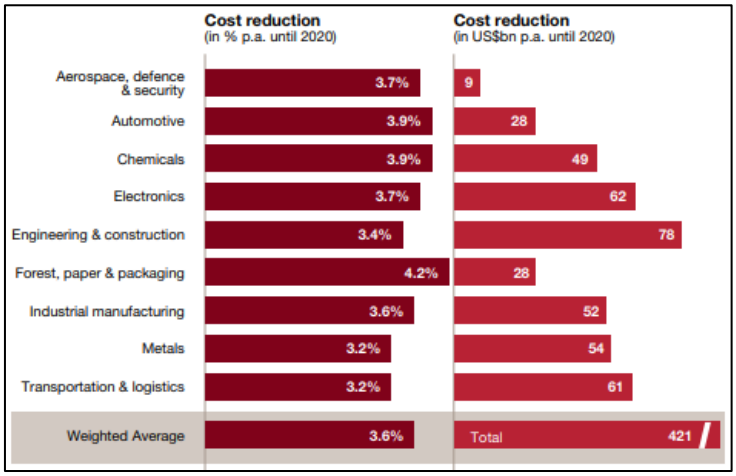

Figure 8 - Companies in every industry sector expect significant cost reductions

After having seen that the worldwide capital expenditures for the digital innovation, it is important to focus in the amount of cost savings and the increase in revenues. We said that, on worldwide average, the companies invested the 5% of their digital revenue and earned $493 billion, making the additional revenue about 2.9% (on average). Parallel to this value, there is the costs reduction of about 3.6% on average, which means a total savings of about $421 billion. The major additional revenues and the lowering costs drivers can be summarized in this way:

1. **Additional Revenues:** New digital services and products, offering big data as services, customizable products (mass customization), capturing insights from data that can be exploited by the business and increase in the market share.
2. **Lower Costs:** Real-time quality control by Big Data Analytics, horizontal and vertical integration, predictive maintenance, process digitalization and automation and by increasing the market share of the products.

In the previous Chapter 2.5, we talk about data competencies, as the skills required by the company to have a functional and positive Industry 4.0 implementation. According to the

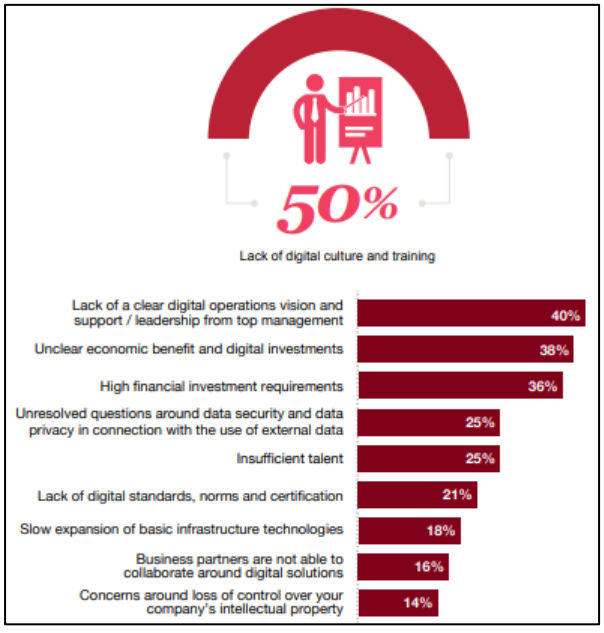

Figure 9 - Lack of digital culture and training is the biggest challenge facing company

survey, the companies found more difficult to train the staff than in implementing a new process based on data. The problem relies on the employees' lack of experience in the digital. Moreover, companies prefer to invest in the development of a production automatic process instead of training the employees, as the financial expenditure compared with the benefits are higher with the automation than with the human-machine relations.

The previous data support the fact that Industry 4.0 ha already become the main trend among the most important companies around the world. The pressure to become the first mover and the promises (supported by the previous analysis) that in few years there will be the total recovery of the initial investment, are pushing all the companies in investing in data analysis.

The numbers are describing that many industries (Aerospace, Industrial Manufacturing, Engineering & construction, Chemicals, Electronics, Transportation & Logistic, Automotive, Packaging and many others) are not going to decrease the Industry 4.0 trend and, on the contrary, they are increasing the amount of investment on this filed for the next years.

The main application of the 4.0 Revolution can be grouped into the next chart, which separate every possible improvement (insert them into the corresponding column) and evaluating them in terms of the operational value chain.

In the following Chapters, we are going to deep our analysis about the Driven-Supply Chain and about the new Digital Sales & Marketing Functions.

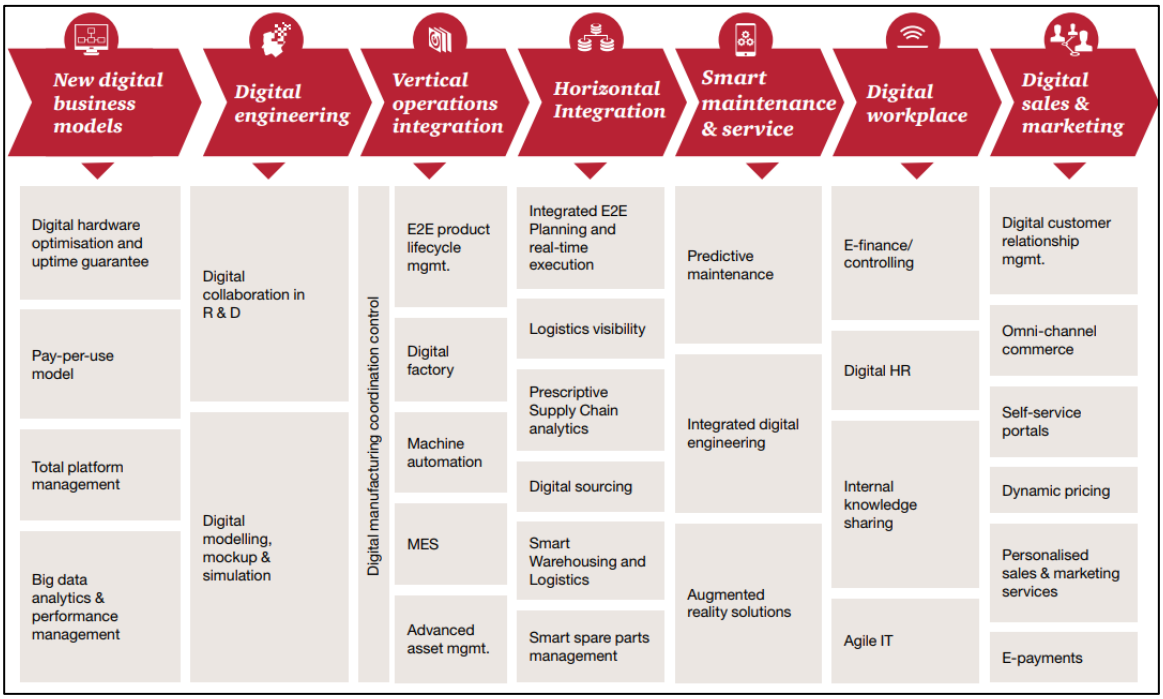

Figure 10 - Industry 4.0 pilot opportunities exist along the full vertical and horizontal operational value chains

Which are the Pros and Cons of the Industry 4.0?

Since now, we have already explained all the motivations that are making the 4.0 Revolution one of the most innovative and fundamental step ever happened in the economic history. Therefore, we can assume the previous information as Pros of the Industry 4.0.

The main consequence of the 4.0 Revolution relies on problem that connect all the players (Companies, People and State). In fact, with the increase of the utilization of machinery in the production and the creation of software that are automatically capable of transforming data into insights, the tendency of company will be to reduce humans and increase the exploitation of machines. This theory is even supported by the high cost for the employees' formation and the lower benefits obtained, in contraposition with the high benefits generated by the machines with lower costs of implementation.

Therefore, companies will reduce the demand for "normal" human labor (for example, the blue-collar jobs) and increase the demand for mathematicians, statistical and engineers. These phenomena would create an economical "black hole", where the unemployment rate is going to increase, raising even the needs of state aids. Moreover, the state should move the money used for supporting the companies for incrementing the amount of state aid used for the unemployed people. The problem is that this circle would finish in reducing the firm's revenues (as the high unemployment rate is directly proportioned with a lower customers' purchase capability) and stopping the 4.0 Revolution. To prevent this, the state must increase the investment on instruction and push new young talents to choose the engineering course of study.

Moreover, Professor Klaus Schwab argued that there are other social problems related to security, privacy and, of course, inequality[23]. Above all, the last one of these, as the only player that is benefiting from the 4.0 industry are the company. Even if the consumers are obtaining high benefits from the utilization of the new 4.0 devices, the ones that are gaining power and money are the companies' owners.

However, Industry 4.0 is bringing all the advantages listed in this Chapter while, for the moment, the effects of the problems that could arise with its implementation are almost zero (as some of them are almost theories). For these reasons, we have all the right permissions to confirm the Big Data driven Industry 4.0 as the backbone of the future business and operational processes.

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23 "1,2,3.. Here comes the 4th Industrial Revolution" - Gulandam Khan & Dean Isreb, PwC (2018).

3. The Data-Driven Supply Chain

After having presented and examined the whole Industry 4.0 system, as said previously, now is the moment in which we are going to deeper the analysis by starting exploring how this Revolution has affected the way enterprises are exploiting their supply chain.

This fundamental functional process has evolved in the years and the 4.0 phenomenon have had a great impact on it. In fact, nowadays machines and sensors have make analyzable every single step of the supply chain. Data and information are the main source of this new management style: this is why the 4.0 Supply Chain is better known as **Data-Driven Supply Chain**.

Companies use the supply chain to increase their earnings and gain competitive advantages against competitors. In effect, by exploiting functionally its machineries, the company can transform them into a strategic operation and process capable of beating the market. This is exactly where the 4.0 Industry laid its foundations: by constantly pushing the entrepreneurs' minds for searching the best way possible to create a sustainable process where the goal is to maximize the profits and minimize the costs.

In this chapter, we are going to answer at the next questions: *What is the Supply Chain and why it is so important for a company? Which are the impacts of Data in the Supply Chain? What is the Data-Driven Supply Chain? How can a company create a Smart Factory?*

This analysis will enable us to prepare for the last chapter, where we will analyze and comprehend how a Fashion & Luxury company should exploit the Data world in the Sales function, for achieving the best possible economical results. This previous step become fundamental as the Sales function as an integrated and essential part of the company's Supply Chain, as it is easily includable into the distribution process.

3.1. Supply Chain's Main Characteristics and Configuration

A clear definition for the Supply Chain does not exists. However, it is possible to describe it as the "Flow of material, goods and information between and within the organizations, linked by a range of tangible and intangible facilitators (as processes, relationships, activities and integrated systems). These flows of items are capable of creating a physical network, composed by different players, which can be both national and international".

The managerial processes that today we call Supply Chain have been at the center of every single economic activity since the creation of trade and commerce. The motivation of its existence relies on its intrinsic capability of connecting the demand, coming from the customers, with the supply, provided by the suppliers. This is the main reason way, the network between the three principal players (Suppliers, Company and Customers) have created clusters since the very first years of trade. In fact, in the past, the demand and the supply laid the foundations for the creation of these clusters, which are describable as a group of companies that creates a specific production chain in specific place. A typical example of this "primitive" supply chains could be the Venetian glass maker, where all the production processes where confined on the island of Murano, while the most famous cluster of our days is the Silicon Valley in California, where all the tech giants companies have their headquarters.

However, new developments, studies and innovative processes (and we must not forget the Industrial Revolutions), gave the possibility to the Supply Chain function to continue its evolution from a simple procedure, based almost in the same city, to a revolutionary network capable of answering the customer demand by imposing the best possible price, while maximizing the profits for the firm. In fact, to simplify a difficult concept, the main objective for a manufacturing firm is to find the perfect equilibrium between all the possible players in this chain, in order to obtain the highest possible outcome. To do this, companies must operate difficult choices for trying to obtain the best outcomes from the network, balancing the profits maximization with their personal managerial capabilities.

How the Supply Chain function could be organized and managed?

To better understand how the world of the Supply Chain has changed over the years, it would be really helpful to firstly analyze how this function could be molded by companies. This operation will enable us to comprehend how and which have been the main processes of evolution and their drivers, enabling us to understand why the Supply Chain is shifting again towards the Industry 4.0.

The Supply Chain is literally a "chain", where there are different flows that link together all the companies that are participating and creating a net capable of generating a value-addition to the whole process. It mainly consist into an upstream flow, which is the supplier's supply, and a downstream flow, which is the consumer's demand. Typically, the Supply Chain is always represented with a core company that is capable of focalizing both the demand and the supply. Usually, this company is called Original Brand Manufacturer (OBM) or Original Equipment

Manufacturer (OEM). At the end, we can consider the need of serving the final consumer, with products or services, as the fundamental reason of the Supply Chain existence.

The next figure is the best possible way to visualize the Supply Chain, as linear process through which the product/service is manufactured and distributed. However rather than a chain, we can consider this process as a Supply Network, in fact the real world is mainly sustained by a network of interconnected business with a web of relationships of varying strengths.

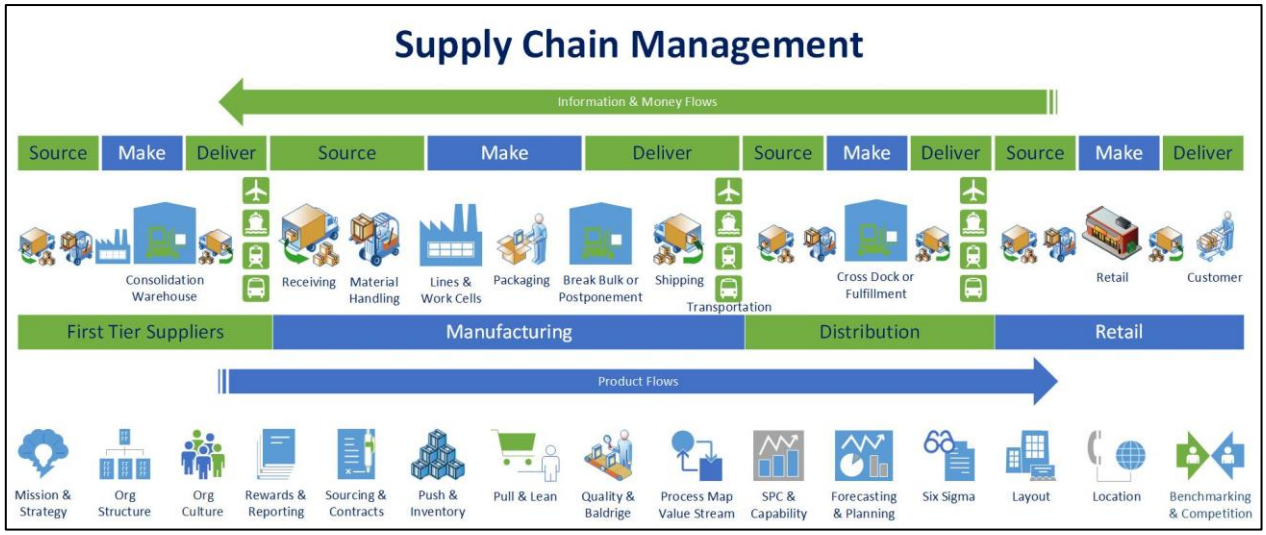

Figure 11 - The Supply Chain Management processes and flows

Therefore, we will still exploit this simplified figure to understand which the main dynamics of the Supply Chain are. It is possible to comprehend that, in parallel to the normal processes' dynamics coming from the downstream suppliers and going to the upstream customers, there are four other intrinsic flows, everyone with its own peculiar direction:

1. **Material Flow:** Is related to the supply chain main purpose to serve the final customer's needs. Is the process that begins with the acquisition of raw materials from suppliers, proceeds with the manufacturing and ends with the sales in the end-consumer in the retail function. In addition to the previous function, the flow requires the transportation management and a functional distribution network capable of connecting the supply with the demand. The typical example is Ikea, the Sweden furniture manufacturer, which acquires the wooden raw material for the creation of home furniture and, finally, sells them into their mono-brand retail shops.

   Furthermore, this can be considered as an industry specific, as the width of this flow depends on the core business of the firm.

2. **Information Flow:** The supply chain should be constructed in order to promote and facilitate the communication of information flows among all the companies that are involved. Contrarily to the previous flow, this can be considered as duplex, in fact, the information process can be exchanged in both the directions, downstream and upstream. Similarly, this flow is can be considered as industry specific, as the information and data coming from a sector are not useful for other sectors.

   Moreover, the ability to capture the flow of information is fundamental for exploiting two important step of the company:

   - **Efficient Supply Chain Planning:** To create a structure capable of maximizing the efficiency, the ability for the OEM to collect the upstream and downstream information's flows became fundamental. In fact, thanks to these data, managers can implement functional production plans for building a perfect system on the equilibrium between all the players involved. For example, with the demand information flow, the company is capable of forecasting the levels of the future sales and planning the production processes, the distribution and the retail selection. Moreover, the analysis and planning can be assisted even by the utilization external data, Structured or Unstructured, coming from third parties, incrementing the managerial ability in drafting the plan.
   - **Collection and Exploitation of the Information:** Companies can utilize data and information coming from upstream and downstream for developing a personal knowledge of the industry in which they are working on. In fact, as said before, data can be stored by the companies and used for the development of new products (for maintaining or incrementing the customer share), for increasing the profitability or even for selling them to other interested companies.

     For this reason, companies are creating database for stocking information and protecting the most important ones through Intellectual Property (IP).

   This is the "newest" flow among the four, and it is rapidly changing the way companies are implementing their Supply Chain. In fact, as the data and information are the main drivers of the Industry, they are even the main drivers of the Data-Driven Supply Chain.

   For these reasons, we are going to analyze deeper this flow in the next paragraphs in order to better understand how it is influencing the supply chain's world.

3. **Finance Flow:** The Supply Chain survives mainly thanks to the financial flow, without it the network would not exist. It is as downstream flow, in parallel (but with opposite direction) to the material one. The managers are willing to bridle this flow in order to maximize the revenues and the profits for their companies by increasing the possible incomes coming from the retails (leveraging the distribution and focusing on the highest possible customer segment for the product) and decreasing the outcomes (stipulating contracts with suppliers capable of delivering the same raw materials or services with a lower price than the market). However, the downside of exploiting this strategy is that the top management should be capable of reaching a sort of "equilibrium" that spreads the right level of contributions and awards across the chain, in order to allow a perfect alignment of all the participating companies.
4. **Commercial Flow:** Is in parallel with the material flow, it is the processes of changes the ownership of the product from a company to another. This transactional process shifts continuously in every single passage, from the supplier to the buyer, until the last step, where the buyer is the end-consumer. The only requirement for the existence if this flow is related to the presence of, at least, more than one company involved in the supply chain. In fact, it must not be confounded with the normal logistic process (exploited by a perfectly vertical integrated company), as there is the presence of the material flow but not the ownership change, so no commercial flows.

These are the most important flows that travel across the supply chain and we can consider them as the economical streams that keep alive the whole structure. The managerial ability to focus the attentions on them is vital for the company, as an interruption of just one of the flow (because of inefficiencies or wrong decision planning) could become the first step for the supply chain failure. This could expose the company to high losses and decreases in the customer share percentage (due to the reduction in the quantity provided to the end-consumers and a possible decrease in the quality).

We have seen the backbone of the chain, which are the main features, and the vital streams, that are the four main flows. To maintain all these activities perfectly balanced, company must develop strategies capable of aligning all the different players among all the chain. This process is at the base of the **Supply Chain Management**.

The Supply Chain Management (SCM) can be defined as "the management of the flows of goods and services that includes all the process beginning with the acquisition of the raw materials,

proceeding with the manufacturing of the final product and end with the distribution to the final consumers". Therefore, it is possible to easily summarize it as the management of all the previous features.

The easiest possible managerial structure that companies can implement is the Plan, Source, Make, Deliver and Return model:

1. **Plan:** Is the first step that companies must manage in order to exploit successfully the supply chain. Managers should ask themselves questions about how to segment or cluster the final customers, where to sell the products and through which channel, which is the right quantity needed for preventing bottlenecks or low inventory problems. During the execution of this step, the key point that must be reached is to find the perfect balance about demand and supply, in order to create a successful path for the company capable of answering its sourcing, production and delivery requirements.
2. **Source:** Is the very first tangible process that companies must develop after the creation of a plan. The objective here is to obtain all the materials, raw or finished, from the suppliers that can positively answer the company' demand. This process is done through the selection among all the possible suppliers (basing this on the delivery time, the cost and the quality), the arrangement between the parts through contracts sand the assessment of the performances required by the different players. Moreover, this is the step in which companies can decide to out-source or not, to transport and warehousing, in order to decrease the costs and reduce the time spent on the planning step.
3. **Make:** This is the step the group all the processes that transform the raw materials and the semi-finished into the final product, in order to answer the consumers' demand. To exploit in the best way this step, a company requires great capabilities in planning, understanding the market and set the right relations with the suppliers.

   Thus is the moment in which the COO (Chief Operation Officer) lay down the foundations for the creation of a functional production chain. The main answers that he must find are related to how to set up the manufacturing process, how to make more efficient the chain and how to improve the making process by implementing new machineries.
4. **Deliver:** Is the step that delivers the final product to the retailers and to the end-consumers. As for the "Source" step, here the management must analyze the company's capabilities and decide if to out-source the delivery and the warehousing. This is the step in which

company delivers its finished products to the customers through different distribution channels: Retail, Wholasale, Outlet or Online (e-commerce).

5. **Return:** This is the last step of the chain even if it concerns with a reverse logistic where the products are sent back to the motherhouse for problems related to the quality, for recycling or for post-sales customer support. We can consider this as an activity with lots of difficulties related to the planning. This because it is not easy to forecast the probability that a product must be sent back to the company, mostly if we are talking about new products with new technology inside.

These are the five steps in which the basic Supply Chain can be divided into. The Supply Chain Management must understand firstly which are the main driver of the industry and, after having analyzed them, spread all the strategy among the whole process. The challenge for the managers relies on the balance that must be reached between the level of inventory (for both the raw materials and the finished products) and the need of maintaining a high level of availability (so preventing problems during the manufacturing processes or in the delivery times).

However, we have already seen in the previous passages that the economic world can rapidly change and shift thanks to new technological developments and new managerial ways for implementing strategies. Moreover, we even understood that the Supply Chain has already shifted from a regular flow of steps to an intricate and sophisticate network that connects all the different players to the core center of the net. Managers must achieve and understand the capability that the company that they are administrating is just a part of the process, even if the company is at the center of it. In fact, is well known that only the supply chain that is capable of beating the industry's competition will be the only one capable of obtaining extra-profits for every step of the process. This is way basic and more sophisticated network of companies still relies their existence to the relationship that are stipulated between the parties, to the achievement of an appropriate strategic position, to collaborative abilities, to high level of integration and the leadership in the industry.

In addition, with the fact that the procedural phases differ depending on the industry in which the company is working, in order to better comprehend which have been the main passages through which the Supply Chain has evolved in the years, it is possible to cluster the various possible activities of the Supply Chain Management (SCM) into three main groups:

1. **Supply Chain Configuration:** Groups all the Supply Chain's construction development activities that must be undertaken by the management. In this step, managers will analyze all the information obtained from downstream, upstream and even from the company itself.

In fact, to develop a profitable Supply Chain, is fundamental to comprehend and evaluate the possible base of the network, for example by analyzing the width of the vertical scope of the firm or the quantity and quality of the processes that are outsourced and even the composition of the downstream retail market.

The Supply Chain architecture can be considered as a highly strategic processes.

2. **Supply Chain Relationship:** Relates to all the activities that are associated to the inter-company relationships and connections across the Supply Chain. Relationship can be divided and distinguished through their level of the relations and their typology, as these attributes are capable of determining the actual "streghth" of the exchanges done between the companies.

   Managers often do not take completely into consideration these activities, thinking that are less important than others are or underestimating the benefits that they could bring to the company. In fact, as these are considerable as processes that relies on the strategic and operational level, the first company in the industry capable of exploiting these steps in the best possible way will gain great competitive advantages against the competitors (in terms of higher quality materials, lower purchasing and delivering costs and best retailers).

3. **Supply Chain Coordination:** Relates to all the activities that are associated to the inter-company operational coordination across the Supply Chain. These activities are strictly connected to the Supply Chain Relationship, as they lay their foundation on the concept of creating a sustainable, continuous and efficient material exchange through the chain, from the first supplier to the final consumer.

   There are several activities involved in this group. For example, there are the "Inventory Management", where the final aim is to drive the flow of materials across the manufacturing processes (preventing bottlenecks and raw materials shortages), the "Manufacturing Forecasting and Scheduling", where the objective is to analyze the past manufacturing processes for designing the future ones, and even the post-sales customer services.

   All the activities of this group represent the core operational processes that must be planned and executed by the top management in order to gain the advantages needed to overtake the market.

These three clusters group all the different possible activities and processes that constitute the Supply Chain. However, even if all these activities can seems to be mostly exploitable internally, the industries show that the best possible way for creating a functional and profitable Supply Chain

is through the implementation of a great network of processes. This means that companies must leave the old habits of thinking that all the downstream and upstream processes are not directly controllable and exploitable by the company, and embrace the idea of considering the external organizations as an extension of the company managed processes within the same Supply Chain. This peculiar clusterization has the ability of dividing the activity in three macro-areas based on the processes that are involved in the Supply Chain. Moreover, this is the only way of grouping the activities in three areas so that the company must plan and execute at least one process for each cluster.

How the Supply Chain has changed and evolved during the years?

We understood that the Supply Chain Management (SCM), in the years, has become the companies' main driver for revenues and profits, and that the most important activity is related to the development of a sustainable network of organizations that cooperates for completing the whole set of processes. The way firms used to implement these networks depended by the industry and the shifts in the demand for the final product by the end-consumers (price, quality, quantity, etc.). For these reasons, the Supply Chain has always evolved in the years, trying to become the more suitable possible for the company and more efficient for serving the retailers. This "natural" process has advanced in parallel with the periodic changes in the management style and the statistical analysis and forecasts.

Therefore, the Supply Chain Management, as we think it today, is a relatively modern concept. In fact, the development of the modern SCM is relatable to the value capture needs of the early 2000s. The evolution of the Supply Chain Management has been characterized by a constant **increase in the degree of integration** of the processes. This concept

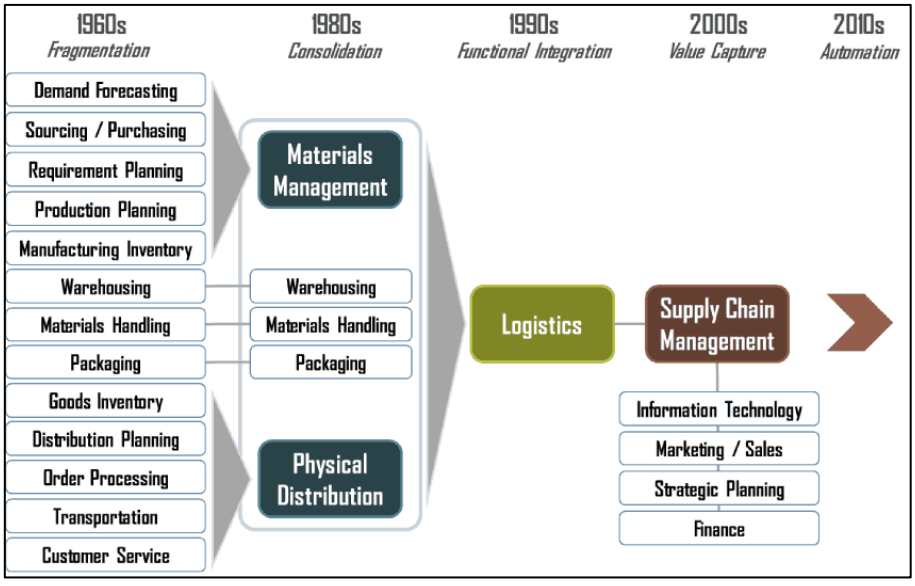

Figure 12 - The Evolution of the Supply Chain Management

his highlighted by the methods in which all the activities were fragmented in the sixties, leading to a poor exploitation in terms of profitability, costs reduction and increase in productivity. Successively, in the eighties, the companies started to integrate all the processes, until between the nighties and the early 2000s, where all the activities were integrated in one big branch. The supply Chain Management begun to be planned and developed in parallel with the activities related to marketing, sales, strategic planning, finance and, above all, information technology.

Moreover, the evolution of the Supply Chain Management (SCM) can be divided into six different periods, thanks to the different drivers that were used for creating the architecture of the chain:

1. **Product Driven:** Developed in the early eighties, this was the very first moment in which the processes started to be grouped into a chain. The key driver of the processes was the quality of the product across all the manufacturing passages. The organizations were planning their activities focusing them especially on the management of the inventory (trying to avoid possible shortages and to obtain higher quantities of materials with lower prices) and in maintaining the lower possible production costs (but still preserving the quality).
2. **Volume Driven:** In the late eighties, the management style changed completely thanks to the changes in the consumers' needs, which shifted from limited quantity of quality products to high quantity of low cost product. This period was the one in which the mass market started to become popular and, for this reason, companies had to follow the demand given by their industry. The key driver of the processes was the cost. Managers were creating their strategies trying to achieve the ability of exploiting at the best the production chain (working hard for increasing the production capacity).
3. **Market Driven:** Is the advance of the previous period, in fact in the early nighties, the markets started to become extremely globalized, increasing the import and export towards new emerging countries. For these reasons, the firms started to globalize and externalize part of their production process, for maintaining the price to lowest possible level and for increasing their profits. The key driver was the product availability, made by mixing high production quantities with great distribution capabilities (the market for the companies started to become international). The management split the old main objective into two, focusing on both increasing the market share (creating a wider range of product to be sold in different areas depending on the consumer's demand) and to develop the ability capable of reducing to the minimum time the period needed to serve the end-consumer.

4. **Customer Driven:** In the late nighties, the customer demand shifted again in every industry, modifying completely the markets. Companies started to focus their manufacturing processes around customers, making the lead-time as the key driver of the company. Being able to respond to the customer needs in the lowest possible time and reduce the time-to-market (for both the "time to market" and the "time to order") became the most important managerial achievement that firms were trying to achieve. To accomplish this, companies started huge campaigns for clustering and segmenting the customers, for forecasting their needs and developing products capable of creating higher customer satisfaction. This strategy has a dual function: to increase revenues in future years, through the customer engagement, and to increment the value of the brand.
5. **Knowledge Driven:** The advent of the internet with in addition the information obtained in the previous period, laid the foundation for the fifth phase of the Supply Chain. The key driver here is the information. In fact, the real-time communication devices has brought to the firms the ability to connect with the upstream and downstream organizations, and gave them the possibility to coordinate all the activities and processes. These, in order to minimize the problems related to the lack or shortages of materials and to reduce even the production times needed for the final product to be sellable to the end-consumer. Moreover, all the data and information obtained by these activities started to be stocked into servers and exploited by the Business Intelligence (BI) to forecast the future possible scenarios of the Supply Chain. The final aim of the top management was to create a network of companies that constitute the Supply Chain, linked together and organized for obtaining the highest possible profits while reducing the risks. This is the period in which the Supply Chain Management (SCM) rose and started to gain importance, day by day. Moreover, this is the phase in which companies started to create the basis for the future Vertical Integration.
6. **Data Driven:** This phase started at the beginning of the second decade of the twenty-first century and it is still exploited and developed by the Supply Chain Management. This period is strictly connected with the previous one and we can consider it as its continuation. The key drivers are the data, in fact, with both the developments of new products that contain hardware (capable of obtaining information from the customers' utilization) and the rise of an exchange market of data.

   This is the phase that constitutes the core study of the current chapter and we will going deeper its analysis in the next paragraphs.

After having analyzed historically how the Supply Chain Management has evolved in the last forty years, we can understand easily how every evolution in the management style, in accordance with the change in the customer demand or the new technological development, laid the foundation for the generation of the next wave of management. Therefore, the Data-Driven Supply Chain exploits all the possible new technologies available for obtaining data and information about the customers, while, at the same time, it gains the advantages from all the analytical tools, management style and production processes' devolvement of the previous phases.

In this third chapter, we are going to deeper the analysis on the Data-Driven Supply Chain, discovering how and why it will change the strategies used by the Chief Operation Officer (COO) and how it will improve the results and efficiency of the network developed by the companies.

3.2. Development of the Data-Driven Supply Chain

In the previous paragraph, we understood that both the Supply Chain architecture and management styles changed and shifted over the years. The linearity and the simplicity of the "Plan, Source, Make, Deliver and Return" model is no more applicable to the actual world. In fact, the complications arose with the depth of the demand and the width of the downstream and upstream organizations. These phenomena make necessary the construction of a dynamic network capable of answering all the end-customer's needs with the quickest possible process and with the highest possible level of autonomy.

The final result in the evolution of the Supply Chain Management is the **Data-Driven Supply Chain**, that relies its key feature on the data analysis and exploitation. As viewed in the second chapter, the firm's ability of obtaining data and developing the analytical tools needed for the analysis of the information, are the core competences required for a congruent implementation of the Revolution 4.0. Consequently, it is easily to understand that the rise of this new Data-Driven Supply Chain Management is strictly linked with the Industry 4.0, as both of them are operating in the Big Data and Internet of Things (IoT) competence field.

Moreover, we must remember how the Internet of Things (IoT), as one of the main pillar of the Industry 4.0, is transforming the way people (or customers) and employees live, work, communicate, and interact with others. It is also transforming the way in which are managed all the processes and the procedures for manufacturing, transporting, and warehousing goods. The Fourth Industrial Revolution is setting a new standard: Industry 4.0's solutions are simplifying both the manufacturing and the logistics processes, making them more efficient and flexible.

Therefore, the application or the development of the Data-Driven Supply Chain is normally felt as quite expensive; however, the results are almost above the expectations. For example, Bosh, the German multinational engineering and technology company, has decide to exploit the 4.0 wave and start implementing it through all its processes, with the aim to save a billion euros at its own sites and generate a billion euros in additional sales by 2020. The strategy for reaching this goal is dual: implementing connected solutions through all its 280 plants all over the world and continuing developing Industry 4.0 integrated products. This strategy is also helping Bosch in increasing its sales of industrial technology by 7.7%, to 6.7 billion euros, in 2017[24].

This example shows one company that is successfully achieving its Industry 4.0 implementation, through a specific strategic planning and execution. Many other firms working on different industries, that could be either technological or not, are following the same path, trying to achieve the benefits of the 4.0 Industry.

Which are the areas that must be exploited by the company to achieve its goals?

Before analyzing how to plan the implementation of the Data-Driven Supply Chain, it is important to understand which are the main benefits that will impact on the firms.

The technological disruption made by the Industry 4.0 is constantly changing the way information, materials, financial and commercial flows could be managed. The Industrial Internet of Things (IIoT) focuses on the creation of a connected manufacturing system that enables companies to observe all the processes through the response of the machinery. In fact, these new devices, capable of delivering informations about both the process and its status, are created for preserving a constant connection with an End-to-End (E2E) data network. Therefore, for the top management and other function (such as Finance, Business Intelligence, R&D and others) being able to observe the whole process and obtain data from it is becoming the crucial feature of the Data-Driven Supply Chain.

Moreover, it is possible to divide the areas where company can focus its Data-Driven Supply Chain integration into three main groups:

1. **Manufacturing Machinery:** The improvement of the manufacturing process passes through the implementation of new 4.0 machinery. These devices are integrated with hardware (Laser, RFID, heath measurers, etc.) and software capable of monitoring the

[24] "Industry 4.0 at Bosh: the power of an Idea" – Dennis Christmann, Bosch Media Center.

activities that are performing, registering the information captured and send those data to a central database. This implementation requires a great amount of investments for acquiring, installing and programming those machines. However, at the end of the implementation procedures, the company will have developed a fully production chain that can connect both to the central database and to other machines. These means that the devices can all be programmed by one engineer and they are capable of monitoring and analyzing the production processes, in order to decide, autonomously, if to speed up or slow down the production (for example if there is an increase in the demand or if there are problems related to bottlenecks).

The manufacturing process adaptation to the Industry 4.0 is the best possible way for the top managers to monitor the production and obtain information that can be analyzed and exploited by reallocating the force power (human and not), reducing the cost associated to the wrong stock analysis and avoid problems related to the production chain, as bottlenecks and downtimes.

Moreover, even if the Industry 4.0 machineries are more sophisticated than in the past, at the same time, their design is created for advantaging the company through flexibility. In fact, when the firm has to redesign the internal Supply Chain, it just have to reassemble the machineries in order to create the base for the implementation of the new processes.

2. **Horizontal and Vertical Integration:** The production process's typical flow starts from an upstream organization, passes through the Original Brand Manufacturer (OEM) and ends with the downstream retail service. Moreover, we have seen that in the Supply Chain evolution, the architecture trend switch from the linear and rigid structure to the network and flexible structure[25]. Thanks to the rise of the Data-Driven Supply Chain, this second structure has become the standard for the Supply Chain

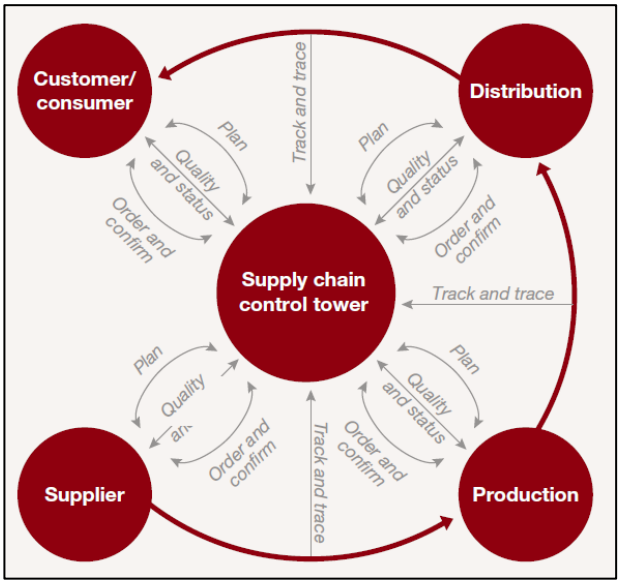

Figure 13 - The Integrated Supply Chain

[25] "How digitization makes the Supply Chain more efficient, agile and customer-focused" – PricewaterhouseCoopers (PwC).

managers. As visible in Figure 13, every single step is connected to a "Supply Chain Control Tower" that scans every single process of the network and give a feedback to it. By implementing this strategy, it becomes possible for firms to analyze the whole production process, even outside the firms' boundaries, and to create a network where the information are shared with the supplier and distributors. The key idea of exploiting data in the Data-Driven Supply is to integrate vertically (supplier to consumer) and horizontally (internal manufacturing processes) all the activities in order to maintain the control through the exploitation of continuous monitoring and forecasting actions.

The main advantage coming from the application of this strategy is related to the decrease in the time spent in organizing the different flows (material, informative, commercial and financial) among the different players of the network, reducing both the time and the costs spent in the coordination activities.

3. **Product:** Even if it seems useless, products are one of the best tracking system ever created. In the past, their sales amount where used for forecasting the possible future developments and productions quantities by analyzing where they were sold, when they were sold and, if possible, which were the end-consumers. Nowadays, thanks to the Internet of Things (IoT) system integration, products comes out with hardware (as chips, microphones, sensors, cameras, etc.) and, possibly, even software that are capable of helping the company in obtaining data about how the end-consumer utilizes them. These instruments are fundamental to answer the only question that in the past was almost impossible to achieve, as the products were not connected to the internet.

   Everything can obtain information about us. For example, the electric toothbrush can analyze the way we brush our teeth in the morning, by counting the time spent on this activity, how many times a day we brush them and even which areas of our mouth are more brushed then others. In addition, of course, this kind of product have apps for phones that can help the consumers in understanding how to improve the way we are using the toothbrush (making mandatory the personal registration on the firm's databases). Imagine just the amount of data that these products can obtain about their customers and how the company could exploit these for R&D, Marketing, Sales forecasting and other activities.

These are the three most important groups that should be exploited by the firms in order to gain the advantages promised and expected by the implementation of the Data-Driven Supply Chain. However, there is not a precise strategy or path that firms must follow and there is not even one

company that has already implemented the "perfect" Supply Chain. For this reason, I have inserted the Product in the three main areas, as the first two are mandatory for the implementation of a functional Data-Driven Supply Chain (or better, Network), while the third one goes in parallel with the first two. In fact, the data, coming from the utilization of the product, can help the managers in understanding if there are issues related to its utilization or even if customers are decreasing its utilization, in order to redesign the strategy for the next products (design, quality, cost, efficiency, etc.,), before than waiting the information obtainment through the old channels. The Bosh example, inserted at the beginning of the chapter, is the clear explanation that the companies that decides to create a dual strategy that embrace both integration and 4.0 integrated products, are the companies that will achieve the goals promised by the Data-Driven Supply Chain implementation.

Which are the main benefits that arise with the implementation of the Data-Driven Supply Chain?
By choosing between the two previous strategies, that are deciding to focus on just the integration or decide to focus on both integration and 4.0 integrated products, companies can obtain a wide range of benefits. More of them are visible directly in the short term while others in the medium-long term.
The most remarkable benefits for a company implementing the Data-Driven Supply Chain are:

- **Reduction in Transaction Costs:** The improvements in the efficiency of obtaining data from products and machinery has reduced the transaction cost for the company, thanks to the possibility of creating a dynamic and real-time system where transaction between different parties are at the center of it. Managers can predict and manipulate the transaction between the parties by analyzing the data obtained.

  Moreover, when there are issues related to low liquidity levels, the data analysis could create even the opportunity for the company, when its transaction costs possibilities falls, to switch its reaming transaction capacity to new different partners.
- **Shift from a Linear to a more Dynamic Network:** We have already seen that the adoption of the Data-Driven Supply Chain shifts the firm's processes from a linear to a network architecture. These net structures are capable of reducing the managerial latency between the decision-making and the material action, avoiding the costly problems related to the "bullwhip" effect[26]. Moreover, the constant connection between all the organizations is

[26] The so called "bullwhip" effect is a sophisticated issue that arises with a shift in the demand of a product and that is reflected, for the time needed for the information flow to reach every single point of the all the

capable of helping the stakeholders in organizing the structure in the most dynamic way possible, by integrating all the companies through the utilization of shared database and strategies. The final results of this process of integration is the creation of a network that communicates, aggregates, analyzes and operates upon shared data and information.

- **Innovation in Products:** Data analysis can help R&D developers and designers to create more fashionable and functional products. Therefore, it can even help the firm, through a previous Data-Driven Supply Chain implementation and integration, in remodeling the same supply chain when the demand slows or the price falls. The flexibility obtained in the Supply Chain can push the managers in adopting even the "small production lots" strategies, helping the company to achieve the product focalization (or even customization) and to increase the variety of the firm's portfolio.
- **Losses Reduction and Profit Improvements:** Data Analytics and Data-Driven Supply Chain integration can lead the company to decrease the losses that are generated across all the Supply Chain processes. The Business Intelligence's analysts, through the exploitation of the predictive analysis strategy, are capable of understanding where losses could occur. In fact, with the ability of obtaining real-time data, it is possible to minimize the latency wastes created during the normal Supply Chain processes.

  For example, Tesco, the multinational grocery retailer, wanted to minimize wastes arose by the latency of the Supply Chain. They solved the problems by exploited the external whether information (a simple data obtainable by every company) to understand which where the wheatear-dependent products (such as ice creams or sun lotions). The inventory was adjusted by organizing the supplier orders on a store-by-store basis for minimizing the missed revenues. This very simple strategy helped the company saving approximately $140 million[27].

These are the most important benefits coming from the Data-Driven Supply Chain. However, it is possible to comprehend how even all these benefits are shared and spread among all the participants of the network. This is the reason why the companies involved should not work just by looking inside their boundaries, however, they must act as a group by cooperating for the maximization of the revenue, the improvement of the performances and the increase in the operational efficiencies.

Supply Chain, in an increase in the losses for all the organization involved. This because the shifts in the demand fluctuation are being amplified stage by stage towards the Supply Chain.

[27] "Supermarket Tesco pioneers Big Data" – Rohan Patil (2014).

It is possible to divide the characteristics that are making the Data-Driven Supply Chain as a source of managerial benefits, for both the single company and the network, into five groups[28]: "Always-on" Agility, Connected Community, Intelligent Optimization, "End-to-End" Transparency and Holistic Decision Making.

How it is possible to plan and develop the Data-Driven Supply Chain?

The implementation of the Data-Driven Supply Chain passes through a process of Digital Transformation. Nowadays, Digital Transformation is driving organizations to evolve toward the Industry 4.0 in order to maintain and, possibly, increase the level of the competitiveness that characterized them.

Digital Transformation does not forces firms to adopt the latest disrupting technologies for beating the competition in the industry. However, its aim is to align the firm's Supply Chain objectives with the many possible digital initiatives, in order to adopt a digital model capable of exploiting the unutilized company's potential with existing resources and capabilities. For example, a company has both the possibility to choose between shifting completely to a totally autonomous Supply Chain or converging these new technologies with the classical human power.

The Digital Transformation requires a plan and a strategy capable of revolutionize the way firm's Supply Chain operates. Before going deeper in the execution of the plan, managers must comprehend which are the fundamental steps and processes of the firm's Supply Chain and design a strategic plan for their revaluation in relation to these four main areas:

1. **Internal Collaboration:** Related to the firm's internal collaboration, with the alignment of the vertical value chain in order to improve the existent connections for the creation of a network that covers all the process for the internal Supply Chain to the customer fulfillment.
2. **Supply Chain Management:** Related to the activities executed by the company for the improvements in the internal digital technologies processes, capable of increasing the alignment with both the downstream and upstream organizations.
3. **Distribution Network:** Enabling digital technologies to redefying the processes associated to the firm's downstream retailers, with the final aim of improving the flow of information (avoiding interruptions) among all the network's participants.

[28] "The Rise of the Digital Supply Network" - Adam Mussomeli, Doug Gish & Stephen Laaper, Deloitte (2016).

4. **Customer Insights:** Related to the digital technologies that can help a company in gaining improvements with its end-consumer, providing them a better customer service, while maintaining a stronger control on possible market shifts.

All the previous areas show that the digital transformation, for the implementation of the Data-Driven Supply Chain, need at least a digital technology for the generation of some benefits. In fact, digital technologies, for example the machinery, are capable of delivering the top management's expected transformation.

Furthermore, the digital transformation passes through the exploitation of Industry 4.0 developments in instruments and process. Data analytics, Artificial Intelligence (AI), Augmented Realities, Autonomous Robots, Industrial Internet of Things (IIoT) and others are the main pillar of this Revolution that have been created for the support of the management in monitoring the status of the production processes.

Once understood which are the areas and processes that will be affected by the Data-Driven Supply Chain digital transformation, the company must focus on the internal businesses and technical capabilities, by analyzing all the internal processes for understanding where to set the digital transformation. The request possibilities could be related to:

1. **Better Decision Making:** The digital transformation can provide the top management with better and transparent information.
2. **Automation:** The digital transformation deliver to the firm the capability of designing an automated Supply Chain process that can help the management in reallocating the human force power towards more valuable tasks.
3. **End-to-End Consumer Engagement:** The digital transformation is capable of creating a more valuable and profitable consumer engagement for the company, giving to the managers new information for the creation of a strategy built around the customer experience.
4. **Innovation:** The digital transformation of the processes can bring to an improvement in the firm's Business Model, with a focus on the collaboration with both the upstream and downstream organization.

The final step in the development of a digital transformation plan is the creation of a roadmap with the projection of the transformation, spread in several years in the future. This means that the management have identified the operational improvements and the digital technologies solutions

that will be developed exploiting the companies' existing capabilities for the creation of other new capabilities needed by the Data-Driven Supply Chain.

Therefore, too summarize the concepts, a company, by firstly analyzing internally its strengths and weakness about both its production procedures and capabilities, must decide the areas where the development of the digital transformation must begin. This decision is based on the company's digital plan. Technological transformation and digitization are capable of removing or bridging all the managerial and economical barriers that prevent the perfect harmonization of the network, with the aim of creating a perfect place with a new degree of resiliency and high level of responsiveness, in order to beat the industry's competition by serving the end-consumer with the most transparent service. This place will be the Supply Chain's completely integrated new Ecosystem.

3.3. The Smart Factory and Supply Chain 4.0 Ecosystem

Previously, we have seen how the Supply Chain has evolved in the years, by laying the foundations for the Data-Driven Supply Chain, how this 4.0 Supply Chain is developed and how a company should plan the digital transformations required for a functional implementation of the Data-Driven Supply Chain. We understood that the Industry 4.0 is totally changing the way firms are exploiting the Supply Chain, as the data and information sharing among the different organizations (both upstream and downstream) are shifting the old an linear processes with the new network one.

The managerial vision on the Data-Driven Supply Chain must be focused on the goals' achievement for all the organization, by thinking that nowadays the most profitable company in the industry is the company that has even the most profitable Supply Network.

Moreover, we have analyzed which are the main impacts areas directly touched by the implementation of the Data-Driven Supply Chain, but without focusing on the main activities that are fundamental for the development of a functional and profitable Supply Chain 4.0, that could be exploited by the firm for achieving its performance goals. For this reasons, in the chapter we are going to deeper the analysis on the 4.0 functional elements that constitutes the real and physical Data-Driven Supply Chain.

What is the Smart Factory and why is it important for the 4.0 Revolution?

Before analyzing these elements, it could be important to define the environment that their implementation will create. This new environment for company is known as the Smart Factory.

The Smart Factory can be described as a flexible system that is capable of optimizing the performances automatically among the network, to adapt and learn from new conditions in real or near-real time and run autonomously the entire production process[29].

This environment will be the place where the companies integrate their digital transformation with the existing processes, enabling the connection between human and new 4.0 machinery. Therefore, as one of the main Industry 4.0 pillar is the Big Data and its Analytics, the exploitation of the information achieved by the company is capable of generating a wave of automation of the current product lines and the maintenance of a high quality standard of autonomy on the detection and resolution of the issues.

However, even if the company can seems capable of running autonomously, thanks to the adoption of the new 4.0 machinery, the firm's digital transformation requires, at least, a minimum presence of human force power. The reason behind this is that to sustain the whole process, the company needs an informatics engineering team that programs and develop all the necessary software for the implementation and the support of the Data-Driven Supply Chain.

Samsung, the Korean technological multinational, thanks to the implementation of the Smart Factory on its air conditioners' production plants, through three-dimensional scanners, Industrial Internet of Things (IIoT) technologies and integrated machines control, has brought to a reduction of the overall costs associated to the production, with a capacity improvement by 25% and the halve of the defective products[30].

The key characteristics required from a functional digital implementation of the Smart Factory for a company, can be grouped into five main features:

1. **Connection:** This is considered the most important features of the Smart Factory. In fact, 4.0 machineries are capable of connecting together creating a network in which the processes' information are shared in order to develop a real-time and autonomous decision making. The data obtained by the production are united with the ones coming from traditional processes, enabling the company to better understand how it could exploit both the organizational network.
2. **Optimization:** The Smart Factory allows the company to execute its manufacturing processes with lowest possible human power rate. The processes are more functional and can provide an increase in the long-term profitability.

29 "The Smart Factory: Responsive, Adaptive and Connected Manufacturing" – Deloitte (2016).
30 "Samsung expediting Smart Factory for home appliances" – Yoon Sung-Won (2017).

3. **Transparent:** Real-time data can be transform in profitable insights by the company, which can utilize them for the development of more accurate decision across the Supply Chain. Moreover, all these real-time data must be shared across the network in order to align the organization involved and increase the overall efficiency.
4. **Proactive:** The Smart Factory is capable of monitoring itself and understanding or forecasting the outbreaks of procedural issues. The 4.0 integrated machinery, is capable of analyzing the process, checking if there are some anomalies and, if present, to modify autonomously in order to prevent downtimes in the manufacturing processes.
5. **Agile:** The Smart Factory feature of being flexible makes it even more agile. This because, thanks to the fact that the machinery can be easily reassembled, the company can minimize the changeover time and enabling the possibility of scheduling the product changes (due to shifts in the customer demand).

The decisions about how to the plan the digital transformations, by adopting or expanding the Smart Factory, must be aligned, as said previously, to the company's already-existing resource, capabilities and specific needs. By following this path, companies can generally gain the following benefits:

- **Asset Efficiency:** Every single machines of the factory generates data that reveals the exact performances level and could either monitoring issues for self-correcting them. This ability is related to the reduction of the changeovers and to the avoidance of possible downtimes (that is reflected in a decrease in the firm's profitability), done through the automatic (and data-driven) reallocation of the production processes.
- **Quality:** Smart Factory, combined with Data Analytics, is capable of detecting quality lacks due to machine, human or external environmental causes. For this reason, the Supply Chain process can provide a better quality products, with a significant decrease in the defects and possible recalls.
- **Lower Costs:** The optimization of manufacturing process in the Smart Factory can lead to a significant decrease in the costs of production. The capital expenditures associated to the decision making or to the production process can be decreased thanks to the technological autonomy given by Data Analytics. Moreover, if the processes in the network becomes transparent, the costs decrease thanks to the reduction on the lead-time needed for the information to be shared among all the organizations.

- **Safety and Sustainability:** The Smart Factory and, above all, its facilities are capable of increasing the employees' safety by avoiding the human errors. Moreover, it can reduce the firm's environmental footprint by decreasing the manufacturing defects.

Summarizing the concept, the firms' digital transformation, especially for the ones operating on manufacturing industry, passes through the implementation of the Smart Factory, as the normal evolution from the old factory system. The environmental shift to the Smart Factory is becoming even more fundamental for the stakeholders for the will of observing the whole production process without observing directly and physically all the manufacturing procedures done on the Supply Chain. This is another motivation for the transformation of the company towards the Data Driven Supply Chain as a managerial source of control on the production.

These stakeholders could be internal or external. The internal stakeholders could be the top management, the production director, the analysts and the Business Intelligence, while the external ones could be other companies on the supply chain or even the end-consumer. The internal stakeholders are willing to monitor and adjust the production processes while the external ones to align the actions, for the other organization on the Supply Chain, or, for example, to check the delivery status for the end-consumer. Moreover, as the trend of the online sales is growing rapidly, the needs of distributing real-time information to the need-consumer is vital, in order to transform the customer's simple click on the "Buy" icon on the cart of the company's webpage into a visible and tangent process for the client.

Data are capable of delivering these information to all the stakeholders present on the industry, transforming and "simplifying" (in terms of monitoring) the Supply Chain. Therefore, this is another motivation that is showing how much the information flow, that is moving through the Supply Chain, is fundamental for the company to understand and let understand the effective status of the processes to the all the involved parties. However, to be efficient, the Data-Driven Supply Chain and its Smart Factory need a peculiar and modern group of new processes and 4.0 integrated machines capable of delivering the hoped benefits.

What is the 4.0 ecosystem and which are the core new technologies adoptable by the company?

It is possible to comprehend that there is common red thread across many industries. The willing of creating a standardized process that brings the product to the end-consumer with the highest efficiency. These workflow starts with the marketing that forecasts the possible sales, basing the analysis on the customer's demand, proceeds with manufacturing, that orders the right quantity if

material and aligns the production, and ends with the distribution channel, that organizes the shipment of all the products coming down the pipeline and inform the different customer with their correct delivery time. If all follow exactly this procedure, with even the right times, the gap between the supply and the demand will be the smallest possible, making the firm more profitable and the end-consumer more satisfied.

However, this utopian view is very difficult to reach, as the company must adopt a dual strategy based on both the data analysis and in the increase in transparency. In fact, the lack of data could create losses derived by the wrong forecasting analysis and the lack of transparency the decrease in the firm's profitability. Therefore, the digital transformation created by the implementation of the Data-Driven Supply Chain is capable of reducing these problems through the better exploitation of the data analysis and the creation of an ecosystem that reduce the lags between the processes.

The final aim of this ecosystem is to increase the transparency through all the production steps. However, the creation of this ecosystem is expensive and ambitious, as it demands a new Supply Network capable of responding quicker and more efficient. For implementing it, the company must gather new technologies, develop new competences and transform the entire organization.

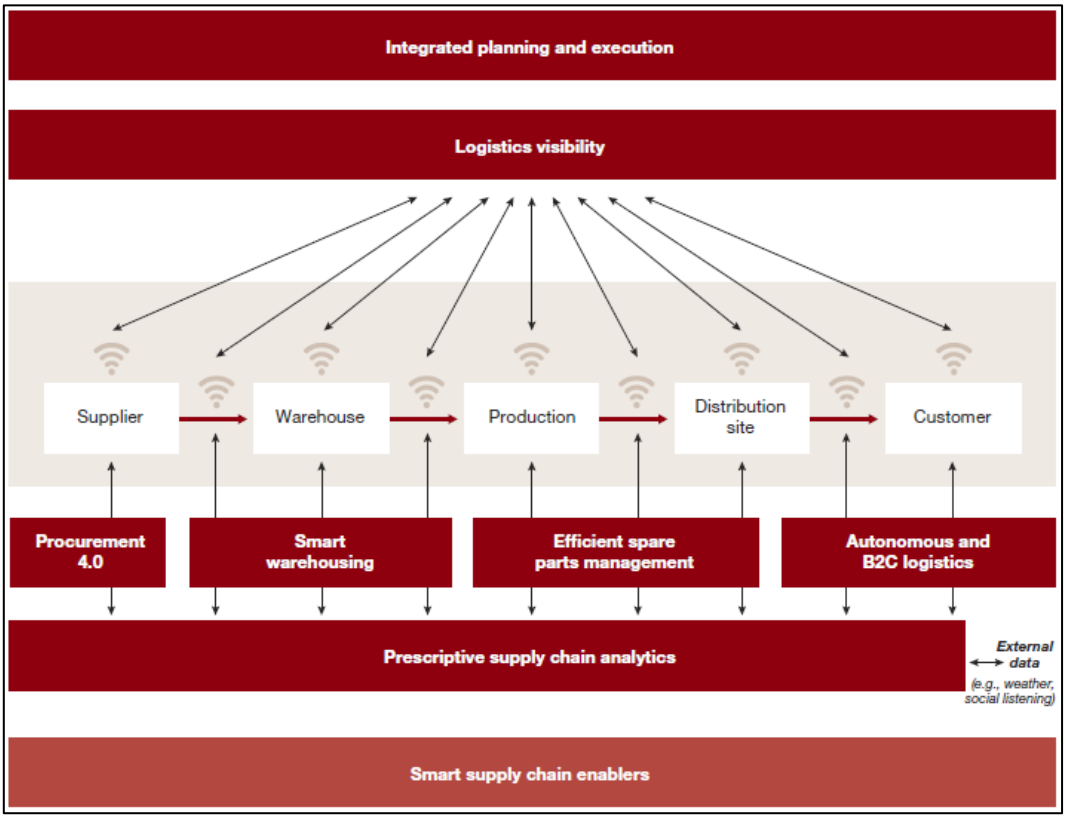

Figure 14 - Eight Key Elements for the Data-Driven Supply Chain

The procedural production passages, in accordance with the Data-Driven Supply Chain requirements, can be segmented into eight key areas[31]:

1. **Integrated Planning and Execution:** The Business objective, as said previously, is to deliver the final product to end-consumer in the right time. To achieve this goal, the firm require a responsive and reliable Supply Chain, which is fully integrated and connects the processes made by the suppliers, the manufacturing ones and the logistic. For this reason, the core organization must create central control tower that monitors the whole set of processes. Moreover, as the demand for the customized manufacturing is increasing, the firm's ability and span of control must grow, in order to deliver the best possible service to the final-customer.

   Business Intelligence and the Management must coordinate for exploiting simulations and what-if scenarios to assess the impacts on capacity, inventory, suppliers and customers. The results must be shared with all the organization involved in the network for the alignment of the whole Supply Chain processes. The increase in transparency should encourage the partners to plan collaboratively utilizing the same data and information as a unique source of truth. This Data-Driven Supply Chain ecosystem, based on real time processes (with a human intervention reduction), is capable of reducing the delivery lead times and improving the inventory management system, boosting the agility of the entire chain.
2. **Logistic Visibility:** The functional key for the Data-Driven Supply Chain relies on an efficient and rapid exchange of information. However, the traditional Supply Chain is full of friction created by communication lacks and the increased level of the activity outsourcing makes harder for the company to monitor and adjust the arises of possible issues. This is way visibility is became one of the key elements of the Data-Driven Supply Chain ecosystem.

   The typical framework for the internal development of the logistic visibility among all the possible partners is this:

   - Data achievement from both internal and external sources and stock them into one single database.

[31] "Industry 4.0: How Digitization makes the Supply Chain more, efficient agile and customer-focused" – Schrauf & Berttram (2016).

- The Data analysts and the Business Intelligence consolidates data and information with cross-referenced information, in order to improve the quality of the shipment. For example, data about traffic, weather and other typology of news.
- The new set of information should be ran and linked together in the databases through analytics and simulations.
- The results must be shared with the organization in the Supply Chain in order to create an alignment capable of creating transparency and visibility.

Many different example of the logistic visibility are related to the "Track & Trace" (T&T) systems. The adoption of this technology in fundamental for the company to trace the movements of the products through the whole Supply Chain. The companies could integrate their products with two different systems: the Radio Frequency Identification (RFID), or the Bluetooth, for tracking the inventory through the different firm's different processes and plants, and the Global System for Mobile Communication (GSM) for tracking the product in the shipment towards the end-customer.

3. **Procurement:** The Data-Driven Supply Chain ecosystem needs also an implementation for the processes related to the procurement of raw materials for the production. The goals are the improvements in the existing processes in terms of planning, sourcing and boosting the cooperation. It is fundamental that even the suppliers have developed the digital transformation in order to have a functional procurement capability. Moreover, it would be helpful to acquire the contracts for the utilization of software that must be utilized by all the firms involved in the network for monitoring the raw material movements through the supply chain. The advantages brought by the 4.0 procurement are related to the possibility for the company to develop a more flexible structure, capable of answering efficiently to possible shifts in the demand and to create the base for the customer products' customization.
4. **Smart Warehousing:** The warehousing is one of the most capital-intensive process for a company. This is the reason why Data-Driven Supply Chain is capable of delivering the right improvements for the decrease in the costs and the increase in the efficiency and safety. The aim here is to create the perfect digitalized ecosystem.

   First of all, the company should develop the 4.0 inbound logistic, where the Warehouse Management Systems (WMS) can selects autonomously for the optimization of both the just-in-time and the just-in-sequence activities. Through sensors, the system is capable of

organizing every single step of the warehouse processes, starting with the decision of which dock exploit for the materials unload, to the decision related to where the materials should be stocked. Everything must be constantly updated in order maintain the inventory the most accurate possible.

Moreover, new 4.0 integrated technologies can help the WMS software for the management of the warehouse in the Data-Driven Supply Chain. For example, DHL, the delivery company, has tested the utilization of augmented reality technologies in one of its Netherlands warehouse (through the utilization of Google Glasses). The result after three weeks, 20.000 items moved and 9.000 order fulfilled, was an increase in the optimization of the task by more than 25%[32].

Furthermore, the deploy of the autonomous robots can reduce the costs and inefficiencies related to the human error and increase the profitability derived directly from a more automated and efficient inventory management.

5. **Efficient Spare Parts Management:** Another high cost related to the warehousing are the spare parts. In fact, without knowing when these will be exploited, they occupy the warehouse even for decades. However, the digitalization of the Supply Chain will even reduce these inefficiencies by analyzing data and create forecast, matching the actual demand for spare parts with the probability that the demand actually exists. Moreover, the 3D printing can allow companies to print on-site the parts that are needed. This is capable of reducing the liquidity spent and immobilized on inventory and to react faster to the creation of the demand by exploiting hardware that produces, though 3D printing, even dated parts that probably are not even more produced.
6. **Autonomous B2C Logistic:** The management of the logistic between the factory, the warehouses and the final customer, is one of the most difficult and costly operation of the process. The online trend is increasing and, in parallel, firms must decide if to outsource or internalize the final delivery processes. These processes have two main issues: the first one is relate to human errors (incidents, traffic, etc.), associated with the slowdown of the activities, while the second is associated to the presence of a physical person capable effectively to receive the product (especially for buildings in which there is not the doorkeeper).

[32] "DHL successfully tests augmented reality application in warehouse" – DHL Press (2018).

Industry 4.0 have answered these problems with the creation of driverless trucks, capable of avoiding human errors, reducing the time needed, reacting in real-time to the inefficiencies generated by the traffic and give to the company a more reliable and ecological process.

While for the so-called “last mile” delivery, which is the last process of the chain (actually, when the products arrive to the end-consumer), the Industry 4.0 have answered through the development of self-driving delivering robots, drones, intelligent mailboxes and many other. The utilization of these devices creates a wave of savings for the company, as, for example, robots and drones do not need any direct human intervention, exclusively some engineers for programming their software.

7. **Prescriptive Supply Chain Analytics:** All the previous features for the development of the Data-Driven Supply Chain Ecosystem, relies on the key principle of the Industrial Internet of Things (IIoT), as verifiable on the first chapter. However, for the implantation of whichever of the previous elements, the firm must obtain and exploit Big Data, through the Big Data Analytics, another of the main principle listed in the first chapter.

   The aim of the utilization of Big Data Analytics for a company is to lay the foundations for all the new processes and machineries that will be utilized with the new ecosystem created for the implantation of the Data-Driven Supply Chain. Many firms are starting to plan the utilization of the Big Data capability for increasing their ability in predicting critical elements of the Supply Chain with an unprecedented accuracy and adjusting the whole production process in accordance to the demand level.

   However, the final goal of the Big Data Analytics is not just updating and improving the existing processes, as planning, production, procurement and delivery. Its main aim, thanks to the data and information adaptability, is to optimize any single possible aspect that can arise in the whole Supply Chain process, for the future years.

   Moreover, the utilization of external information and data becomes fundamental once the firm has already created an efficient Data Analytics function. This because the integration of the Supply Network’s data with data coming from outside their boundaries is capable of improving significantly the self-learning algorithms utilized for the prediction and anticipation of issues.

8. **Smart Supply Chain Enabler:** The Data-Driven Smart Factory and Ecosystem are very difficult and expensive to implement and firms must comprehend that a wrong

implementation will probably lead to the entire failure of the company. For these reasons, the company must prepare a detailed plan for both the improvements of the existing processes and the acquisition of new business model. The key fundamental capabilities required for the right implementation of the ecosystem and the Smart Factory includes:

- **Digitization:** The total digitization of the processes, in order to connect the suppliers to the customer and reduce the organizational space between them.
- **Skills and Competences:** The creation of new skills and competences that will allow the company to achieve the perfect digital transformation. In fact, firms require employees with talents and capabilities such that they will be able to assist the evolution of the chain, from the simple to the Data-Driven one.
- **Performance Measurement:** The fundamental creation of key performance indicators that can help the management in understanding and measuring if the outcomes generated by the implantation of the Data-Driven Supply Chain are effectively positive.
- **Partnering:** Creating new and positive partnership with other organization in order to boost the implementation of the Data-Driven Supply Chain, as the creation of the integrated network cannot be exploited without the presence of a wide variety of supplier, distributors and technology providers.
- **Technology:** Create a plan for the improvement or the disposal of old machinery, as the technology is at the center of the Industry 4.0. Firms must remember that the first step should be the acquisition of database as software for the Data Analytics.

3.4. Recent Trends in the Data-Driven Supply Chain

The adoption of the Data-Driven Supply Chain is at the center 4.0 Revolution. The motivation that are making the Industry 4.0 as a real disruptive Revolution relies on the fact that is capable of converging all the technological development (listed previously in the chapter) into the Supply Chain, lowering costs and improving the capabilities. Moreover, it enables for the company the possibility for the top management to combine the new Information Technology (IT) with the classical Operations Technology (OT)[33].

[33] "Industry 4.0 and Manufacturing Ecosystems" – Sniderman, Mahto & Cotteler (2016).

Therefore, the technology utilized for both the creation of new hardware (such as database and computers) and new devices (robots, augmented reality, drones, etc.), has increased in the years thank to the reduction in the costs associated with the computing, storage and bandwidth (following the principle of the Moore's Law). Furthermore, to understand the scope of this technological improvement, it would be useful to know that between the 1992 and 2002, the computing power has increase at an average of 52% every year[34].

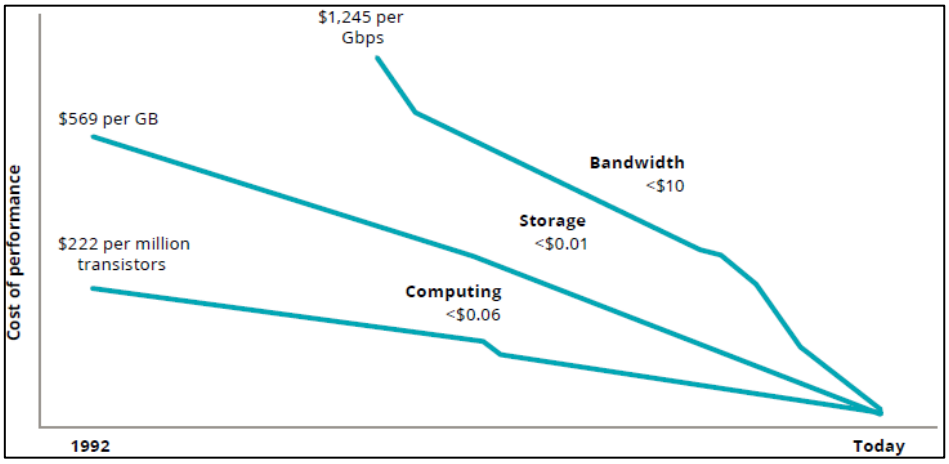

Figure 15 - Declining costs in Bandwidth, Storage and Computing

These motivations has lead the technology producers to continuously develop new devices capable of disrupting even well-established industries.

The creation of these technologies will not stop and, for this reason, firms must take into account that the Industry 4.0 is laying the foundation for the next revolutionary wave, where, by 2030, the network will become the Digital Ecosystem.

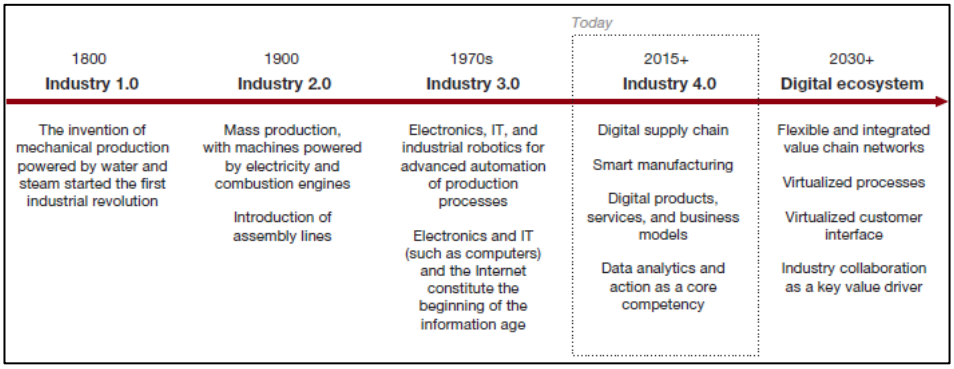

Figure 16 - The Road to Industry 4.0 and the digitization of every aspect of Business

This next gen revolution processes' ecosystem will be based on the improvements that are taking place with the Industry 4.0.

The main objective for the companies that has already started the implementation of the Data-Driven Supply Chain, or that would like to start the development of it, is the become a **Digital**

[34] "History of Processors Performances" – Edwards (2012).

Champion. The Digital Champions are the firms capable of distinguish themselves through their ability in mastery the critical business ecosystem in four principal layers:

1. **Customer Solution Ecosystem:** Here companies put their efforts on the creation of distinctive product and services capable of giving the best offer to the end-customer. This is done through the exploitation of high level of customization and personalization, improved logistics and innovative design. Some example of the activities directly involved in this layer are product, complementary services, performance service, data integration and analytics, e-commerce, advanced customer service and many others.

   We will deeper the analysis on the chapter focusing on the apparel industry in the Fashion & Luxury Sector.
2. **Operations Ecosystem:** Here are grouped all the physical activities that are directly involved in the Customer Solution Ecosystem. These includes product development, sourcing, manufacturing, logistic and after-sales services. Every organization that takes part in the Supply Chain must be integrated into the ecosystem.
3. **Technology Ecosystem:** This layer groups all the technological activities that are directly involved in both the analysis of the Customer Solution Ecosystem and in the monitoring of the Operational Ecosystem. This layer includes the main technologies developed in the world of the Industry 4.0, such as the artificial intelligence, the 3D printing, RFID devices, Industrial Internet of Things (IIoT) sensors and robots.
4. **People Ecosystem:** The last layer relies on the organization competences and culture. Create a functional mind-set that is directly focused on the digital transformation is very complicated and even the most profitable companies can have some lacks on this field. This ecosystem cover skills, behavior and relationships capable of create a powerful support for the digital transformation.

Summarizing the concept into one, the Digital Champion is the enterprise that has obtained a strong position in the market through the creation of a complex and tailored customer solution. Moreover, it must have developed a functional integration among the Supply Chain, aimed for the increase in the connectivity with external networks and with both the abilities of leveraging the different technologies and of marinating a culture focused on the technological development.

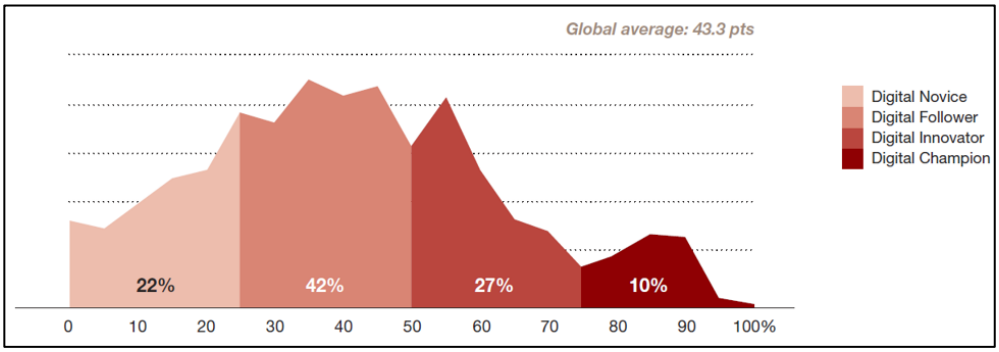

Figure 17 - Distribution of Digital Maturity Levels

Based on the analysis made by PricewaterhouseCoopers (PwC) made in 2018, the previous chart was created on more than 1.150 firms' executives interviews. The results are that the worldwide average in the quality of the layer created for the adoption of the different ecosystems is of 43.3 points[35]. This number, corresponded to the 52.75 percentile, makes most of the company that are trying to become Digital Champions reentering in the group of Digital Followers, which are the ones that wants to develop all the different ecosystem layers but that are still dealing with some issues. Moreover, the result showed that just the 10% of the companies reenter in the Digital Champions group and, of these 10%, the two main industries of are the automotive and the electronics ones.

In this chapter, we have mainly analyzed three of these main layers that are the Operation Ecosystem, the Technology Ecosystem and the People Ecosystem. We saw and analyzed what and how should a company develop for the correct Industry 4.0 and Data-Driven Supply Chain implementation.

Always according to the same survey, it is possible to confirm what we have seen and analyzed previously in the chapter. In fact, through Figure 18,

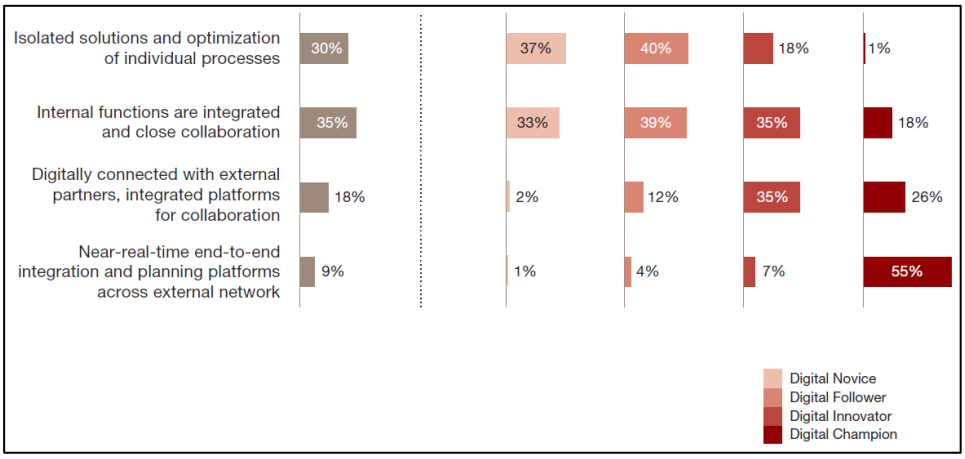

Figure 18 - Supply Chain Development Status

[35] "Digital Champions: How Industry leaders build Integrated Operations ecosystems to deliver end-to-end Customer Solutions" – PricewaterhouseCoopers's (PwC) Strategy & Global Digital Operation Study (2018).

we see that only the Digital Champion group is the one that have mainly focused its streghth into the implementation of a digital integrated platform across external network. In fact, it is possible to observe a peculiar curve that, cutting diagonally the graph, creates a descendent path from the basic and old isolated Supply Chain ecosystem, still utilized by the 37% of the Digital Novice, to the 55% of the Digital Champions Integrated Solution.

Moreover, by observing the Figure 19, it is possible to comprehend which have been the most adopted devices in the Technologic Ecosystem. First, it is easily readable that there is a reduction in the gap between the Digital Champions firms and both the Digital Followers and the Digital Novice groups, making the acquisition of new 4.0 integrate technology the very first ecosystem in which the top management usually bet for the implementation of the Data-Driven Supply Chain. The most common technologies are the ones mainly related to the Supply Chain processes, as the predictive maintenance, the Industrial Internet of Things (IIoT) and the integrated end-to-end Supply Chain Planning. Nevertheless, even the Digital Champions still have difficulties in the development of functional Artificial Intelligence (AI) capabilities, as this software requires elevated cost of implementation and high-skilled informatics engineers.

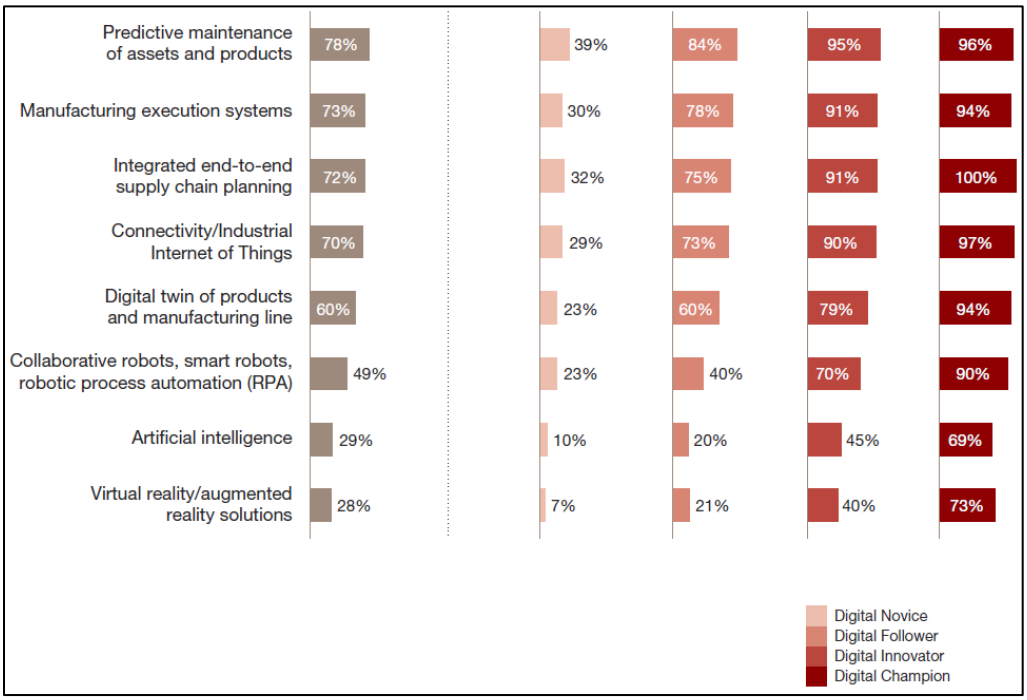

Figure 19 - The main 4.0 integrated Technology adopted in the Supply Chain

It is important to focus on every single aspect of the previous ecosystems for the implementation of a functional Digital Transformation and enter into the Digital Champion Group as areal leader of the Industry.

However, we are still missing one of the most important ecosystems, the Customer Solutions. We will see it in the fourth chapter, where the study on the Industry 4.0 is deepened through the analysis of the impacts on firm's Sales & Marketing function, by focusing in the analysis on Fashion & Luxury Sector. Since the Distribution is an integrated part of the Supply Chain, this final step is capable of concluding the set of various activities and processes that a firm should develop in order to become a Digital Champion.

4. Sales & Marketing Function in the 4.0 Revolution

After having examined which are the main characteristics of the Data-Driven Supply Chain, what is the Smart Factory and three of the four ecosystems, now is the moment to focus on the last one, which is totally related to the end-customer and more in particular on the Sales & Marketing Function of the company.

We will discover which strategy should implement a firm to exploit completely the benefits of the Industry 4.0. The analysis will be manly focused on the Fashion & Luxury Sector, as is one of the most complicated industries for the difficulties related to continuous shifts in the demand, as there are many industry among this group that need to continue reinventing their products. This is the reason why we will focus our attention on the Personal Luxury Goods sector (apparel in particular), as they need to change completely their products, at least, every six months (as they suffer of seasonality). Moreover, as the prices are higher than other sectors (especially for the apparel) and the same prices of the different products are, more or less, in the same range, the problems of maintaining an high level of market share, in respect to the other competitors, becomes fundamental.

Therefore, in this chapter we are, firstly, going to analyze the Fashion & Luxury sector, understanding which are the main drivers and players, and then we will focus on which should be the strategies for the Sales & Marketing function that must be implemented by the Luxury firms in order to develop an efficient Industry 4.0 Revolution.

4.1. The Fashion & Luxury Sector

The choice of this specific industry among the others, and in particular the Personal Luxury Goods sector, relies on the fact that the competition is very high among all the players and the importance of comprehending the firm's customer segmentation goes in parallel with the creation of the products. For these reasons, the adoption of the Industry 4.0, with its Big Data Analytics and its Data-Driven Supply Chain, can plays a huge role in the increase of both Brand Valuation and in profitability. In fact, a wrong Forecasting Analysis or customer segmentation can lead to the failure of the products' collection, which is reflected in both the decrease of revenues and profits with an increase in the inventory stocked in the warehouses.

Furthermore, differently from other industries, the customer segmentation and the sales forecasting are fundamental for creating the right product design and for the acquisition of the right quantities of stock. In fact, as previously said, the products here suffers of seasonality and the wrong numbers during the acquisition process could lead to losses in sales (if there lack in inventory or even in the sizes) and increase in the inventory (if leftovers).
However, before entering deeper in the analysis about how the Industry 4.0, it would be helpful to comprehend how this market is composed, which are its main characteristics and which are the main players.

4.1.1. History of the Sector

"Luxury is a necessity that begins where necessity ends" - Coco Chanel
The beauty of "luxury" relies on the many different shapes that this word could be melded in peoples' minds. In fact, every single person has a different idea and perception about the theme and, for this reason, this could be either positive or negative. However, a thing is certain, that during the past decades and centuries the importance of being a successful individual and the showing of the personal wealth has never changed. Conversely, luxury has not always been perceived as it is today, things have changed during the ages, thanks to wars, conquers, religion, revolutions and other phenomena.

How did evolve the concept of Luxury in the History?
In order to understand how the events have influenced the sensitivity and the perception of the luxury industry, we have to begin analyzing the whole sector through the centuries.
The word "Luxury" comes from the Latin's *luxus,-us* with the meaning of immoderate and excessive exhibition of expensive objects that have not any intrinsic purposes. During the Roman ages, this was reputed as a wrong personal behavior against the *Mos Maiorum*, the ancestral set of custom and traditions. Directly for this reason, Romans coined the word *"luxuria,-ae"* with the aim of describing all the negative action related to the world of flaunting personal power.
After the Roman conquer of Greece in the second century BC, this phenomenon completely changed. Romans have been such inspired by the Hellenistic's beauty and culture that they brought to Rome gods and all the beauties and aesthetics related to architecture, art, theatre and philosophy. This totally reformed the way romans used to live by creating both a sense of love for beauty and a new concept of splendor.

However, as this universe built around this topic has been highly unstable, the trend has last until the Middle Ages. In fact, Christians used to associate luxury with lust and vices, with the aim of underlining its negative value. This vision was aligned with pauperistic life conduct of Jesus Christ described in the Holy Bible.

During Renaissance, thanks to a better secularization of thought, the luxury's concept becomes functional to power. In this epoch, luxury started to be connected with a profane meaning, but without the counterpart of feeling guilty or being condemned in a social and moral way. It is possible to consider this period as the first real triumph of luxury. This process of evolution begun predominantly thanks to Italian duchies and republics (such as the Granducato of Tuscany, the Serenissima Republic of Venice and many others) and the French sovereign (especially the one of Louis XIV, known as the "Sun King", a reference to the splendor of his reign), between whom was set a particular and extravagant race of patronage. The aim was to show the personal power and the artistic taste by hiring the best artists and architects for the creation of immortal masterpieces. This vision brought to life castles, palaces, villas, gardens, paintings and statues that are still perceived as essences of beauty and as fundaments of artistic intelligence. Peculiar was the Venetian merchants' idea of becoming patrons of arts in order to both elevate the family status and reintroduce money in the economy (instead of keeping it unproductive in a bank). However, this absolute love for luxury and ostentation was accessible just to a small percentage of the population: the kings, the clergy and the merchants. This aroused the other part of the population and laid part of the bases for the French Revolution of the eighteenth century.

After a short period of soberly, luxury changed completely for the last time. The Industrial Revolution begun and a new concept of luxury begun too. The Dandyism was a movement that reformed completely the way in which luxury has been thought before. It was created to promote the cult of beauty and was against the middle class's values of accumulating money, progress and meccanization. This was combined with what is expensive, sumptuous and refined; a way to look positive for emotions and gratifications, and it also becomes a means of personal identity through various businesses, including ostentation.

It is possible to identify the idea of privilege and the sense of "not necessary" as a sort of common thread between the years. Nowadays, the luxury perception is directly influences by the Industrial Revolution. In fact, the concept of Luxury is perceived on the handcrafted and handmade products, which are in net contraposition to the ones developed for the mass-production.

Therefore, we can describe the Luxury as the products or the experiences that are connected with the personal behavior and the needs of feeling satisfied.

4.1.2. Characteristics and Economical Concept

After having analyzed the historical evolution of the Luxury and before analyzing the market structure with its players, it is fundamental to focus on the social motivations for which it is perceived, as something needed by people. *Why should a person spend more money in something that it can purchase at a lower cost?* Now we are going to analyze which are the main motivations that pushes the customers towards the Fashion & Luxury Sector.

Which is the Economical Concept of Luxury?

First of all, the first requirement for the customer's accessibility to the sector is the personal income. The first observer of the phenomenon has been Ernst Engel in 1857, which understood that an increase by the 1% in the personal income is reflected in an increase in the capital expenditure for Luxury products by more than 1%[36]. In fact, he understood that the percentage invested in capital expenditures for the acquisition of prime necessity goods (cereal and legumes) was higher for poorer family, while with an increase in the personal income the same percentage was lower (as the people to be fed were the same). Therefore, the richer family, with higher personal income, were shifting the demand toward superior products or luxury products.

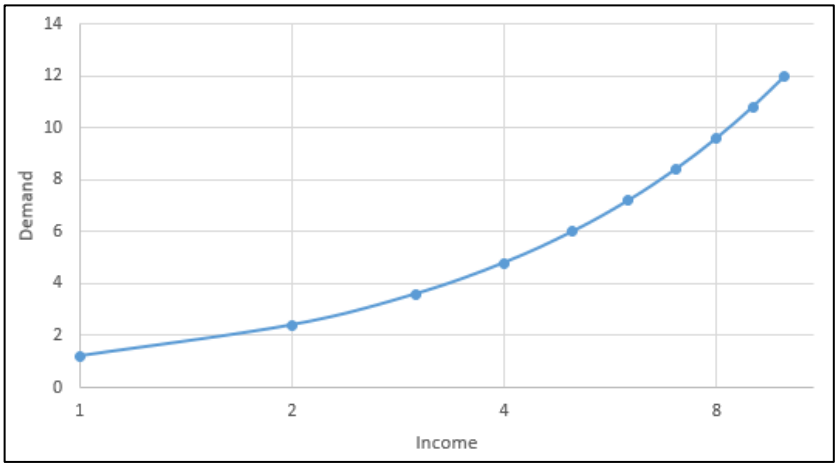

Figure 20 - Engel Law's Curve

Moreover, the economist Thorsten Veblen, in 1899, realized that the Luxury products reenter in a peculiar group of goods that does not follow the rules according to which an increase in the price is reflected into a reduction in the quantity sold. This because the consumption of luxury products

[36] "Microeconomics" – Besanko, Braeutigam (2016).

is related to the personal necessity of feeling them as a status symbol. Some example are Swiss watches, jeweler, leather good, wine and luxury cars.

Which are the main Social Characteristic of the Luxury products?

We saw that the concept of luxury is related to personal behavioral processes and needs. However, the nature of the luxury products is superfluous and unnecessary in respect to the products of first necessity. The economist Ezra Solomon, by analyzing the consumer behavior field, he understood which are the main motivation that pushes the customer in purchasing the luxury goods.

Solomon divided the personal needs into two main group: The Biogenic Needs and the Psychogenic Needs. The first ones are related to the physiological and vital needs, while the second one to personal power and status. Furthermore, these two categories may comprehend other two different needs, the Utilitarian ones and the Hedonic ones. The Utilitarian Needs are the ones directly observable and measurable characteristics, while the Hedonistic Needs are linked with the experiential nature of the needs[37].

Thanks to these descriptions, it is possible to reenter the Luxury needs into the Psychogenic needs and, specifically, into the Hedonistic ones. In this group, there are the products that are capable of delivering pleasure to the purchaser, in terms of satisfaction and emotions.

Moreover, the economist Abraham Maslow, in 1954, deduced that there is a hierarchical sequence of needs that are connected to the human nature[38]. The structure of this hierarchical structure was individuated in a pyramid, where at the base of it there are all the vital needs (sleeping, eating, drinking, etc.), while ascending to the summit there are all the auto-realization needs and dreams. According to Maslow, human being must answer every single need they have, and the structure of the pyramid does not reflects the quality but the need's importance.

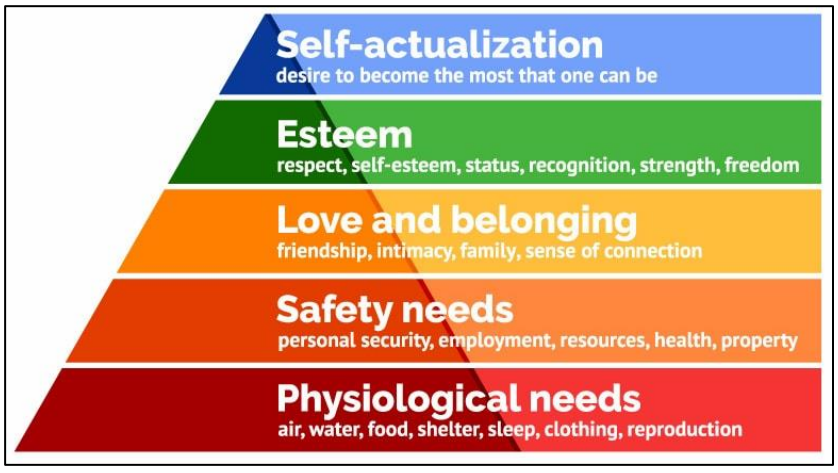

Figure 21 - Maslow's Hierarchical Needs Pyramid

[37] "Consumer Behavior" – Ezra Solomon.

[38] "Hierarchy of Needs" – Abraham Maslow (1954).

However, the luxury need can be inserted between the "Love and Belonging" and the "Esteem" categories. This because the luxury is capable of answering the human needs related to the sense of belonging to a cluster or to a certain status and the needs of being felt recognized into a social and personal group.
Therefore, after having analyzed the nature of the human behavioral needs, Psychogenic and Hedonic for Solomon, or "Love and Belonging" and "Esteem" for Maslow, we must understand why they are answered by the acquisition of luxury products. This is because, luxury is perceived as a particular and unique way of answering the personal needs associated to the status belonging. Moreover, thanks to these peculiarities, luxury goods are capable of responding even to the needs of higher level, as the "Self-Actualization" ones.

However, the only problem related to the luxury good is that the company's marketing function will never be able to create a personal need, as they can only be created by the human being. The only capability that firms must develop for the marketing function is to push the customer in understanding that a specific luxury product is capable of answering its needs.

4.1.3. Principal Players in the Fashion & Luxury Sector

The Fashion & Luxury Sector is difficult to be defined and, to complicate the situation, many different consulting companies have developed their own definition. In order to proceed with the analysis of the Sector it would be fundamental to choose one definition, in order to better comprehend which are the main industries that reenter into this sector.
Fondazione Altagamma, an Italian company that makes researches and analysis for the Fashion & Luxury firms, clusters the Fashion & Luxury sector into nine different industries: Personal Luxury Goods (apparel, jewelry, watches), Luxury Cars, Luxury Hospitality, Fine Wines & Spirits, Gourmet Food & Fine Dining, Fine Art, High Quality Design Furniture, Private Jets & Yachts and Luxury Cruises[39]. Bain & Company supports this view of the sector and, together with Fondazione Altagamma creates yearly a report on the sector that is published in the most important economic magazine around the world.
Moreover, the idea of a wide Fashion & Luxury sector, that contains nine different industry, is even supported by the real composition of the different groups that are present in the sector. For example,

[39] "Altagamma 2018 Worldwide Market Monitor" – Claudia D'Arpizio, Federica Levanto (2018).

LVMH, the world most valuable Luxury group with its €188 billion market capitalization[40], is competing in the three different industries of Personal Luxury Goods (Louis Vuitton, Dior, Fendi, Bulgari, etc.), Fine Wines & Spirits (Moet & Chandon, Hennessy, etc.) and Luxury Hospitality (Cheval Blanc, Belmond, etc.).

FY2017 Luxury goods sales ranking	Change in ranking	Name of company	Country of origin	FY2017 Luxury goods sales (US$m)	FY2017 Total revenue (US$m)	FY2017 Luxury goods sales growth*	FY2017 Net profit margin[1]**	FY2017 Return on assets**	FY2015-2017 Luxury Goods CAGR[2]*
1	⬌	LVMH Moët Hennessy-Louis Vuitton SE	France	27,995	48,057	17.2%	13.2%	8.2%	10.9%
2	⬌	The Estée Lauder Companies Inc.	US	13,683	13,683	15.7%	8.1%	8.8%	10.2%
3	⬌	Compagnie Financière Richemont SA	Switzerland	12,819	12,819	3.1%	11.1%	4.8%	-0.4%
4	⬆ +1	Kering SA	France	12,168	17,446	27.5%	12.1%	7.3%	17.2%
5	⬇ -1	Luxottica Group SpA	Italy	10,322	10,322	0.8%	11.4%	10.4%	1.8%
6	New	Chanel Limited	UK	9,623	9,623	11.5%	18.6%	19.6%	ne
7	⬇ -1	L'Oréal Luxe	France	9,549 e	9,549 e	10.6%	n/a	n/a	8.2%
8	⬇ -1	The Swatch Group Ltd.	Switzerland	7,819	8,082	5.4%	9.5%	5.6%	-2.9%
9	⬆ +1	Chow Tai Fook Jewellery Group Limited 周大福珠宝集团有限公司	Hong Kong	7,575	7,575	15.4%	7.1%	7.3%	2.2%
10	⬇ -1	PVH Corp.	US	7,355	8,915	10.7%	6.0%	4.5%	8.1%
Top 10				**118,909**	**146,071**	**14.2%**	**11.6%**	**7.8%**	**7.5%**
Top 100				**246,664**	**276,754**	**10.8%**	**9.8%**	**7.6%**	**5.3%**
Economic concentration of Top 10				**48.2%**	**52.8%**				

Figure 22 - Top 10 Luxury Companies by Sales, FY2017

The previous list shows the top 10 Fashion & Luxury groups and firms, order in base of their revenues for the year 2017. LVMH, Richemont, Kering are the most famous groups in the sector, that specialized on the management of a multi-brand portfolio businesses, while many other company preferred to focus directly on the management of one single brand.

LVMH, as said before, is a French group that currently is leading the list with its €46.8 billion revenues in 2018, with a net profit of €7 billion[41]. From the Wine & Spirits they earn $5 billion, Fashion and Lather Goods €18 billion, Perfume & Cosmetic €6 billion and Watches & Jewelry €4 billion.

Kering is another French group that has reported €13.6 billion euro with a net profit of €3.7 billion in 2018. With its 30,945 employees, it manage a brand portfolio with companies such as Gucci, YSL, Balenciaga and Pomellato[42].

[40] Market Capitalization of LVMH updated at the 31 of July 2019.

[41] "LVMH Financial Year Ended December 31, 2018" – LVMH Press Release.

[42] "Kering Reference Document 2018" – Kering Press Release.

The first two Italian Fashion & Luxury firms are Luxottica and Prada. Luxottica is a company that produces eyewear for both acquired and licensed brand, such as Persol, Ray-Ban and Oakley. For the financial year of 2018, the revenues reached €8.9 billion and the net profits €0.9 billion[43]. Instead, Prada, with its five brand portfolio (Prada, Miu Miu, Church's, Car Shoe and Marchesi 1824) has reported in 2018 revenues for €3.1 billion and net profits for €0.2 billion.

4.1.4. Fashion & Luxury Sector Trends

We saw that the Fashion & Luxury is a sector were firms are actively fighting for becoming the world leader in the Luxury world. Moreover, it is possible to comprehend that the most important companies, for both revenues and profitability, are groups that mange multi-brand portfolios.

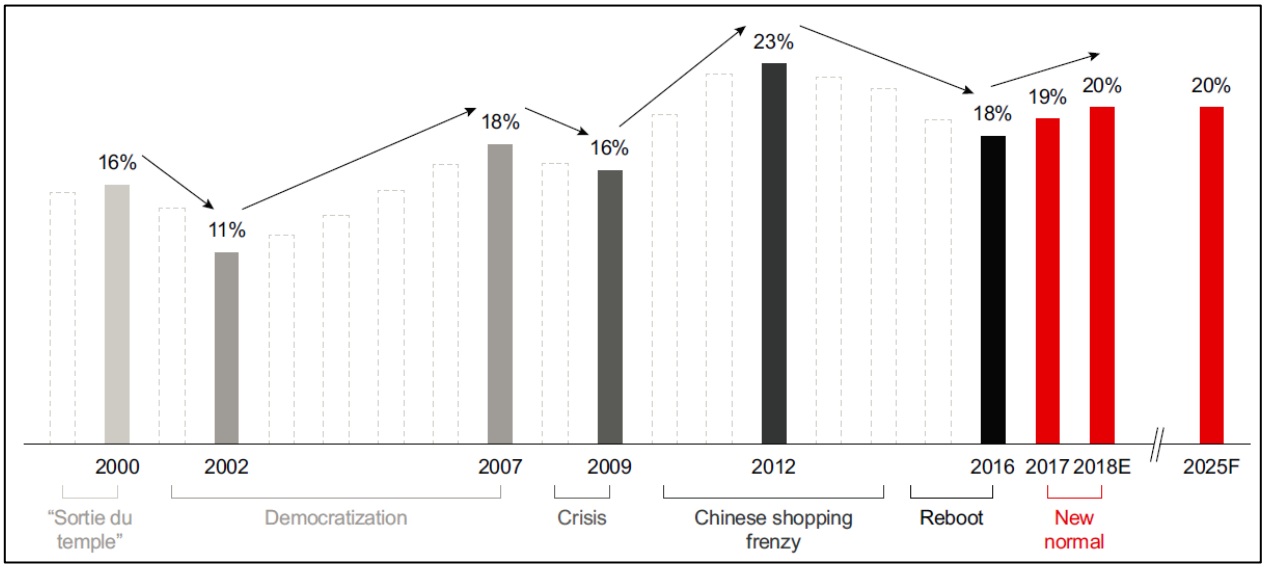

Figure 23 - EBIT Margin Evolution (for the Personal Luxury Goods)

One feature of the Fashion & Luxury sector is the capability of over performing in respect to other sectors. The profitability average level for the 2018 is about 20% (in terms of EBIT), with a constant growth for the third consecutive year. Furthermore, the profitability forecasts for the 2025 shows that the EBIT will remain around the 20%[44].

In fact, since 2017, has started a new period called "New Normal", in which the profitability level of the market will stabilize making the average EBIT, for the Personal Luxury Good, around 20%. This flattening in the profitability level is related to the Digital Disruption that will continue to affect the companies' P&Ls.

[43] "Luxottica Annual Report 2018" – Luxottica Annual Reports and Publications.
[44] "Luxury Goods Worldwide Market Study, Fall-Winter 2018" – Bain & Company (2019).

The total value of the Fashion & Luxury Sector is €1,171 billion and that the industry that are performing better are the Personal Luxury Goods (increased by 2% in respect to the 2017), The Gourmet Food & Fine Dining (increased by 3% in respect to the 2017) and High Quality Design Furniture (increased by 3% in respect to the 2017). Overall, the Fashion & Luxury has grown by 1% in the 2018 and by 5% in constant growth rate.

The next chart, prepared by Bain & Company, summarize the overall economic situation of the market for the year 2018[45].

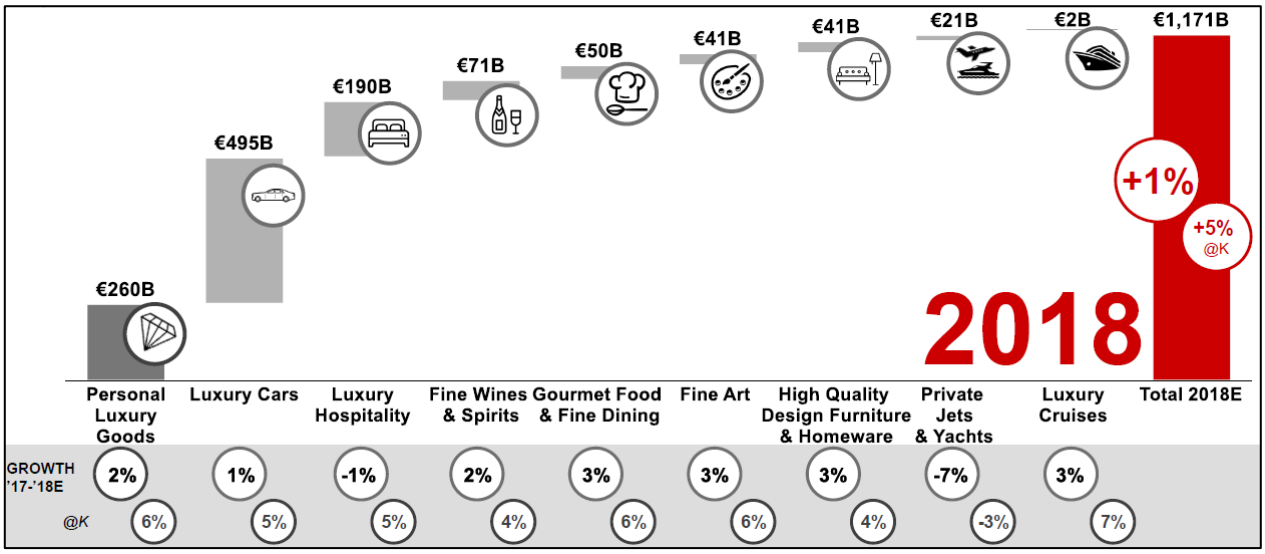

Figure 24 - Global Luxury Goods Market 2018 (@k is the constant rate growth)

However, the Fashion & Luxury Sector will continue increasing its total value in the future years. The Personal Luxury Goods industry will continue growing, from the actual 254 billion to a value that is between 320 and 365 billion of value[46].

Moreover, even the percentage of value divided per region will change. There will be a continuous increment of demand in the developing countries, will the old economies will maintain balanced their demand for Luxury goods.

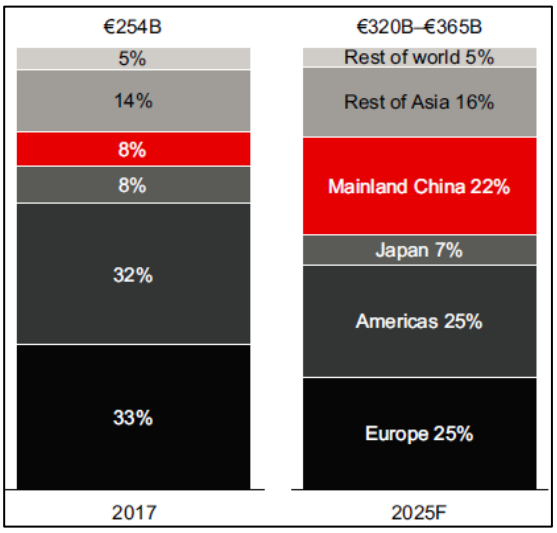

Figure 25 - Share of global Personal Luxury Goods markets (divided by regions)

[45] "Altagamma 2018 Worldwide Luxury Market Monitor" – Bain & Company and Fondazione Altagamma (2019).

[46] "Luxury Goods Worldwide Market Study, Fall-Winter 2018" – Bain & Company (2019).

This phenomenon is normal as the increment of personal income (increment of GDP per capita) is strictly linked with an increase of the demand for luxury goods, in accordance with the Engel's Law.

4.2. Main Features and Differences among the Distribution Channels

The economic world has always been shocked by different changes in the way in which the top managers organized the end part of the Supply Chain for connecting the final product to the consumer. In the Chapter three, we saw how the Supply Chain has evolved in the years firstly toward the customer and afterwards toward the Big Data. The aim of these continuous changes in the management and in the implementation of the Supply Chain are strictly connected with the firms' needs of creating new final products suitable for the customers. Moreover, we have seen that, for implementing this strategy in the best possible way, firms must exploit the Big Data acquisition activity in order to obtain the greatest amount of information from the customer habits and tastes.

The Industry 4.0 Revolution has already radically changed the way firms must adapt both their management style and Supply Chain implementation in order to successfully reach their fixed objectives. Nowadays, a company is considered to be competitive in an industry when it has created a positive and functional combination between product differentiation and customer satisfaction, laying the basis for the obtainment of the highest percentage of industry share. This combination must be created since the very first passage of the production, as it is fundamental to develop a functional final product capable of both answering a customer need and creating in him a sense of positive experience.

However, to complete the whole process, firms must exploit the different distribution channels in order to connect the product they have produced with the end-consumer. This step is very important and complicated, as the top management must take all the decisions on how to sell the final product. This must be executed through a previous analysis of the customer, creating a segmentation of it, in order to decide the price of exit and the different possible location of the shops, in which selling the products, in order to completely satisfy the consumer's preferences.

It is possible to consider this step as the final one of the Supply Chain. Moreover, the process of selection is integrated in the marketing activity of selection of the 4Ps, which are Product, Price, Placement and Promotion. The decision taken by the firm's marketing function is fundamental for

the creation of the most attractive strategy, capable of engaging the end-consumer into the shops for the acquisition of the products manufactured.

Which are the different Distribution Channels exploitable by a firm?

The first step to understand which are the main advantages and disadvantages for a firm in choosing the possible different distribution channels is to understand which are them.

The **Distribution Channel**, also known as placement, is a group of different intermediaries that constitutes the continuous connection between the enterprise of the product and the end-consumer of it. It is possible to consider it as the final part of the product's d path, started with all the activities exploited original brand manufacturer, ending the downstream processes.

The activity of choosing the best distribution channel alternative, as said previously, is an integrated part of a marketing campaign started with development of the products (following the information obtained by both the customers and the industry). The aim of the top managers (in particular the ones directly involved in the marketing decisions), is to answer the question "How do we get our product to the consumer?".

The different Distribution Channels can be divided into three main types:

1. **Zero-Level:** The Zero-Level is a Distribution Channel type where the number of intermediaries involved in zero. Here, the Original Brand Manufacturer (OBM) owns directly the retailers shops in which the products will be sold to the end-consumer. This approach is typical exploited by the firms that are more profitable, as the implementation of a retailers network capable of selling the highest possible percentage of the inventory to the widest possible range of customer (in different locations), is very expensive and it reduces the profits coming from the products. The cost associated for the implementation of this particular type of distribution channel are related to brick and mortar expenses, which are the ones for the acquisition of the physical retail shop, and to the decrease in the profitability level of the single quantity of final product sold. Nevertheless, the absence of intermediaries permits to the product to maintain a lower price for the end-consumer, making it often more affordable than in other distribution channels types.

   Moreover, with the advent of the Industry the advent of the Industry 4.0, companies started to create new e-commerce websites for selling directly their product directly to the end-consumer. This new typology of distribution can reenter into the Zero-Level as there is no intermediaries between the manufacturer and the final customer.

2. **One-Tier:** The One-Tier is the Distribution Channel type where an intermediary is present between the Original Brand Manufacturer (OBM) and the end-consumer. Typically, the intermediary is a private retailer that acquires the product directly from the firm and sells it to the end-consumer. The advantages for the manufacturer are related with a decrease in the risks associated with the inventory and with a reduction in the Brick and Mortar expenses. Meanwhile, the main disadvantage is connected with the reduction in the earnings for the manufacturer, as the private retailer, acquiring greater quantities of products, buys them with a discounted value.
3. **Two-Tier:** The Two-Tier is the Distribution Channel type where there are two intermediaries between the Original Brand Manufacturer (OBM) and the final customer. Normally, the first acquisition step is performed by a wholesaler that sells the products directly to other different retailers, which, finally, sell them to the end-consumers. The advantages for the manufacturer are related to the capability to sell the highest percentage of the inventory and to manage precisely the production quantity thanks to the buying campaigns performed before the production starts. Similarly, the main disadvantage is related to the price of the final product, as the increase in the number of intermediaries is reflected in an increase in the price for the end-consumer, and in the reduction of the possible profits for the manufacturer.

It is possible to summarize the previous different types of Distribution Channel into two different methods: the Direct Method and the Indirect Method. The Direct Method has the shortest possible path and connects directly the manufacturer with the end-consumer. The possibilities for the firm are to exploit the owned retail shops or the e-commerce websites. Meanwhile, the Indirect Method takes longer processes for the products to arrive on the market, as there is one or more intermediaries on the path.

Moreover, the manufacturer has the possibility to choose different strategies of distribution, by mixing the different types listed before. The exploitation of this Multi-Channel strategy has the aim of maximizing the earnings (improving the profits by combining the different channels) and reducing to the lowest possible percentage the leftovers in the warehouses.

How is it possible to manage the different Distribution Channels for the Personal Luxury goods firms?

The Distribution Channel Management is the fundamental activity that ends the processes of the Supply Chain and lunches the product on the market, making it available for the end-consumer. This Distribution Channel Manger must deal with many difficulties in both financial and marketing activities. In fact, it has to find an equilibrium between the utilization of the different channels in order to reach the objectives decided by the top management (in terms of earrings and profits), by exploiting the marketing strategy decided by the firm.

Moving forward the analysis, for the **Fashion & Luxury Sector**, and in particular for the Personal Luxury Goods, the choices in the management of the Distribution Channel is quite complicated, but not as much as in other sectors. In fact, the main advantage of the Luxury companies is connected with the Brand Value and with the final consumer perception. Furthermore, these are the reasons why they could decide to utilize exclusively the owned retail shops (Zero-Tier type), to exploit other "selected" private retailers (One-Tier type) or to choose for other different methodologies. The not-controlled retail stores are willing to stock their fashion products, exploiting a marketing "push" strategy were the customer is convinced to enter in the stores thanks to the same presence of the luxury goods (Brand Awareness's power).

For these reasons, many Luxury firms, instead of utilizing one single strategy for the Distribution Channel, are exploiting the Multi-Channel strategy, by dividing the whole production among these four main channels:

1. **Direct Operated Stores (DOS):** Normally, one of the greatest asset voices in the Fashion & Luxury firms' balance sheets are the tangible asset. In particular, they are mainly composed by the present value of the Property, Plant & Equivalent (PPE). The value of the owned retail stores is inserted here and increases the company's evaluation. It is not difficult to see from the Annual Report of the most important Luxury Groups that firms, in the years, have developed a functional chain of mono-branded stores where they can sell directly to the consumer their final products. For example, Prada Group owns 638 stores, Gucci owns 540 stores and LVMH owns 1852 stores (exclusively for its Fashion and leather goods brands)[47].

   The necessity for Fashion & Luxury brands in owning stores, is because these physical spaces are designed to be attractive for the final customer, and, by entering, every person can experience the taste of luxury they wanted to. Moreover, these stores are placed in

[47] The number of the stores (DOS) owned directly from Prada Group, Gucci and LVMH have been taken from their specific 2018 Annual Reports.

prestigious location and in international shopping destination, in order to increase the customer perception of image, heritage and exclusivity of the brand.

Nowadays, these are still the main source of the earnings, as the customer still prefers to buy their luxury goods directly from the classical store distribution. For example, the breakdown of the earnings of the Kering Group shows that, in 2018, the 77% of the earnings comes directly from the DOS Distribution Channel[48].

2. **Wholesale:** Usually, it is how the Luxury companies call the private retailers (even in the Annual Report). These are luxury selected stores, not owned or directly managed by the company, that buy stocks of luxury goods from the manufacturer at a discounted price. These products are ordered and bought by the wholesalers in a buying campaign that comes previously than the production, making these goods sell-out rate equal to 100% for the OBM.

   The main advantage, for the Luxury brands, in the utilization of the so-called Wholesale stores, is to improve the geographical coverage by entering in new cities or in department stores where the acquisition of a physical space is not as convenient. Moreover, this permits to the luxury company to increase its earnings. However, often the luxury goods that are bought by the wholesalers are particular items developed and manufactured exclusively for them, which will not be fundable in the brand OED stores.

3. **E-commerce:** The raise of the Industry 4.0 has permitted for the luxury companies to create their own personal website for selling their products directly from the internet. The implementation (or the exploitation of pre-existing private website, such as Yoox or Luisa Via Roma) of the e-commerce is lead the luxury brands to reduce the exploitation of the wholesale channel. This strategy has a dual power, in fact is both capable of increasing the profits for the manufacturer (by excluding the intermediary step) and to create a peculiar new "online brochure", where the end-consumer can check, choose and buy its luxury products.

4. **Licence:** Licenses (often integrated with the wholesale earnings in the Annual Reports) are the release to a third party of special permission that gives to him the possibility, by paying the royalties, to produce (but not always to design, as this activity could be left to the company that owns the brand) and sells directly the products to the end-consumer. The

[48] "Kering Reference Document 2018" – Kering Press Release.

most clear example in the Luxury industry is Luxottica, that both owns eyewear brands (Oakley, Ray-Ban, etc.) and produces eyewear for other luxury brands (such as Prada, Gucci, Chanel, Bulgari, etc.).

However, even if this could not be considered properly as a direct or indirect Distribution Channel, it could be inserted in the list as the brand company gains particular advantages from exploiting it. First, it could help a company in exploiting markets in which it has no experience (in the previous example, Luxottica pays for branding their luxury eyewear and selling them), second, in increase its profitability (as there are just cash entries with few related cash expenditures). Moreover, the licensing is capable of incrementing the advertising level and geographical spread of the brand even in markets not completely linked with the original core businesses.

The Distribution Channel management for the Luxury Brand, as said seen before, has many different possibility for the development of a sustainable distribution chain. Nevertheless, the shareholders expectations must be completely satisfied in terms of the sell-out values and in maximization of the revenues (and their relatives' profits). Therefore, to reach all these objectives, managers must reach an equilibrium of the previous distribution channels.

By deepening the analysis on the previous list, it is possible to comprehend that the question is quite different for Licenses and the Wholesales. In fact, for the first one the only direct expectation of the company is related to the royalties payments (and a required brand advertisement level), while for the second, the expectations are just related to the amount of orders obtained in the buying campaigns (as the sell-out problem is left to the intermediary).

For these reasons, we can assume that, nowadays, the Distribution Channel management should focus their attention mainly on the last two channels: the Direct Operated Stores (DOS) and the e-commerce.

Which are the main advantages and disadvantages, for a Personal Luxury brand, in the choice of the classical DOS channel vs the new E-commerce channel?

The DOS and the e-commerce channels, as said previously, are the ones that must be at the center of the managers' decisions in order to be fully integrated into the strategic view of the company. However, taking strategic decision in this field is not as easy as it could seem and a first sight. In fact, balancing the production into these two channels must deal with the following typology of questions: Which percentage of our production should we reserve for the e-commerce channel?

How should we organize the distribution in order to serve effectively and successfully the different geographical areas? The difficulties could arise during the managerial processes set for answering the previous questions. In fact, the presence of many DOS, for these luxury companies, could lead to a disuse of the e-commerce websites or either to a concrete disorganization in the management and exploitation of these two channels.

However, the choice of the right balance between the classical DOS and the new e-commerce passes through the SWOT analysis of the two different channels:

1. The **Direct Operate Stores (DOS)**, as said previously, are the first source of revenues for the luxury firms. Nevertheless, even if they are still very profitable, there are many advantages and disadvantages that managers must analyze both in short and long terms, in order to plan the distribution strategy of the luxury company for the future years.
    - **Advantages:** One of the greatest advantage of the DOS is related to the value that they represents in the luxury firm's balance sheet. In fact, their financial power is both connected in the quantity and even in the geographical locations in which they are placed (most of the times are historical places, city center or important malls). Moreover, there is the possibility for the company to sell them, with the aim of increasing their liquidity level to buy other stores or simply to spend these cash in other investments. There are even high barriers to entry for the new luxury company that would like to build a functional store chain.

      The DOS are the places through which the end-costumer enters in contact directly with the luxury firm. For this reason, the design, the employees and the physical spaces must be created in order to transmit the brand heritage, creating a new experience into the final consumer, gaining a distinctive competence against the competition.
    - **Disadvantages:** The main disadvantages are related to the high implementation costs. Another drawback is the high expenses associated to with the design and the construction of the stores' interiors (as about every five years they must be completely rethought and remodified). Moreover, the management and the training of the sales assistants requires time and high capital expenditures.

      However, the greatest disadvantage, which has emerged in the last years, is related to the difficulties in the obtainment of important information from the end-

customer, as is complicated to gain and store data different from just the personal information.

- **Opportunities:** The opportunities to improve the DOS distribution channel are related with the possible and multiple strategies that a firm could exploit for creating a new customer experience. In these terms, the 4.0 integrated technology could enter into the game for changing radically the level of consumer involvement.
- **Threats:** The greatest possible threat is the e-commerce constant increase in the utilization levels. In fact, in the long term, if customers' preferences switches from the DOS to the websites, the physical stores will disappear.

  Moreover, there could be problems related to both new adverse geographical policies and laws or to the changes in the stakeholders' tastes.

2. The **E-commerce** has a completely different, almost opposite to the DOS channel, set of advantages and disadvantages.
   - **Advantages:** The main advantage for the e-commerce is related to the low cost needed for the implementation, as these expenditures could be almost zeroed by exploiting third companies' websites (Yoox, Luisa Via Roma, Amazon, etc.). The boundary-exemption of the e-commerce permits the firm to reach place in which the products were not sold before. The profits of the website's sold products are higher than the ones sold in the DOS, as the fixed costs are lower.

     Moreover, the online advertisement is capable of having higher ROI with lower costs (is also advertises for the DOS channel).
   - **Disadvantages:** One of the greatest downsides of the e-commerce remains the high number of consumers that prefer continuing purchasing into the classical DOS for purchasing their goods, as they still would like to try the product before buying it. Another disadvantage, related to the previous one, are the customers that return the products they purchased, creating logistic problems for the company. These inventory weaknesses arises because many companies uses the single stores' warehouses for the e-commerce, in order to reduce the time utilized to serve the end-consumer. This strategy could reduce the DOS revenues, reducing the firm's revenues too.
   - **Opportunities:** E-commerce is nowadays the greatest firm's opportunity to increase its revenues and profits, as the companies can easily enter into new areas

and location by serving new and old customer 24/7. The growth of the online luxury purchases is expected to be, averagely, the 25% of the whole purchases by 2025, making one luxury product out to four sold via internet[49].

- **Threats:** In the e-commerce channel, the competition is harder, as the barriers to entry are almost zero. Customer can easily go from one website to another and check which product is better in terms of design and cost (however, not in terms of quality). Moreover, there is the possibility that, in the future, governments could decide to write new legislations to impose taxes on online purchases (as the countries are losing tax revenues through this phenomenon), reducing the profits gained by the company.

In particular, for the Personal Luxury Goods, which are the recent trends in the Distribution Channel Management?

We understood that the DOS and the e-commerce are two opposite channel that luxury companies must exploit for reaching their objectives. For the luxury companies, being able to comprehend which are the future Distribution channels' trends becomes fundamental for planning a long-term strategy.

	FW16/17	FW17/18	y/y chg (%)	Group	Delta	as % of total	as % of total
Dolce & Gabbana	737	2,235	203%	*Catching up*	1,498	*25%*	**59%**
Prada	876	1,846	111%		970	*16%*	
Fendi	764	1,182	55%		418	*7%*	
Brunello Cucinelli	292	818	180%		526	*9%*	
Tod's	259	424	64%		165	*3%*	
Hermes	2,863	3,876	35%	*Extending the lead*	1,013	*17%*	**48%**
Gucci	2,502	3,477	39%		975	*16%*	
Burberry	1,778	2,182	23%		404	*7%*	
Saint Laurent	1,270	1,622	28%		352	*6%*	
Bottega Veneta	817	971	19%		154	*3%*	
Moncler	682	700	3%	*Surfing*	18	*0%*	**2%**
Valentino	528	568	8%		40	*1%*	
Zegna	478	531	11%		53	*1%*	
Balenciaga	390	419	7%		29	*0%*	
Louis Vuitton	1,814	1,333	-27%	*Bucking the trend*	-481	*-8%*	**-10%**
Ferragamo	1,160	1,040	-10%		-120	*-2%*	

Figure 26 - Styles Available for Online Purchases

In figure 26 is possible to understand that in just one year, between the fall-winter season 2017 and the fall-winter season 2018, different luxury firms has begun increasing consistently their products

[49] "Altagamma 2018 Worldwide Luxury Market Monitor" – Bain & Company and Fondazione Altagamma (2019).

range on the e-commerce websites. Dolce & Gabbana, Prada and Fendi are the luxury firms that are driving this growth in their online product offers. The majority of the most important and famous brands are increasing their online presence in order to follow the e-commerce trend that will become one of the firsts source of revenues.

Therefore, as seen previously, by 2025 the luxury world will be completely reshaped. The online distribution channel for these companies will become as important as the DOS one. Both together will account for the 50% of the total revenues in the market[50].

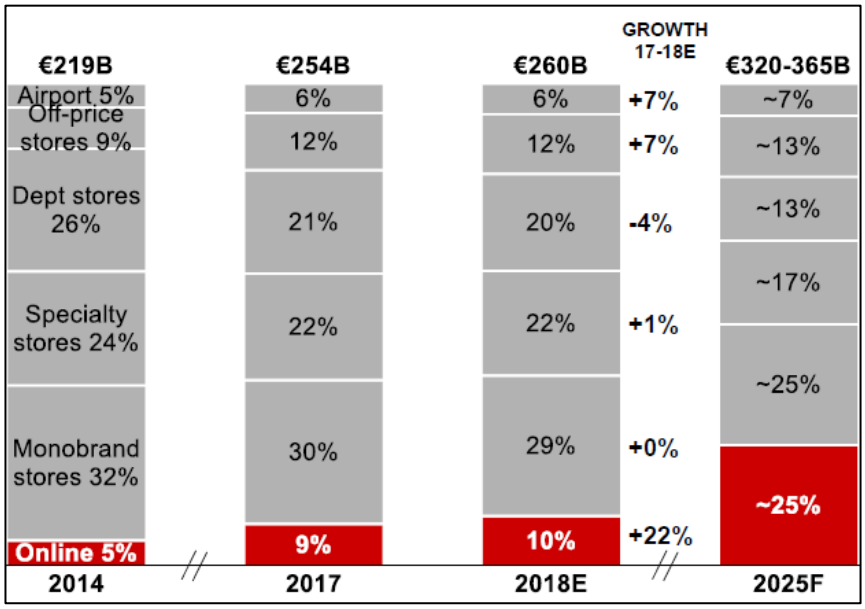

Figure 27 – Personal Luxury Good Channel Growth by Market

Thanks to the following image is possible to better comprehend how much the e-commerce market will grow, in just 6 years, and how all the physical stores (DOS and not) will be affected by this change. The effects of both these two phenomena, pushed in particular by the high level of digital disruption that this market will face in the nearest future, will stabilize the luxury firms' average EBIT margins around 20%[51]. Nevertheless, this disruption process will affect their P&L statements and for this reason, firms must develop strategies capable of focusing on the shareholders objectives and of being more agile in achieving them.

Moreover, according to Bain & Company, the luxury market forecast to 2025, shows that there will be even a great increase in the percentage of the purchases made by younger generations. In fact, the Y and Z Generations will represent the 55% of the future customers, where just the Y ones (the people born in the temporal arch between the eighties and the nighties) will cover the 45% of the market. Re-focusing the products and the marketing campaigns on the next generations will become very useful for answering the shifts in the distribution channels utilization, giving the best possible solution to the consumers, both with DOS and with online channels.

[50] "Altagamma 2018 Worldwide Luxury Market Monitor" – Bain & Company and Fondazione Altagamma (2019).

[51] "Luxury Goods Worldwide Market Study, Fall-Winter 2018" – Bain & Company (2019).

Related to this, there will be even an adjustment on the consumer nationality trend, where, by 2025, the Chinese consumer of Personal Luxury Goods will become the 46% of the total (from the 33% of the 2018). This will have great impacts for the luxury firm, as more than one euro out to five of their revenues will be gained in Mainland China.

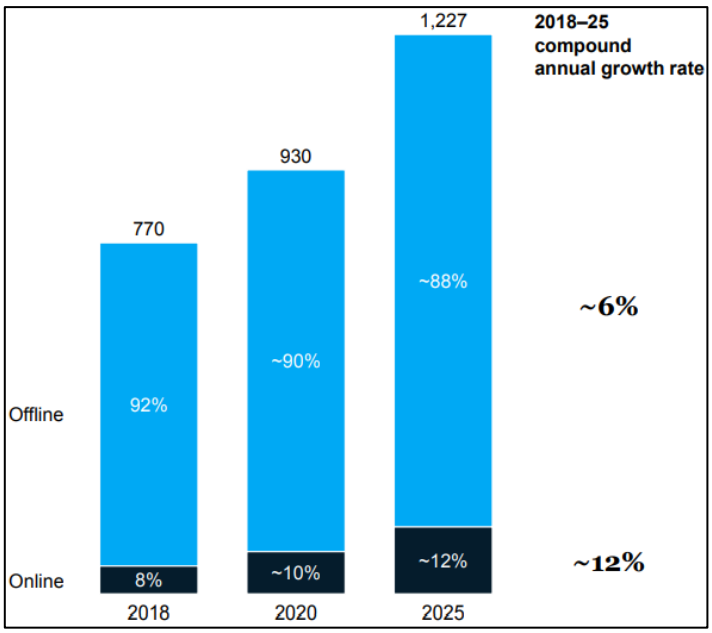

Figure 28 - Breakdown of the Chinese Luxury Spending (RMB billion)

Firms must focus on the "Red Dragon" trend as, if more or less the half of the luxury consumer will be Chinese, the products and the distribution for them must be design properly to their tastes.

However, according to a McKinsey & Company survey, the Chinese consumers will still exploit the offline distribution channels more than the rest of the world[52]. Only the 12% of the total amount of the Chinese purchases will be done via online channels, instead of a worldwide average of 25%. However, answering their requests for high level of online intermediation and disruption becomes fundamental for the luxury, especially in the marketing, events and the 4.0 evolution of the DOS processes.

Another great impact that the luxury market will face in the next 6 years is related to the changes in the geographical areas where the consumers will purchase their Personal Luxury Goods. Even in this field, the greatest impacting segment will be the Chinese one. In fact, there percentage of luxury products that will be bought directly in the Mainland China will double by 2025, passing from the actual 24% to the 50%. This shift will have huge impacts on the luxury companies' ability in forecasting there sales, as the increase in the Chinese domestic sales percentage will means a reduction in the annual rate growth of the other regions. In fact, Europe and America will lower annual growth rate than in the past years, as their annual rate will be approximately around 1.5% while the average one will be between 3% and 5%. This phenomenon is influenced by the

[52] "China Luxury Report 2019: How young Chinese consumers are reshaping global luxury" – Mckinsey & Company (2019).

slowdown of the native European and American demand and by the reduction in the foreign purchases made by the Chinese customers[53].

For the top management, following all these different trends must be the basis for the implementation of the firm's strategic plan for the future years, remembering even that there are other fields in which forecasting and planning is not simple, but it still remain mandatory for achieve successfully the shareholders' objectives.

Is the Distribution Channel Management the main activity that must be performed by the managers in order to answer positively the shareholders and customers' requests?

The decisions taken by the management for the balancing of the DOS and e-commerce channels is the fundamental step for connecting the company to the final customers, ending the supply chain processes. However, before these decisional activities, in order to balance positively the expectation for these two channels, managers must take into account other fundamental sales constraints.

In fact, in chapter 3, we have seen that, in the past years, the firms' Supply Chain management has evolved focusing the attention directly to the final customer. The results are visible in the constant increase in the importance that the Marketing & Sales Management function has gained in the years. Therefore, this function, in which the Distribution Channel management is included, must answer the entire set of question that are fundamental for the success of the sales campaign.

Therefore, the questions that must be answered by the Fashion & Luxury companies (Personal Luxury Goods), for reaching the maximization of the pre-fixed objectives, are related to these different fields:

1. **Product:** First, the firms operating in the luxury sector must deal with an important problem related to the management of their products. In fact, especially for the Personal Luxury Goods (especially for the apparel), the different products have just few months for being sold to the end-customer, because they suffer of seasonality. The difficulty in this field is, firstly, to create a collection that is capable of attracting and inspiring the end-consumer and, then, to start producing the perfect quantities in order to maintain the unsold percentage at the lowest possible rate, by covering the greatest possible area (with every single available Distribution Channel), in order to maximize the revenues levels.

[53] "Altagamma 2018 Worldwide Luxury Market Monitor" – Bain & Company and Fondazione Altagamma (2019).

2. **Size Grid:** The Size Grid problem is strictly related to the previous one. In fact, the goods production (especially for the apparel) needs to be organized dividing the quantities in relation to the sizes. The management of this field is fundamental for the luxury apparel as the customers' request is to have the best possible "tailored" product, in accordance with the higher priced demanded by the manufacturer. One of the most difficult process in this field is the analysis of the past years sales in order to forecast the quantity of production, divided by sizes, for filling the different stores. This activity must take into account that the different geographical areas have diverse human beings that differs in terms of their physical aspects. For this reason, the segmentation of the geographical areas becomes fundamental for the production of luxury apparel with a suitable size grid for the population present in a specific area.

   Moreover, a related problem with the size grid is related to wrong forecasting. Errors in forecasting are reflected in revenues reduction as the sizes lack in stores are lost sales.
3. **Price:** The Price decision must be considered equally important in the creation of the collection. In fact, the style department must analyze the market (both customers and competitors) in order to create a gamma of products that covers a series of different price ranges. The exploitation of this field becomes fundamental for acquiring the greatest possible amount of different customer (in relation with their income capabilities). This, as the entrance in new markets (such as the millennials one), with specific products designed for it, is capable of increasing both the customer share and the revenues.
4. **Quality:** At a first sight, quality could seem to be one of the easiest field to accomplish. However, directly to quality are connected two different possible problems, the first one is related to the minimum quality level for the raw materials, that must be sustainable and must deliver the excellence of the brand to the end-consumers. While, the second is connected with both the quality of the work force and of the processes utilized in the production chain (especially if the products are handcrafted).

   If these two factors are not managed positively by the top management (and by the production supervisors), the luxury company could face problems related to the brand image (for example, if the raw materials are not sustainable). Alternatively, it could deal with high quantities of returned goods, if there are problems with the production (related with stocking, repairing and delivering the product or with the customers' repayment).

5. **Localization:** The management of the location, that is an integrated part of the Distribution Channel Management, is a luxury company's central activity for two reasons. The first one is related to the cost-benefits analysis that the company must develop in order to plan the strategy for the opening of new possible DOS or in the case of closing a group of old stores present in area, for the opening of one new DOS in the same area. While, the second, is connected with the size grid forecasting, as the geographical studies (combined with internal historical information) are capable of helping the managers in the organization of the production for specific areas, in order to maintain a high level of product coverage over the territory. Moreover, being able to experience and comprehend new countries, is important for the luxury company as they can plan the creation of small peculiar collection handcrafted exclusively for their national festivities, for increasing both the brand awareness and the revenues. A clear example is the Chinese Valentine's Day, where luxury companies can boost their profits by selling (through the e-commerce, in particular WeChat) their revenues. In fact, in 2017, Givenchy has been able to sell all its Chinese Valentine's Day Bags stock within 12 minutes, earning £150,000[54].
6. **Customers:** The luxury firm ability to analyze and segment its own customer is a fundamental step for the forecast of the future years. By focusing the attention directly on the consumers, firms could gain informations about their age, their buying frequency, their average bill, when they enter into the shop (which day and period), which products they buy and many other vital informations. The ability of obtaining, stocking and analyzing these customers' information has become, nowadays, fundamental for previsioning the development of the future collections. In fact, the combination of the whole set of information is capable of reducing the errors made in the development of the strategic plan for the new collections and to increase the company's earning and profits (by decreasing the leftovers products in the inventories).

   The management of this field has now become one of the most important even because, by serving the customer efficiently, it is possible to obtain many information. This information are vital for the creation of a machine-learning forecasting software that mixes them together with other external data, in order to beat the competition and answer positively to the different shareholders' requests.

[54] "In China, Valentine's Day is all about designer handbags, not true love" – Lucy Siege (The Guardian).

7. **Competition:** This field is not directly manageable by the company. However, by monitoring the competition in the luxury market is very important, as from the competitors a firm can obtain different information about their strategy. Knowing the opponent strategic plan could have positive reflections on the firm's strategy, helping the company in obtaining new competitive advantage in one or more field previously inserted in this list.

All these fields show how many factors a luxury company must deal with in order to develop and implement a successful sales campaign. The achievement of a successful strategy passes through the right analysis of all the previous points. Data achievement, storage and Information Analytics are becoming more and more important within the years for the luxury brand, as the demand for new hardware and software is rising in parallel with the need of increasing both the revenues and the profits. The managers of the whole luxury industry agree that the capability of analyzing the data for obtaining functional insights is, nowadays, a required ability fundamental for a successful strategy development and implementation.

The new Industry 4.0 Revolution approaches, seen in the Chapter 2, are capable of answering this continuously increasing demand, in ways never applied before in the market, helping the company in the everyday challenge of beating the competition and continuing to increase their market share. The new development of technology, smaller and smarter, applied to the luxury industry, could have extremely positive impacts in the obtainment of information form the customer. Moreover, the analysis of the data obtain by the new products, would became the basis for the implementation of a future forecasting structure, through which the firm could obtain information applicable in the management decisional processes. These will surely help the company in the achievement of the shareholders' objectives such as: profit increases, costs savings, reduction in the seasonal leftover percentage and in the management of the distribution channels (both DOS and e-commerce).

In the next paragraph, we are going to comprehend which are the main Industry 4.0 technologies that are already present in the market or that could be brought in the near future.

4.3. The Big Data and their possible implementation in the Fashion & Luxury Sector

As seen in the previous chapters, the Industry 4.0 Revolution is reshaping the way firms are strategically implementing their Supply Chain in order to reduce costs and increase the levels of efficiency. Nowadays, the will of creating a Data-Driven system capable of lessen the dimensions

of the internal management spaces and increase the quality of the monitoring activity through all the value chain, is becoming a fundamental tool for achieving future success.

For the previous reasons, even the Luxury Firms have already moved the first steps into the digitalization world. The main objectives for these companies are two:

1. **To efficient the whole Supply Chain:** The necessity of creating a more efficient Supply Chain grows with the needs of producing high quality luxury goods with the lower possible percentage of defects and errors. The times required for the design, acquisition of raw textiles materials, the production, the distribution and the sales activities are so compact that, normally, the project for a season takes just one year of time. This to understand how much the luxury world is different in terms of organization from other industrial realities.

   Organizing and coordinating all the employees, activities and function is both time and money consuming. However, the digitalization era and the utilization of Big Data can help the top management in preparing and managing all the previous activities by just utilizing Analytical Software and firm's information.
2. **To forecast the future activities:** While the first objective is related to the organization of the current activities, the second one is connected with the forecasting processes needed for planning the future years' activities. Being able to utilize data and information for understanding which will be the future demand and what the demand would like to purchase, becomes fundamental for the luxury companies. The obtainment of the customers' personal informations is the fundamental step for the achievement of the previous objectives, as from the end-consumer the firm can easily obtain a great quantity of data exploitable by the different software.

   This is a needed activity for the luxury company. In fact, errors in the creation of the forecast can lead the firm in incurring revenue losses, if the expected quantities are lower the actual demand, and cost increases, if the expected quantities are higher than the actual demand.

These two objective can be easily achieved by the right implementation of a Data-Driven System. This strategy is extremely expensive for the luxury companies, as there are many different internal and external indicators that must be carefully analyzed. However, in the medium-long term, once all the company's different actors will have gain familiarity with the new 4.0 software and tools, the company will achieve a functional competitive advantage against the competitors, making it more nimble in an extremely difficult market.

Which are the Data-Driven tools and technologies that can be implemented for making the Supply Chain more efficient and agile, for a Luxury Company?

The luxury firms' Supply Chain is one of the most delicate processes to be managed. The problems around this field are mainly related to the difficulties present in obtaining the raw materials (there are products whose raw materials are listed in the CITES[55]) and in the handcrafted processes. These two steps are fundamental for the luxury firms, as the success in the exploitation of these processes can lead to great deliverance of the brand's quality and heritage to the final customer.

However, these steps cannot be done through the exploitation of machinery or other tools. The acquisition of the must be properly done by purchasing the products physically from different suppliers. These suppliers can change according to the season, to the design of the products (in terms of material, colors, etc.) and to the species from which is derivate the material (fur, snake, etc.). While, the production processes requires the presence of human beings for the steps in which the raw material is prepared, cut, sewed and the packaging of the final product. The absence of the handcrafting steps or the integration of automated machineries in the production processes could be not view positively by the final consumer, especially because the heritage, the brand and the final price will not be justified by the presence of automated machinery in the process.

Nevertheless, the Industry 4.0 is capable of delivering its benefits even in this field. In fact, the application of a monitoring system will allow the luxury company to increase its agility in the planning of the whole set of processes fundamental for the production. A production software can organize the order of the different products, in terms of delivery time, in the quantity of time spent on the production and on the quantity of goods needed for serving the distribution. These, in order to avoid bottlenecks and to reduce the time needed to serve the DOS and the e-commerce websites. Moreover, the monitoring system can be helped by the implementation of QR codes, barcodes and microchips (as now their costs is almost zero) in the different luxury goods, one per each piece, that are constantly connected to a set of receivers. This strategy can increase the production manager capability of overviewing the whole set of processes, leading the firm to:

- Increase the level of control of the production trends, as it will be possible to monitor how many pieces are in production in certain time, in which production step is a particular good,

[55] CITES is the acronym for the "Convention on International Trade of Endangered Species", it is a provenience certification that enables the manufacturer to produce goods with raw materials obtained by the fur of not endangered species.

which are the percentages of already finished goods in the total of ordered quantities and many other information.

- Reduce the possible bottlenecks or downtimes by constantly monitoring the level of production and in the event of a breakdown in the chain, everything can be slowed in order to solve the problem in a more efficient way.
- Increase the agility levels by reassemble the production chain in accordance to the steps that the products needs to be manufactured.
- Increase the organizational quality by the utilization of microchips in the Personal Luxury Goods. These would be very helpful for the company as, since the first production step, they could store different product's information. For example, they could store the SKU[56] code and the final destination of the product.

  Moreover, the microchips could be helpful for understanding if the product is real or false, as it can contain a code easily readable by the brand's DOS sales assistants.
- Enable the possibility to **customize** the products for special customers, as the microchip can contains the information of the required customization. Through these constant monitoring systems, it would be possible to insert a customized product directly into the production chain, without utilizing a preferential channel, leading to a reduction in the costs associated with the customization processes.

The monitoring system are capable of storing the information and of using them for forecasting the future production processes. In fact, the Machines Learning can understand autonomously, through the SKU composition, which are the passages needed for every single typology of products (its constraints) and to create several scenarios for assembling the Production Chain, in order to develop the best possible scenario in terms of time or efficiency.

Furthermore, there is the necessity of organizing the storage and the final distribution of the production. Microchips are useful also in these fields. In fact, through the utilization of readers, the warehouse workers can divide easily the luxury goods in relation to their geographical destination. Moreover, there is the possibility to constantly check the exact amount of stock through the RFID technology that is capable of scanning the inventory with its frequency and understand what there

56 The SKU, or "Stock Keeping Unit", is an identification code capable of dividing the products in terms of type, color, material and other many different features.

is in the warehouse. At the same time, for delivering the stock to their final destinations, warehouse workers have only to do the same previous operation, nut in the opposite way.

Just these last two activities of the luxury's Supply Chain could be exploited through the utilization of automated robots that stores and deliver automatically the production, following the scheme created by the monitoring system exploited for the production.

Summarizing the concepts, integrating the machinery in the luxury Supply chain is quite difficult, as the brand could lose the reputability and the handcrafted quality requirements demanded by the final consumers. However, there are many great possibilities for the development of software capable of monitoring the production, the storing and the delivering activities, especially of exploited in different locations around the globe.

Another field in which the software are capable of answering a great number of problems is the Shop-to-Shop stock management. The questions arise as the DOS can store exclusively a small quantity of product for every single typology and for this reason, the luxury firm requires great communicational level between all the different DOS and the Warehouses, in order to serve properly the end-consumer. The "Stock Replenishment" Tool is a software that is capable of helping the Distribution Managers in dividing the quantities among the different stores in order to cover efficiently the greatest possible area. When a store requires a particular size of a product, the Stock Replenishment Tool helps in finding the researched good in the nearest possible store or warehouse. The choice among the different possibilities is done through an algorithm, whose decisions could be based on the shop importance (as if the sender has higher volumes in terms of sales than the receivers, it would be better to choose another store) or in distances terms (the smaller is the distance between the sender and the receiver, the more is lower the cost of transport).

Which are the Data-Driven tools and technologies that can be implemented for increasing the firm's ability in forecasting its future activities, for a Luxury Company?

Nowadays, this is the area in which there is the greatest amount of new 4.0 integrated technologies, easily applicable by the different luxury brands. We have seen that forecasting the future is fundamental for planning all the different activities in the future years. However, forecasting properly is not an easy activity, especially for the Fashion & Luxury world, where the consumers' tastes and needs change continuously.

The Industry 4.0 is capable of answering these specific needs by giving to the luxury firms the possibility to obtain information from both external and internal environment and to analyze them, with the aim of creating future possible scenarios utilizable in the planning decisions.

Therefore, managers, for exploiting functionally a forecasting study and obtain positive information in the development of a masterplan of the different future activities and processes, need two invest in the 4.0-integrated technology into two different fields:

1. **Analytical Software:** First, luxury firms have to make huge investment on the acquisition of the utilization right of a pre-existent analytical tool or to develop it internally. The differences between these two choices is related to the quantity of liquidity that the firm is willing to immobilize in this expenditure. In fact, acquiring the utilization rights is less costly than implementing a custom analytical tool internally, however, the second choice is the only one capable of delivering to the firm a competitive advantage against its competitors.

   The Analytical Software is the fundamental calculator of the different data obtained by the company, from both internal and external sources, with the aim of creating diverse possible scenarios of the next years. The ability of this software has remarkable increased in the recent years thanks to the last developments in the machine learning tools. These abilities became fundamental as the Analytical Software can understand and comprehend automatically how to utilize data in order to extract from them functional insights, utilizable for the planning activities. The advantage coming from the utilization of the machine learning is that it can help the management in understanding how to utilize new data while the software continue, autonomously, to calculate and analyze the original information.

   In this field is fundamental to combine internal data with external data. In fact, is by mixing together all the different information that the software gives the best insights. For example, with this tool it would be possible to analyze a DOS purchases trends during the years in relation with other external factors, such as national holidays, events in the area or even the weather. Moreover, it would be possible to segment the customers in relation with the age, the gender or nationality.

   The applications of these instruments are countless. It is important to program the software in order to create a basic analyzable table that constantly calculates and gives insight to the managers. This step is fundamental in order to have a system that copies the important informations from the internal databases and that continue updating the values in order to

have the most accurate possible forecasting results. The aim of this strategy is to have correct and precise values capable of delivering the right information to the management. Moreover, another advantage of the automatic update is related to the improvements in the scenarios created the day before, as the forecasting analysis is more accurate when the time distances are minor.

Another, great innovation on this field is related to the Artificial Intelligence and the machine learning. These technologies are increasing rapidly their importance as they could stock and analyze the Data in a way that companies has never had before. In fact, as said in the first chapter, the machine learning is capable of using the information and push the forecasting analysis to another level. According to "Tableau"[57], the three main areas where these technologies will result in an increase in efficiency and profitability (with the reduction of costs) are:

- **Inventory Accuracy:** The more informations that can be analyzed and forecasted, the more accurate will be the orders and the inventory hold in the different warehouses. In fact, by knowing the tastes of the customers, the average size split (in the different geographical areas) and the frequency of the purchases, the company will be able to increase its capability in manufacturing the right quantities of products and to stock them properly in the world's different warehouses. This will increase the accuracy of the inventory by more than 60%, reducing the costs associated to the transfer of the stock between the warehouses and increasing the possible sales amounts by having in the stores a specific product in the right moment.
- **Pricing Optimization:** The ability of analyzing the Data, combining them with other information, could be vital for the company to reduce the marginal errors associated with creation of the pricing list of the manufactured products. For a Company operating in the Fashion & Luxury Sector, this would mean an increase in the profitability as they could set a better price both in terms of different geographical areas and in term of consumer's preferences, resulting in a decrease in the seasonal leftovers.

[57] "3 Ways Retailers are winning with Artificial Intelligence" – Jeff Huckaby (2019).

- **Personalization:** Finally, the Fashion & Luxury firm could increase the possibility of giving a customized and personalized retail experience to the end-consumers by suggesting particular products basing the decision on their preferences and tastes. This Artificial Intelligence technology could be either exploited in the offline and online world. The advantages associated with this technology are mainly related with the increase in the firm's capability of customizing the products offer for the customer and gain more revenues.

2. **Information Obtainment:** We have seen that creating the analytical software could be either difficult and costly (but that generates a competitive advantage for the company) or less difficult and less costly, depending in the strategy perpetrated by the management. However, the field of data obtainment is quite more complicated, as obtaining functional information is not easy.

   There are different information and data that must be gained by the luxury companies for increasing their forecasting capabilities:

   - **Consumers' Data:** The consumer's data can be considered as external data, however, as these data have a very great significance for the company, it would be important to analyze and mention the, separately. One of the most difficult activities in the information obtainment field is to gain the information from the consumers. These can be obtained directly from the end-customers during the purchasing processes at the DOS point of sale. Currently this activity is done through the compilation of a form (via tablet) where the end-consumers fill all the spaces with their personal information.

     However, there are three problematics that arise in the utilization of this activity. The first one is related to the choices of the consumers of giving its personal information to the firm or the willing to flag the check-box on the form where they agree with the utilization of their personal data for commercial uses. The second is related to the fact, that often some DOS have difficulties in linking the purchaser's information with their effective purchase, making the total set of data not as effective as they should be for the Analytical Tool. The third is relate to the missing purchasing information made in the wholesale distribution channel (it could seems as not a relevant problem, but the sales' information have vary huge impacts in the development of the new collection and strategies).

To avoid some of the previous problems, it would be possible to associate a personal "fidelity card" (or a personal profile on the firm's app on the smartphone) with which the consumer must utilize during their purchasing activities. Moreover, it could be utilized in the e-commerce website for purchasing online luxury goods. This strategy is capable of incrementing the quality of the data collected and it enables the company to create a personal profile of the different customers. The customer segmentation is fundamental for understanding many useful information, for example, which kind of products are more appreciated by the under 30, which are the different bestseller in a peculiar area and how the purchasers and many other. Therefore, the segmentation is capable of attributing and suggesting to the single consumer a specific range of product, according to its previous purchases, in order to focus them directly on the homepage of the online store, increasing the purchasing rate.

To boost the utilization of the "fidelity card" the different brands should utilize them to store all the information and the identification codes (present in the microchips) of the different products purchased by the single customer, making them fundamental for the product recognition in case of reparation. This will surely push the consumers in agreeing to the utilization of their personal data.

- **Internal Data:** This data are easily obtainable by the different companies. For achieving these data is fundamental to implement a functional system that connects together the whole set of different counters and that stores all the information in central databases. All the information obtained during the purchasing activities (goods and customers' data) are shared along the system and the database makes them available for the Analytical Software.

  It is important to create a system that share constantly the data among all the devices and the central database. The more updates there are during the day, the more accurate will be the quality of the information present in the database. This is reflected in the quality of the insights delivered by the forecasting analysis.

- **External Data:** This data are important for improving the analysis with environmental information. This data are obtainable by the third parties companies. The most important information for the luxury companies could be related to the weather, the national census and the tourism values. Alone, all the previous data are

not able to give right insights to the firms, but they must be combined with the internal and the consumers' one in order to obtain the best possible insights.

Whether informations can help the companies in understanding which is the relation to the atmospheric conditions and the consumers' purchases, even by deepening the analysis on the relation between atmospheric conditions and the typology of products sold. The national census enable the company in understanding how the population of a certain city, where there are firm's DOS, is evolving in the years, in terms of number of citizens, of gender percentages, of age ratios and of GDP (pro capita) trends. Finally, the tourism data are fundamental to estimate the quantity and the nationality of the tourist present in an area in the different periods of the years, in order to plan the production for serving accurately all the consumers (very important information for the choices of the size grids in which should be sold the different products).

The obtainment of different data from these three fields becomes fundamental, as, just by combining all of them together, it is possible to obtain functional insights capable of enriching the management decisions.

However, before starting the campaign of data obtainment, managers must firstly understand which are the information that the firm really needs for the forecasting activities and later implement the strategy for the gaining them. This process is utile in order to focus exclusively on the information that are relevant, making the obtainment processes and activities more profitable, instead of deciding to gain the maximum quantity of different data without any decision, making the activity as time-consuming and not effective.

Which are the latest technological advances in the field?

Summarizing all the previous concepts, for both the Data Obtainment and the Analytical Forecasting, the luxury brands need to focus their activities in developing a great and functional 4.0-integrated system that vertically and horizontally integrates all the internal functions and procedures. In the previous chapters, we have seen that the future management activities will be integrated by the exploitation of new software and new machines that can improve their decisional processes. This is the reason why we can easily consider this change as the normal evolutionary process that every single firm faces during its existence. Luxury firms cannot escape from this shift. Nevertheless, the first mover in this industry will gain a great competitive advantage against the

competitors by improving both the quality of the management and the quality of the customer experience.

The Industry 4.0 has the right features for modifying completely the luxury market. The fact that people and customers have agreed in the entrance of this revolution in their life, by digitalizing and changing their action in accordance with the new technological releases, poses a huge challenge for the luxury companies. Being able to change internally for answering positively to the external pressures and demands is the 4.0 challenge that luxury must face in the future years.

The luxury companies, as seen before, have different challenges to face in their managerial processes: Product, Size Grid, Price, Quality, Localization, Customers and Competition. Data and information are capable of delivering the right and functional insights to the companies in order plan positively the strategies for the different challenges, with the aim of beating the competition and obtain a higher customers' share.

Many non-luxury apparel and footwear companies has already stared to exploit the different Industry 4.0 technologies. For example, Vibram, the Italian soles manufacturer, one of the world leaders in the sectors, has started exploiting a software called "Robochain", developed by a software company called Altea Up. The aim of the company is to decrease the time needed for reaching the market, to optimize the production cycle, to increase the monitoring level on the production and to be able to create different production scenarios base on the different market's demand and need[58].

Under Armour, the American footwear, sports and casual apparel, in 2016 has opened the "Lighthouse", its technological manufacturing test center in Baltimore. The production chain starts with the technicians that studies the athletes' movements through a 3D body scanner, in order to understand the points of streghth and weaknesses in the development and design of a new products. Moreover, they have implemented different software capable of organizing the production within a series of robots. There are even new 3D printer for the production of footwear soles, giving to the firm the possibility to manufacture shoes with lighter and more efficient soles[59].

On another level, Nike, the American footwear, apparel and equipment manufacturer, has recently unveiled its new Nike Adapt BB. These shoes will completely change the footwear market in the future years. The main feature of these shoes is the integration with the technology, as it has an

58 "Vibram chooses the Robochain Software for answering the market requests" – Altea Up Press Release (2018).

59 "Under Armour's new Innovative Lab features robots that make sneakers" – Business Insider (2016).

automatic lacing system that closes automatically by clicking a button on the special app on the smartphone. This works by combining together the minimization of the mechanical parts and the utilization of the 4.0 technologies[60].

These examples shows how the Industry 4.0 technologies are reshaping different markets and customers tastes. From the Supply Chain adaptation to the product technological integration, this Fourth Industrial Revolution will change every single decisional and managerial process.

The luxury firms have always been in a different type of industry, where the heritage and the brand value were the main drivers of the customers' purchases. However, nowadays, customers and people in general are looking for something new and different. Technology is now a part of our life and the thing that in the past were perceived as extraordinary, now become ordinary. This could happen even to a strong and valuable industry as the luxury one. We saw that this market will grow in the next 7 years, but the luxury firm will grow and change with the market. In addition, both the e-commerce and the retail sector must change for satisfying completely the consumer's needs and demands. Therefore, the first movers will surely gain high level of competitive advantage in combining magnificently the heritage of their products with the modernity of the latest technological releases.

Industry 4.0 will be the key of success for the future of the luxury industry's profitability. Of course, if well implemented.

4.4. The Luxury Sector in the Future, from the Consumers' Prospective

The economic world is rapidly changing. The digitalization has brought to an important change in the developed countries, where the economy is growing slower than in the past (or even the growth is flatten) and the consumers are shifting their spending from products to services, boosting the value creation from the retail industry[61]. In addition, the trend will not seems to stop in the nearest future.

We have seen that this phenomenon will affect even the luxury industry. However, thanks to previous different analysis, we have seen that the Industry 4.0 is capable of giving functional technologies for transforming this customers' behavioral change into a possible growth in the firm's profitability. Big Data and information are at the basis of this revolution. Nowadays, the

60 "Breaking Down the Nike Adapt BB" – Nike News (2019).

61 "Painting the Digital Future of Retail and Consumer Goods Companies" – Accenture Strategy (2017).

purchasers are less loyal and more egocentric, they have less time but they are more conscientious. This is one of the reasons why luxury brands must change in order to answer this needs, and with them, even the distribution must transform.

What will the luxury consumers (of Personal Goods) see in the future: a great development of the e-commerce channel or a great renovation of the retail distribution?

To comprehend at the best this final step, this time we will start the analysis by starting from the answer: the consumers will see both of them.

We have said and seen that these are years in which technological improvements and changes will reshapes the way people lives. Luxury companies have already started vast online campaigns, both in terms of e-commerce and of advertising. As customers are less addicted to the value of the brand, now these brands must deliver a real new sense of luxury, renewing the old and dated luxury of the past decades, the one that has never updated with the changes.

The main strategy is to focus the attention to the consumers' needs, manufacturing peculiar and unique products and develop strategies capable of creating a new customers' experience, by inducing amazement in them.

For these reasons, luxury companies will never abandon the classic retail distribution, exploited through the DOS. In fact, by abandoning the in-store distribution channel, Luxury Companies can easily be perceived as not different to the other e-commerce retailers, reducing even more the brand value perception and attention in the end-consumers. The luxury stores of the future will be combined together with the e-commerce. The 4.0 Shopping Experience must be inserted at the center of the strategies focused on the customers' needs, merging marketing with sales.

Therefore, in the future years, consumers will assist to a luxury industry where the strongest companies will have exploited the sequent strategies:

- **Marketing & Advertising:** The future of the luxury industry, and of the single firm, will be related to the success in reaching the younger generations and transmit to them the luxury values of the brands. Firms, has already started utilizing the social media for

Brands	Instagram	Facebook	Twitter
Louis Vuitton	22.4	20.7	7.3
Gucci	22.3	16.7	5.5
Dior	18.8	16.1	8.3
D&G	16.2	11.1	5.3
Prada	14.9	6.3	1.0
Calvin Klein	11.9	12.2	3.6
Versace	11.7	5.0	4.5
Burberry	11.2	17.0	8.6
Ralph Lauren	7.6	8.9	2.3

Figure 29 - Followers of Luxury Brands Social Networks (millions) - 2019

exploiting this strategy, as viewable in Figure 29. It is fundamental that these luxury companies continue to invest massively in this function, as the biggest challenge here is to utilize these instruments for achieving the management pre-fixed goals, without compromising the value of the brand and by transforming the virtual "likes" obtained online in an interactive and engaging experience for the end-consumers.

All the advertising and marketing campaigns will be managed both in the online and in the offline world, in order to cover the greatest possible range of customers. The digtal campaigns will be more built around the classic marketing, for example by exploiting the online advertsisemnt, while the physical one will be mostly related on different types of events.

- **Price & Products:** The price of goods will increase, thanks to the luxury campaigns that will be held by the firm in order to restore the original heritage and the brand exclusivity. This strategy will begin with the change in the product portfolio structure, reducing the range of the products and focusing on the ones that are capable of delivering the brand prestige. The lower price strategy, utilized in these years in order to increase the amount of sales, mostly on the online distribution channel, will be abandoned to re-establish the normal price range in order to restore the brand exclusivity and perception.
- **Wholesale:** The Wholesale distribution channel will still represent an important percentage of the total revenues of the different brands. Nevertheless, luxury companies, always for re-establishing their original level of brand's tradition, could opt not in a reduction, but in a new selection of more peculiar store that are aligned with the firm's objective of delivering the luxury and the heritage of the brand.
- **Online:** The online distribution channel, as seen in the previous pages, will be the channel that will grow the most in the next years, covering the 25% of the total luxury sales by 2025. There will be a great combination with this channel and the retail one (DOS), as just the e-commerce is not capable of delivering the brand's luxury characteristics. For these reasons, we will see online sites, in particular the ones owned directly by the luxury companies, which will have just a limited range of products, in order to push the purchasers in continues exploiting even the physical stores.

  Websites will be more user-friendly, will be able to give suggestion to the different users and to focus the marketing advertisement by analyzing the consumers' preferences and information.

Moreover, periodically these firms could utilize the web in order to sell limited editions of products through the online auction, in order to reach every single purchaser in the world and increase the customer experience. The only customers that will be admitted will be the ones that are considered "VIC" (Very Important Customer), that are the ones that had the greatest amount of interaction with the firm in a specific period. The utilization of the customers' information will be vital for the success of this distribution channel.

- **Retail:** Retail is the distribution channel that will change the most in the next decade. We already said that, for luxury companies, its existence is related to the firm's ability in promoting the heritage of the brand. Culture, passion, handcrafting is shared by the beauty and the design of the stores. For these reasons, DOS will be reshaped in order to deliver the characteristic wanted by the management and to increase the consumers' experience and connectivity. The interconnection with the online world is fundamental, as it creates a unique place and service where the customers can feel the pleasure and exclusivity of a being part of a luxury family. Moreover, this new interconnectivity of the DOS will become very important for achieving more information directly from the purchasers.

  For example, Farfetch, the online luxury fashion retailer, has developed the "Store of the Future", where online and offline are combined together[62]. This new DOS focuses the attention on the customers, which will be recognized at the entrance, thanks to the brand's app that will also be a fundamental part of the experience. These stores are highly technological integrated and can promote a great experience through the augmented reality. The "Connected Clothes Rails" can understand which clothes the customers picked up and shows directly on its app. The "Smart Mirrors" will help the customer in the buying activities, even by suggesting other products that could be combined with the product they are trying. Finally, the "Interactive Hologram" can give to the customer the possibility to check the shape and the design of products that there are not in the store and could be utilized for the customization of the product. The purchase will be completed via app and the items will be delivered to the costumer's home.

  This store is revolutionary, however some of its concepts could be utilized by the luxury companies for designing the "Luxury Store of the Future".

[62] "Store of the Future: Revolutionizing Luxury Retail one store at time" – Farfetch Blog (2019).

Other differences that will occur in this change are related to the quantity and the placement of the DOS. In the future, the luxury brand will redesigned their Brick & Mortar Portfolio by decreasing the quantity of stores and by moving the remaining part in location that are more desirable by the companies. Moreover, the firms and their designers could opt for manufacturing a limited edition production that will be sold exclusively in the DOS of just peculiars part of the world, in order to create exclusivity among the brand and to maintain a high level of revenues incurring from the touristic movements.

From the purchasers' points of view, these are the main characteristic with whom the luxury industry will be reshaped. The combination of the online and the physical in an Omnichannel strategy is already undergoing. Luxury, as we see it today, will not exist anymore in the future, thanks to these new selling techniques and the application of the Industry 4.0 tools.

As we can comprehend from the subsequently interview, the Luxury Sector's stores will be even more differentiated by the classical Retail ones. In fact, this change will be intensified by the utilization of different technologies in the fast-fashion brands' stores, which will not be used in the luxury one. In fact, the luxury world exists thanks to the human interaction and the experiences that a computer is not capable of giving to the consumer. However, there could be the possibility of the creation of "pop-up" stores or corners in the malls, where the Luxury companies can decide to exploit the technologies that have been used for the creation of the Farfetch's "Store of the Future" and many others. Additional technologies that can be seen in the Retail sector, more probably in the "Fast-Fashion" stores, are related to:

- **Virtual Reality (VR):** This technology could be exploited by the companies to offer a peculiar experience to the specific set of customers, in store or at their home. For example, the company could create a Virtual experience for the customer and show it to him at the store or directly at home (through an invitation sent via email). This experience could be about the history of the brand or about the productive cycle and others. The main disadvantage, associated with this tool, is related to the fact that the user must wear a particular devices called headset in which he can only watch videos. This can crate a very complex and useful experience for the end-consumer, however the exploitation of this devices is not directly related with an increase in sales but only in the experiential level that is given to the consumer.
- **Augmented Reality (AR):** For example, the utilization of real-time Data about stock (size grid availability) and color of a particular product could be shown in the mirror of the fitting

rooms in order to assist the customers in the purchase. The objective of the Augmented Reality is to increase the consumers' experience but without forcing them to utilize the headsets, the smartphones and tablets, in order to let them exploit both their ends during the purchasing processes.

As said, these technologies belongs more to retailers' brands that are not competing in the luxury sector. In fact, according to "CB Insights", there are many different example of utilization of these technologies in the retail world, as they find acceptance thanks to their aim in helping the company in areas going from the increase the customer satisfaction to the store planning[63].

However, even if the technologies related with Big Data and Internet of Things (IoT) has been developed and utilized by many companies, the adoption or integration of all the previous tools is a great challenge that is still open among the different players and competitors of the luxury sector. The first mover will gain a competitive advantage in the industry, pushing the brand's value and the level of customer's experience (that boosts even the firm's profits), of course, if well implemented.

4.5. Interview with the Head of CRM and Retail Digital Transformation of Prada Group.

To complete the analysis, I interviewed Luca Giornofelice. Currently, he covers the position of "Head of CRM and Retail Digital Transformation" of Prada Group since January 2016 and before he covered the position of "Operational Marketing Manager" of the Group. Previously, he has covered the position of Marketing Manager West Europe and Global Head of CRM for the Italian automotive company Ferrari for 5 years.

I asked him seven different questions regarding his ideas and thoughts about the possible impacts that Industry 4.0 will have in the future of the Luxury Sector, trying to understand which will be the final objectives of Prada Group for focusing the company's strategies towards the end-consumers.

1. *What is your function in the company?*

   The function of "CRM and Retail Digital Transformation" mainly covers the development of technologies and the implementation of Software, which enable the company to monitor and manage the purchase activities perpetrated by the end-consumers. This implies that the

63 "Retail Trends 2019" – CB Insights (2019).

final objective of the aforementioned function is to create sets of databases of consumers' information, so to improve the customer experience during the selling processes, both in the e-commerce and in the physical company's DOS.

2. *What do you think about the Industry 4.0 and its main approach to the Big Data, Internet of Things (IoT) and Artificial Intelligence (AI)?*

   I believe that Industry 4.0 is a natural and fundamental process that will change completely the market in which we, as Prada Group, are players. The use of technologies, software and databases are constantly increasing, thus there is an improvement in the capacity of the company to obtain Data, analyze them and then obtain functional insights for the implementation of future strategies built around the end-consumers.

   So, I think that Big Data, Internet of Things (IoT) and Artificial Intelligence (AI) are fundamental for our company and are capable of supporting all the processes that arise across the supply chain, and in particular the ones that can deliver the best possible experience to the final customer. For these reasons, our function has been created in order to help the company in entering in this new revolutionary period in which no single company must lag behind its competitors. Moreover, the first movers in the Fashion & Luxury Sector will be the ones that will obtain more customer share in the future, through the experience given to end-consumer.

3. *Currently, the Retail sector (in particular the Luxury one), is the second sector after Health & Life Sciences with the lowest rate of Digital Disruption. According to you, which are the main motivations around this phenomenon?*

   I personally believe that there are certain sectors in which the Digital Disruption has come before than others. For example, the Travel or the Media sectors are the ones with the highest level of technology implementation, especially because the technologies utilized are directly manageable by the end-consumers. As we said before, technology is reshaping the world faster than expected, however there are sector as the Retail one in which technology still has not been able to fully satisfy the necessities of the purchasers.

   In addition, in the Retail world we can distinguish the Fashion and the Luxury sectors, which are extremely different. Technologies can truly reshape the Retail sector, however, the Luxury one, in which Prada Group is a player, has the advantage of being more profitable but, at the same time, it has the disadvantage of the need of maintaining a heritage and brand image, which the Fashion companies do not need. This means that the

technologies that could be implemented in this sector are not totally exploitable in the Luxury world, as our power still relies on the human contact and interaction. For these reasons, the technologies that we will implement in the future, for the sales function, will be very useful but, at the same time, they will not be visible to the end-consumer.

4. *Which technologies do you think will be implemented in the sales functions of Luxury companies in the future years?*

   I think that the Virtual Reality (VR) and the Augmented Reality (AR) are the technologies that will completely reshape the Retail world. However, for the Luxury sector, these technologies could not be implemented, as they are not capable of delivering the minimum requirements and human interactions needed by the consumers in a store of a Luxury company. This means that, by assuming that the end-consumer needs human interaction, all the technologies that will be exploited in the Luxury sector, will be mainly utilizable by the sales assistants. For example, the "Smart Mirror", which are capable of helping the customer to find the possible matches, the available size grid, and the colors available, is a technology that will transform the company's stores that are manufacturing the so-called "Fast Fashion", not the Luxury company's ones.

   Therefore, the technologies that are being developed in the Luxury sector, for the sales function, are functional to the obtainment of Data from customers, their storage and analysis, in order to make the insights available to the sales assistants. This has the aim of helping the sales assistants to have the customers' Data about their past purchases, their tastes, their preferences and many other information in order to help them during the purchasing activities, guiding them towards the best choices possible.

5. *Do you think that the physical retail (DOS) will be still important for Luxury companies?*

   It is well known that the Luxury stores and products are the ones that are capable of deliver the most brand's values and heritage. Therefore, in the future the Luxury DOS will not lose their importance, however they will increment it, as there will be an increase in the concept of Omnichannel. E-commerce and Retail will be combined together in order to deliver the best possible experience to the final consumer, as they could exploit both of them for their purchases.

   Here, some difficulties arise, as combining these two channels, for Luxury companies, is more complicated because they must exploit their strengths, while their weaknesses must be reduced. This means that, for creating a real and functional Omnichannel strategy,

companies must achieve a great level of technological integration through the utilization of software and technologies that are capable of clustering the purchasers basing their choices on their personal information. Being able to understand the consumers' needs will become even more important to offer a real Luxury service in which they will find the same benefits both by choosing the E-commerce or the classical physical Retail. For example, by mixing together the different purchases made by a single consumer, the new 4.0-integrated Software will be capable of showing suggestions on the E-commerce websites, and at the same time, in the DOS, to show to the sales assistants which are the consumer's preferences, so to serve them properly and increase the company's revenues.

For these reasons, I think that the number of the DOS owned by the luxury companies will reduce and better located, while the implementation of an Omnichannel strategy will continue growing in order for the companies to reach every single customer even in places where they have not any stores. Another trend the must be well studied for future developments, is related to the capacity of the luxury companies to serve properly the client both in the physical and in the retail channel. In fact, even if the Omnichannel strategy is perfectly implemented, there could arise problems around the availability of a product in some areas, and for this reason, the company must implement a tool that must be capable of delivering the product purchased or ordered in the lowest possible time.

Moreover, there will be an increase in the trend that the physical stores will reduce their products offer, in order to maintain high level of exclusivity. For this reason, the customer will exploit them for trying the products and then the products are delivered directly to their apartment (another strategy to enrich of new information the customer's personal profile owned by the company).

6. *Following your reasoning, the technological future of the luxury sector, especially for the sales function, will be mainly about the obtainment of information form the customer for enriching the capability of the firm in serving them properly, focusing on transmitting the real luxury experience. Am I right?*

   Yes, of course. The future of the Luxury Sector relies on the heritage and on the brand image that the firm is capable of transmitting to the end-consumer. Therefore, the technologies must be mainly exploitable by the firm (assistant and employees) for obtaining, analyzing and utilizing the personal information about the customers. The final aim is to create a complete personal profile of the customer through the utilization of his

Data. First of all, it is important to utilize the information obtained during the subscription on the e-commerce site (or during the first purchase in the physical store) and to insert them into a Database where they could be extracted easily. Subsequently, to enrich more the insights it is important to add different information about him, for example by inserting the average value of its purchase, the typology of the products that he prefers, the frequency of its purchases and many other data. The analysis of the whole set of information will surely help these firm in creating a whole luxury experience, both online and offline. The only visible hardware that the purchaser will see in the retail stores, are the tablets ore the smartphone that are used by the sales assistants during the purchasing processes.

The more Data we obtain, the more insights we can utilize for delivering the best possible experience to the final customer. For this reason, it will be fundamental to increase the collaboration with third-parties companies, which sell sets of information not easily and directly obtainable by the company, in order to increase the value of the personal profile of the end-consumer. One of the best companies in this field, for the luxury companies, is the integration of information about the wealthy level of the customer. Here enters a company called "WealthX", that can enrich our database by inserting a flag that makes us understand if the customer is wealthy or not (over 10 million euro), this in order to understand if it has the possibility to increase the amount of purchases or not. Understanding the users' needs and possibilities remain the biggest achievement that a luxury company must obtain in order to personalize at the best the offer to the customer, without being too invasive.

7. *So, which are the current principal activities and processes that the "CRM and Retail Digital Transformation" function is undergoing at the moment in Prada Group? Which are the final objectives?*

   Currently, Prada Group is working to increase the technological level of the whole company (as it has different brands that are managed by different managers). The process will be long and will completely reshape the way the company obtains, integrates and utilize the customer's Data. For example, we are now starting utilizing the Adobe's Data Management Platform (DMP) in order to increment the quality of the exploitation and management of great amount of Data and information about the customer. The obtainment of this Data is already combined, though the utilization of different software, with their utilization for providing an online and offline luxury experience, that differs from our competitors. Moreover, we are utilizing Artificial Intelligence software that uses the machine learning

technology to increase and enrich the value of the insight that are used to create the personal profile of the end-consumers.

The creation of a real luxury experience is the core business of our function. The old trends that have pushed the luxury sector in the last years are decreasing and, for this reason, the firms must develop a strategy capable of refocusing the products and the experience around the end-consumer. Currently, Prada is utilizing the clusterization, based on the yearly expenditures, to gift its "VIC" (Vary Important Customers) with new luxury experiences. Currently, this particular cluster of customers receives each year a gadget box which contains a gift of the company. Moreover, we are starting a pilot project with the first twenty Americans' "VIC" that will come to Milan for some days and will experience a dinner in the company's restaurant in Fondazione Prada and will be sent, though a helicopter, to have a guided tour of the production plant in Valvigna, Tuscany.

Another important trend that we are following is the transformation of the concept of "Globalization" in the new and more peculiar "Glocalization", in order to answer the consumer need of feeling a territorial identity. This means that the luxury company must manufacture products that are capable of expressing the local traditions and heritage. For example, creating special packages just for Christmas is not sufficient to satisfy the needs and wills a great group of different customer (in this example is the one that lives in countries with a different religion than the Christian one). For this reason, Prada has started creating special packages for other festivities as the Chinese Moon Festival, The Chinese New Year, the Chinese Saint Valentine, the Ramadan and many other. Being able to understand the customers' needs of differentiating themselves even in terms of their believes and tastes passes even through their geographical location.

Prada Group wants to satisfy completely its customer by delivering a unique luxury experience capable of letting them feel the heritage of the brand through the quality and the customization of the products. Therefore, by summarizing what we have said, I can say that our function has the final objective and aim to utilize or implement new software and technologies in order to increase the firm's capability of delivering the best brand image, to personalize at the best the product offer and to maximize the customization possibility for the end-consumers.

5. Conclusions

The journey across the different features and impacts of the Industry 4.0 has ended. We have seen that the existence of Big Data and Information are completely changing every single market and industry. Since people have decided to let new technologies enter in their lives, with smartphones, tablets, smart homes, smart cars and many others, there have been a rise in the demand of technologies capable of obtaining data from the different customers. The answer for this demand are the products that re-enter in the Interment of Things (IoT) category.

We have seen that this technology is the one that is having the greatest impacts on every market. In fact, it is applicable both from the consumers point of view, with devices that are always connected to the net, and even on the companies' Supply Chain, where the manufacturing processes can be monitored and checked automatically by all the players.

Industry 4.0, with its Big Data and Industry of Things (IoT) technologies, will increment its importance in every industry in the near future, as the need of the firms to better comprehend the market and the customers will increase, in order to achieve the best possible outcome from the managerial and strategic processes. The power of the Industry 4.0 relies on the fact that, nowadays, both the company and the purchasers are willing to simplify their daily routines' activities by exploiting new technologies that utilizes the Big Data. This is the main reason why the world of Information is rising and will be the core of the future, as every single player on the chain, is willing to adopt connected technologies that are capable of constantly share the data obtained with other different devices.

By deepening the analysis, we have understood that, even in an industry as strong and reliable as the Fashion & Luxury one, the Industry 4.0 is penetrating very fast and changing the rules of the competition in the market. Thanks to the EY "Disruption Index", we can understand that even in the first quarter of the 2019, the Retail is the second latest sector for Technological Disruption,

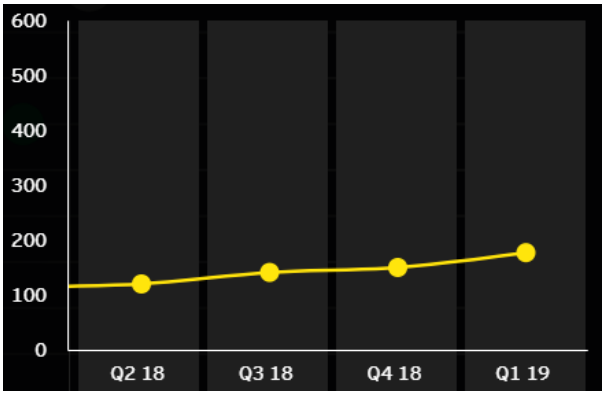

Figure 30 - EY "Disrupting Index" over time for the Retail Sector

after the Health & Life Sciences one[64]. This index analyze the technological deployment in every sector and creates a ranking of the markets in which the technological disruption level is higher than other. Even if there has been a constant increase in the value of the index (growing from 122 points in the first quarter of 2018 to the actual 187, with an increase of the 11.26% per quarter), there is still a great distance with the software and tools utilized in other sectors. However, we have seen that many different technologies have started to be applied in this sector, increasing the level of technological disruption. For example, Artificial Intelligence (AI), Virtual Reality (VR), Augmented Reality (AR) and analytical tools are the most used technologies at this time. In fact, thanks to these phenomena in the first quart of the 2019, the Retail Sector has increase its growth in the utilization of technology, reaching a 17% growth (with an average growth of 19% across all the markets)[65].

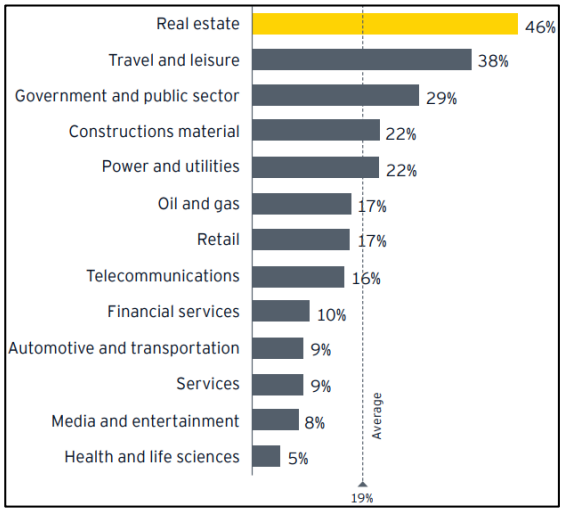

Figure 31 - Quarterly EY "Disruption Index" Rate (Q1 2019)

Nevertheless, we must remember to differentiate the "Fast Fashion" brands with the Luxury ones, as even if they are players in the Retail sector, they are competing with a complete different set of product and customers.

Luxury firms has started moving their first steps in the field, and they are trying to adapt their heritage with the innovations required by the customers and by the shareholders. The difficulties here arises because combining heritage and technology is not easy, as the purchasers could perceive the presence of technology as a lack of luxury. However, instead of applying the Industry 4.0 new technologies and tools in the manufacturing processes, it would be better to first develop a series of processes aimed for obtaining information from the end-consumers, in order to drive the production by increasing the profits and reducing the leftovers in the warehouses.

The potentiality of this Revolution in this sector are extremely significant, as it could be possible to obtain important competitive advantages against the competitors, that can lead a luxury firm to increase the value of the brand for both the end-consumers and the shareholders.

[64] "EY Disrupting Index" – EY (2019).
[65] "Q1 2019 EY Disruption Index" – EY (2019).

The peculiarity of the adoption of the Industry 4.0 in the Fashion & Luxury Sector relies on the fact that, nowadays, there is not a real "leader" that has already implemented a complete and functional strategy built around this new technological trend. This is very different from other industries where often is present a company that has already gained a relevant position against the competitors. For these motivations, we can say that the Fashion & Luxury Sector is one of the industry that will change the most in the next years, making it more desirable for investors and even for the customers, restoring the historical value and heritage by combining it with new technologies and processes.

Finally, thanks to the experience of the Head of the "CRM and retail Digital Transformation" of Prada Group, we have understood how vital has become the technological disruption even in the luxury sector and the level of technology that is still utilized today. However, we have understood that technology must be mainly utilized by the employees of the firm in order to exploit human interaction for increasing the value of the customer experience and the heritage of the luxury brand.

At the end of the journey, we understood that all the previous analysis has shown that the Industry 4.0 is the Revolution that will change completely the world, reshaping it in a way never seen before. Differently than the previous three revolutions, that has started from inside the companies (and the production plants) and then their results were shared with the final customer, this fourth Revolution has a different origin. In fact, the disrupting power of the Industry 4.0 relies on the fact that the new technological devices are sold instantly to the end-consumer, they obtain data that are shared with the company, which analyzes and exploit them for manufacturing other new devices. This circular process is continuing to boost every single industry, making the Industry 4.0 a revolutionary wave that will operate a continuous and innovative change in the way people are living their lives.

Summarizing the whole analysis, we can consider the Industry 4.0 as a vital revolution that is not just irreversible but is even necessary for the companies that would like to be considered as technologically advanced. The costs and the strategy needed for the implementation represent the only real difficulties that a company must face at the beginning. However, the benefits that its adoption brings to the firm are significant in terms of incrementing the capabilities of adopting functional strategies (taking into consideration the future's forecasting) and the quality of the product and services delivered to the end-consumers.

The 4.0 Revolution has already brought many different advantages for both companies and customer in general, even developing new industries that are changing or destroying other

industries that have been very profitable for several decades. The advantages that will bring in the future years will be greater and more impacting in the customers' daily routines, answering the needs imposed by the market.

However, we cannot know right know which will be the futuristic technologies that will reshape our lives. We just know that some great changes will occur, in every sector.

Industry 4.0 represents the revolution of the future. Nothing but the best.

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Executive Summary

Throughout history, society has always been run by the continuous necessity and request of data and information. The typical idea that passes through people's mind is "the more you know, the more you rule". Nowadays, this has never been so true.

From companies to politics, everyone who has more information and data than others, gains a stronger and higher position in a peculiar hierarchical pyramid, in which the most powerful people compose the upper summit. Moreover, the more sensible the information is, the stronger is their ability to obtain a competitive advantage against the other.

However, a question arises immediately as a ringing bell: *Is this a bad thing?*

To answer this question, we have to understand that the world's economy is led by the capitalistic view, in which the main purpose of a company is its profit's maximization that could be reinvested in other activities capable of generating extra earnings. This view is based on a personal *laissez-faire* concept, with the aim of leaving to the private companies the possibility to decide the prices of their specific goods and the quantity that are going to be sold on the market. Theoretically, this should be capable of generating an efficient market where the power is mainly divided between both sides: the supply and the demand.

Nevertheless, as every firm is competing in a specific market, in which are present *n* other companies, the importance of being efficient and enough differentiated arises with the number of competitors present in the same market. For such reasons, the importance of being able to obtain information and data from the competitors, from the market (that creates the demand) and from the company itself, ascends.

The main problem with this organizational and strategical need relies on the difficultness in the creation of a strong and reliable ability capable of capturing, stocking and analyzing both data and information. The specific results emerged from the previous activities should be used by the company's top management to develop a strategy that will sustain an increase in earnings and profits during the future years. However, developing such a difficult capability is not as easy, and the major problem relies in the time needed to obtain it (there is even the possibility that once a company obtains this ability, the technology used has already became obsolete or that other competitors previously developed the same ability).

Therefore, we must understand that for a company there are many different, great and opposite forces that create an everyday challenge for Management. One of the most important problems relies on the continuous shifts and changes in consumers' needs and tastes and with them even the changes in technologies. We do not have to think of technologies only as the devices used by the customers (television, telephones, computer, smartphones, etc.), but even of all the machines employed in the production of goods and services (machinery, calculators, software, robots, etc.). These technologies are improving in such a faster manner that nowadays they are capable of generating an incredible amount of data and information. The data comes from both internal and external sources to the company: a large number of players (workers, shareholders, customers, clients, suppliers, etc.) and factors constitute the company's micro and macro environments.

How should a company collect and exploit these amounts of data and information to gain a competitive advantage against the competitors? How will this improvement in technologies affect the manager's ability to create efficient strategies for all the company's supply chain?

In the past two centuries, the challenges imposed by the market have been positively faced by three different industrial revolutions. Now companies are facing a new wave of revolution, that does not deal with energetic or meccanization needs and does not deal with steam or petroleum. This revolution is the so-called "Industry 4.0", completely built around the necessity of taking advantage of data and information. The object has switched from material to immaterial, but this does not reflect a worsening in its value or in its quality, as the importance of data has increased thanks to the costs and the difficulties in obtaining the capabilities to analyze and extrapolate information that should be able to help the management in implementing functional strategies.

Furthermore, the final customers behaviors and tastes are changing quicker than in the past, making it more difficult for the companies to develop a sustainable and efficient strategy based on a modern customer experience. Moreover, the actual sales' trend shows us that in upcoming years there will be an increase in the utilization of online shopping websites, thus companies must deal with this phenomenon in order to maintain a strong position in the market and to be competitive.

How should a company face the problem related to these trends, in order to survive the competition imposed by the market?

The previews questions lay the basis of the main topic of this paper, in which we are going to answer them by deeply analyzing the effect that the Revolution 4.0 is bringing to the whole economic system. At the end of this paper, the journey across the 4.0 Revolution will help the reader to understand better the 4.0 main characteristic and pillars, starting from the influences made

by data and information to the whole supply chain and by moving forward to focus on the impacts made by this change on the sales function. By discovering the main drivers from both the customers and the company points of views, we will comprehend how a company should develop its own strategy in order to create a lasting customer experience, capable of overtaking the competitors, gain profits and increase the market share.

The "Industry 4.0" Revolution

The very first time in which the world started hearing about the "Industry 4.0", was in 2011 during a conference in Hannover, where Henning Kagermann, Wolf-Dieter Lukas and Wolfgang Wahlster firstly introduced the concept of "Zukunftsprojekt Industrie 4.0". The aim of this project was to revive and modernize the German productive system, in order to develop a strong manufactory industry and retaking it to the world summits, through huge investments on infrastructures, schools, energetic systems, research laboratories and companies.

The achievement of these objectives became fundamental, thanks to the players involved in this Revolution: Companies, State and Workers. This is the first time in which all the possible players are totally involved in the change, implying that for a successful achievement, everybody must play its own role in order to proceed in the development of a coordinated and functional strategy.

Therefore, this Revolution faces a wide range of new technologies that, at the same time, it combines physical, digital and biological spheres. This means that, the 4.0 Revolution is the first one in the human history that will not affect just the economic world, but even how people lives, with the aim of maximizing the human well-being.

These new technologies are impacting all the disciplines, economies and industries, and even challenging our ideas about what it means to be a human. Nowadays, the different technologies are having a multiple potential: they are continuing to connect billions more people to the web (in many different ways), they are drastically improving the efficiency of both businesses and organizations. Finally, they are regenerating the natural environment through a better asset management, with the prospective of undoing all the damages caused by the previous three Industrial Revolutions.

Which are the main pillars of this Revolution?

Every Industrial Revolution has had its own particular and unique characteristics, and this has Communication as its main feature. In the last decades all the communication infrastructures has faced a great improvements, in terms of fastening and security, decreasing the time needed to the

user for surfing and reducing the "distance" between them and the company. Moreover, people are increasing the usage of their device, surfing and inserting information about themselves on the net. Companies such as Amazon, Google, Facebook and others (these can be easily included in the group of the most profitable companies), are obtaining data without doing nothing: they just wait the user to search, buy or posting something. This is way communication has now became the main tool for many firms that have set up their core business on internet instead on the normal retail strategy. However, this revolution has even led to a reduction in the time and cost needed to implement a firm internal net, in which all the devices and machines are linked together and are capable of exchanging information.

According to the Boston Consulting Group, the main pillars of the Industry 4.0 are nine:

10. **Big Data and Analytics:** Big Data are the most important driver of this Revolution. Big data are extremely large sets of different data that may be stored and analyzed by the companies in order to obtain information about patterns, trends and association related to consumer habits.
11. **Autonomous Robots:** The Autonomous Robots are robots capable of performing the activities and tasks, for which they have been created, with a high degree of autonomy.
12. **Simulations:** Simulations are used by the companies to comprehend which is the best possible way to implement the strategy decided by the top management.
13. **Horizontal and Vertical System Integration:** This strategy allows company to switch from the old isolation, to an implementation of an innovative network that embrace every single player of the supply chain.
14. **The Industrial Internet of Things (IoT):** It is possible to describe the Internet of Things as the extension of the Internet connectivity into physical devices. This means that every single object around us is or could be in the future, connected to the net. Analysts have calculated that by 2020 there will be more than 26 billion connected devices (there are estimations talking about more than 100 billion devices).
15. **Cybersecurity:** Is the devices and machines capability protect their systems from thefts and damages to both hardware and software.
16. **The Cloud:** The cloud computing is an on-demand availability of computer system resources. This tool is used, above all, for data storage and computing power, with the aim of increasing the device capabilities and the customer experience.

17. **Additive Manufacturing:** The last trend in firm's manufacturing and R&D functions is related to the "Addictive Manufacturing". This is an innovative process of creating three-dimensional objects and models exploiting 3D printers.
18. **Augmented Reality:** The Augmented Reality is just at its initial phase and is based on systems that supports a variety of services, such as selecting parts in the warehouses or sending repairing instructions on mobile devices.

How could companies analyze Big Data and transform them into insights?

In the process of Data utilization, the company has to decide which are the fundamental data necessary for a correct and functional strategy implementation. After they have found the perfect set of data, their next step is to identify how to transform these data into useful insights. This process is done through **Analytics**, which summarize the concepts of collecting, processing and analyzing data for the generation of insights capable of improving the way firms do their businesses. Therefore, the objective is to study historical data in order to find a wider picture of the industry, discovering which are the specific trends of the future years and creating a new firm's knowledge capable of improving operational performances, monetize data and reach the strategic goals decided by the top management (or by the majority shareholdings). The key point is to better understand more about the industry in which the firm operates and transforming the data collected into the most important of the Big Data's Five V's, that is **Value**.

The world's data production has increased is such a rapid way that, nowadays, every two days we are creating the exact amount of data as we did from the beginning of time until 2003, generating billion's data about post, likes, impression, transaction, track, movements and many others. The only way to deal with these huge amounts of data is the Cloud Computing. The companies' capability of storing and analyzing data increased sensitively with the exploitation of this tool, creating a real technology advantage in the field.

How does Big Data creates Value for the company?

Data and Data Analytics has become one of the main key business asset and the ability of transforming insights in money is the one searched by the companies. At the same time, experts suggest not to focus the whole company in obtaining as much data they can in the hope that one day they will become useful, but to focus on just the ones that the management reputes fundamental for the strategy implementation. Therefore, even if at a first sight it seems that the only source of value relies on the firm's ability of exploiting data for increasing both earnings and profits.

However, we have to understand that now companies are being bought and sold for the data they own or for their ability in analyzing data.

For these reasons, there are three other aspects for the monetization of data, which are:

- **Data as Core Business Asset**
- **Ability to Work with Data**
- **Selling Data to Customers or Interested Parties**

Therefore, the key aspect that the companies should apply for the correct implementation of the data strategy is to create a system where data are generated automatically by users, company or other parties. This will require minimal effort in collecting data and the firm can spend more time in deciding how to develop the analytical part. Proceeding in this way, firms will obtain higher revenues and an increase in the value of its assets.

Which are the trends in the implementation of the Industry 4.0?

According to the PricewaterhouseCoopers Company Reports, the world of the Industry 4.0 is rising year by year. In fact, in 2016, one third of the interviewed companies where rating their digitalization level as high, and this number will increase from 33% to 72% until the 2021.

Moreover, this worldwide rush is nourished by the fact that the first movers are the only companies that are capable of obtaining higher success in the implementation of the Industry 4.0, merging a reduction of the costs with an increase in the revenues (they are 27% more successful than the average). However, this is correlated with huge costs for implementation. The PwC survey discovered that, yearly, the capital expenditures for the investments in Industry 4.0 applications amounts to $907 billion dollar. In addition, these investments are reflected in the increase in revenues for $493 billion (making the expected ROI period about just 1.9 years).

For these reasons, company are directly facing the advantages coming from the implementation and the average is willing to invest 5% p.a., of the total company investment, for digital operations solution (the 20% of the interviewed are willing to invest more than 10% p.a.).

After having seen that the worldwide capital expenditures for the digital innovation, it is important to focus in the amount of cost savings and the increase in revenues. On worldwide average, the companies invested the 5% of their digital revenue and earned $493 billion, making the additional revenue about 2.9% (on average). Parallel to this value, there is the costs reduction of about 3.6% on average, which means a total savings of about $421 billion.

The major additional revenues and the lowering costs drivers can be summarized in this way:

4. **Additional Revenues:** New digital services and products, offering big data as services, customizable products (mass customization), capturing insights from data that can be exploited by the business and increase in the market share.
5. **Lower Costs:** Real-time quality control by Big Data Analytics, horizontal and vertical integration, predictive maintenance, process digitalization and automation and by increasing the market share of the products

Moreover, these companies found more difficult to train the staff than in implementing new processes based on data. The problem relies on the employees' lack of experience in the digital. For this reason, companies should prefer to invest in the development of an automatic production process instead of training the employees, as the financial expenditure compared with the benefits are higher with the automation than with the human-machine relations.

The Data-Driven Supply Chain

The **Data-Driven Supply Chain** is the development of the Supply Chain that relies its key feature on the data analysis and exploitation. As viewed in the second chapter, the firm's ability of obtaining data and develop the analytical tools that for the analysis of the data obtained, are the core competences needed for a congruent implementation of the Revolution 4.0. Consequently, it is easily to understand that the rise of this new Data-Driven Supply Chain Management is strictly connected with the Industry 4.0, as both of them are operating in the data and information competence field.

Moreover, we must remember how the Internet of Things (IoT), as one of the main pillar of the Industry 4.0, is transforming the way people (or customers) and employees live, work, communicate, and interact with others. It is also transforming the way are managed all the processes and the procedures for manufacturing, transporting, and warehousing goods. The Fourth Industrial Revolution is setting a new set of standards: Industry 4.0 solutions are simplifying both the manufacturing and the logistics, making them more and more efficient and flexible. Therefore, the application, or the development, of the Data-Driven Supply Chain is and could be felt as quite expensive; however, the results are almost above the expectations.

What is the Smart Factory and why is it important for the 4.0 Revolution?

This new environment created by the implementation of technological devices capable of communicating together is known as the Smart Factory. The Smart Factory can be described as a flexible system that is capable of optimizing the performances automatically among the network,

to adapt and learn from new conditions in real or near-real time and run autonomously the entire production process. This environment will be the place where the companies integrate their digital transformation with the existing processes, enabling the connection between human and new 4.0 machinery. Therefore, one of the main Industry 4.0 pillar is the Big Data and its Analytics. The exploitation of the information achieved by the company is capable of generating a wave of automation in the current product lines and the maintenance of a high quality standard of autonomy on the detection and resolution of the issues. By implementing the technologies needed for the creation of the Smart Factory, the companies can generally gain the following benefits: **Asset Efficiency, Quality, Lower Costs** and **Safety & Suitability**. However, even if the company can seems capable of running autonomously, thanks to the adoption of the new 4.0 machinery, the firm's digital transformation requires, at least, a minimum presence of human force power. The reason behind this is for the sustenance of the whole process, the company needs an informatics engineering team that programs and develop all the necessary software for the implementation and the support of the Data-Driven Supply Chain. An example, Samsung, the Korean technological multinational, thanks to the implementation of the Smart Factory on its air conditioners' production plants, through three-dimensional scanners, Internet of Things (IoT) technologies and integrated machines control, has brought to a reduction of the overall costs associated to the production, with a capacity improvement by 25% and the halve of the defective products.

Summarizing the concept, the firms' digital transformation, especially for the ones operating on manufacturing industry, passes through the implementation of the Smart Factory, as the normal evolution from the old factory system. The environmental shift to the Smart Factory is becoming even more fundamental for the stakeholders for the will of observing the whole production process without observing directly and physically all the manufacturing procedures done on the Supply Chain. This is another motivation for the transformation of the company towards the Data Driven Supply Chain as a managerial source of control on the production.

Sales & Marketing Function in the 4.0 Revolution

After having examined which are the main characteristics of the Data-Driven Supply Chain and what is the Smart Factory, now is the moment to focus on the Sales & Marketing Function.

The choice of the Retail industry among the others, and in particular the Personal Luxury Goods sector, relies on the fact that the competition is very high among all the players and the importance of comprehending the firm's customer segmentation goes in parallel with the creation of the

products. For these reasons, the adoption of the Industry 4.0, with the Big Data Analytics and the Data-Driven Supply Chain, can plays a huge role on the increase of both Brand valuation and in profitability. In fact, a wrong Forecasting Analysis or customer segmentation can lead to the failure in the collection of new data, which is reflected in both a decrease in revenues and in profits, with a related increase in the inventory stocked in the warehouses.

In particular, for the Personal Luxury Goods, which are the recent trends in the Distribution Channel Management?

We understood that the DOS and the e-commerce are two opposite channel that luxury companies must exploit for reaching their objectives. For the luxury companies, being able to comprehend which are the future Distribution channels' trends becomes fundamental for planning a long-term strategy.

Therefore, by 2025 the luxury world will completely reshape. The online distribution channel for these companies will become as important as the DOS one. Both together will account for the 50% of the total revenues in the market.

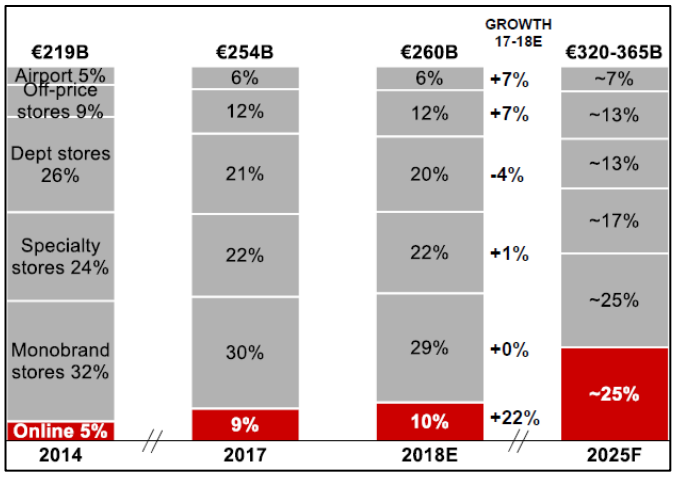

Figure 1 – Personal Luxury Good Channel Growth by Market

Thanks to the following image is possible to better comprehend how much the e-commerce market will grow, in just 7 years, and how all the physical stores (DOS and not) will be affected by this change. The effects of both these two phenomena, pushed in particular by the high level of digital disruption that this market will face in the nearest future, will stabilize the luxury firms' average EBIT margins around 20%. Nevertheless, this disruption process will affect in their P&L and for this reason, firms must develop strategies capable of focusing on the shareholders objectives and of being more agile in achieving them.

Moreover, according to Bain & Company, the luxury market forecast to 2025, shows that there will be even a great increase in the percentage of the purchases made by younger generations. In fact, the Y and Z Generations will represent the 55% of the future customers, where just the Y ones (the people born in the temporal arch between the eighties and the nighties) will cover the 45% of the market. Re-focusing the products and the marketing campaigns on the next generations will

become very useful for answering the shifts in the distribution channels utilization, giving the best possible solution to the consumers, both with DOS and with online channels.

Related to this, there even will be an adjustment on the consumer nationality trend, where, by 2025, the Chinese consumer of Personal Luxury Goods will become the 46% of the total (from the 33% of the 2018). This will have great impacts for the luxury firm, as more than one euro out to five of their revenues will be gained in Mainland China.

Firms must focus on the "Red Dragon" trend as, if more or less the half of the luxury consumer will be Chinese, the products and the distribution for them must be design properly to their tastes.

However, according to a McKinsey & Company survey, the Chinese consumers will still exploit the offline distribution channels more than the rest of the world. Only the 12% of the total amount of the Chinese purchases will be done via online channels, instead of a worldwide average of 25%.

However, answering their requests for high level of online intermediation and disruption becomes fundamental for the luxury, especially in the marketing, events and the 4.0 evolution of the DOS processes.

Which are the Data-Driven tools and technologies that can be implemented for increasing the firm's ability in forecasting its future activities, for a Luxury Company?

The Industry 4.0 is capable of answering these specific needs by giving to the luxury firms the possibility to obtain information from both external and internal environment and to analyze them, with the aim of creating future possible scenarios utilizable in the planning decisions.

Therefore, managers, for exploiting functionally a forecasting study and obtain positive information for developing a masterplan of the different future activities and processes, need two invest in the 4.0-integrated technology into two different fields:

3. **Analytical Software:** First, luxury firms have to make huge investment on the acquisition of the utilization right of a pre-existent analytical tool or to develop it internally. The Analytical Software is the fundamental calculator of the different data obtained by the company, from both internal and external sources, with the aim of creating diverse possible scenarios of the next years. The ability of this software have remarkably increased in the recent years thanks to the last developments in the machine learning tools. These abilities became fundamental as the Analytical Software can understand and comprehend automatically how to utilize data in order to extract functional insights from them, utilizable for the planning activities.

Another, great innovation on this field dis related to the Artificial Intelligence and the machine learning. These technologies are increasing rapidly their importance as they could stock and analyze the Data in a way that companies has never had before. In fact, as said in the first chapter, the machine learning is capable of using the information and push the forecasting analysis to another level. According to Tableau, the three main areas where these technologies will result in an increase in efficiency and profitability (with the reduction of costs) are **Inventory Accuracy, Pricing Optimization** and **Personalization.**

4. **Information Obtainment:** There are different information and data that must be gained by the luxury companies for increasing their forecasting capabilities: **Consumers' Data, Internal Data & External Data**. The obtainment of different data from these two fields becomes fundamental, as, just by combining all of them together, it is possible to obtain functional insights capable of enriching the management decisions.

What will the luxury consumers (of Personal Goods) see in the future: a great development of the e-commerce channel or a great renovation of the retail distribution?

In the future years, consumers will assist to a luxury industry where the strongest companies will have exploited the sequent strategies:

- **Marketing & Advertising:** The future of the luxury industry, and of the single firm, will be related to the success in reaching the younger generations and transmit to them the luxury values of the brands. Firms, has already started utilizing the social media for exploiting this strategy. It is fundamental that the luxury companies continue to invest massively in this function, as the biggest challenge here is to utilize these instruments for achieving the management pre-fixed goals, without compromising the value of the brand and by transforming the virtual "likes" obtained online in an interactive and engaging experience for the end-consumers. All the advertising and marketing campaigns will be managed both in the online and in the offline world, in order to cover the greatest possible range of customers. The digtal campaigns will be more built around the classic marketing, for example by exploiting the online advertsisemnt, while the physical one will be related mostly on different types of events.
- **Price & Products:** The price of goods will increase, thanks to the luxury campaigns that will be held by the firm in order to restore the original heritage and the brand exclusivity. This strategy will begin with the change in the product portfolio structure, reducing the range of the products and focusing on the ones that are capable of delivering the brand

prestige. The lower price strategy, utilized in these years in order to increase the amount of sales, mostly on the online distribution channel, will be abandoned to re-establish the normal price range in order to restore the brand exclusivity and perception.

- **Wholesale:** The Wholesale distribution channel will still represent an important percentage of the total revenues of the different brands. Nevertheless, luxury companies, always for re-establishing their original level of brand's tradition, could opt not in a reduction, but in a new selection of more peculiar store that are aligned with the firm's objective of delivering the luxury and the heritage of the brand.
- **Online:** The online distribution channel, as seen in the previous pages, will be the channel that will grow the most in the next years, covering the 25% of the total luxury sales by 2025. There will be a great combination with this channel and the retail one (DOS), as just the e-commerce is not capable of delivering the brand's luxury characteristics.
- **Retail:** Retail is the distribution channel that will change the most in the next decade. We already said that, for luxury companies, its existence is related to the firm's ability in promoting the heritage of the brand. Culture, passion, handcrafting is shared by the beauty and the design of the stores. For these reasons, DOS will be reshaped in order to deliver the characteristic wanted by the management and to increase the consumers' experience and connectivity.

  For example, Farfetch, the online luxury fashion retailer, has developed the "Store of the Future", where online and offline are combined together. This new DOS focuses the attention on the customers, which will be recognized at the entrance, thanks to the brand's app that will also be a fundamental part of the experience. These stores are highly technological integrated and can promote a great experience through the augmented reality. The "Connected Clothes Rails" can understand which clothes the customers picked up and shows directly on its app. The "Smart Mirrors" will help the customer in the buying activities, even by suggesting other products that could be combined with the product they are trying. Finally, the "Interactive Hologram" can give to the customer the possibility to check the shape and the design of products that there are not in the store and could be utilized for the customization of the product. The purchase will be completed via app and the items will be delivered to the costumer's home.

From the purchasers' points of view, these are the main characteristic with whom the luxury industry will be reshaped. The combination of the online and the physical in an Omnichannel

strategy is already undergoing. Luxury, as we see it today, will not exist anymore in the future, thanks to these new selling techniques and the application of the Industry 4.0 tools.

As we can comprehend from the subsequently interview, the Luxury Sector's stores will be even more differentiated by the classical Retail ones. In fact, this change will be intensified by the utilization of different technologies in the fast-fashion brands' stores, which will not be used in the luxury one. In fact, the luxury world exists thanks to the human interaction and the experiences that a computer is not capable of giving to the consumer. However, there could be the possibility of the creation of "pop-up" stores or corners in the malls, where the Luxury companies can decide to exploit the technologies that have been used for the creation of the Farfetch's "Store of the Future" and many others. Additional technologies that can be seen in the Retail sector, more probably in the "Fast-Fashion" stores, are related to Virtual Reality (VR), Augmented Reality (AR).

Conclusions

Industry 4.0, with its Big Data and Industry of Things (IoT) technologies, will increment its importance in every industry in the near future, as the need of the firms to better comprehend the market and the customers will increase, in order to achieve the best possible outcome from the managerial and strategic processes. The power of the Industry 4.0 relies on the fact that, nowadays, both the company and the purchasers are willing to simplify their daily routines' activities by exploiting new technologies that utilizes the Big Data. This is the main reason why the world of Information is rising and will be the core of the future, as every single player on the chain, is willing to adopt connected technologies that are capable of constantly share the data obtained with other different devices.

By deepening the analysis, we have understood that, even in an industry as strong and reliable as the Fashion & Luxury one, the Industry 4.0 is penetrating very fast and changing the rules of the competition in the market. Thanks to the EY "Disruption Index", we can understand that even in the first quarter of the 2019, the Retail is the second latest sector for Technological Disruption, after the Health & Life Sciences one. This index analyze the technological deployment in every sector and creates

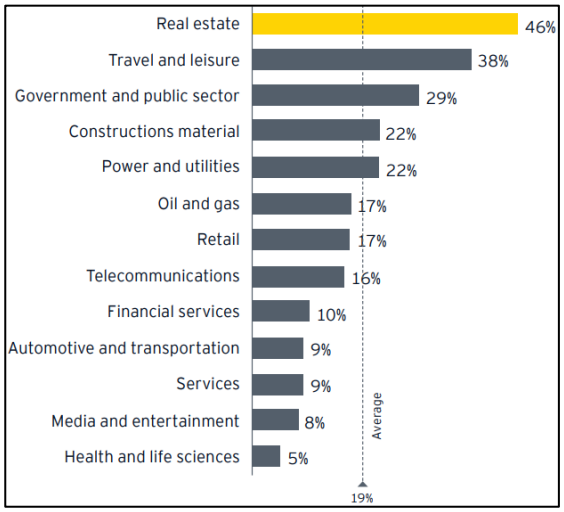

Figure 2 - Quarterly EY "Disruption Index" Rate (Q1 2019)

a ranking of the markets in which the technological disruption level is higher than other creates. Even if there has been a constant increase in the value of the index (growing from 122 points in the first quarter of 2018 to the actual 187, with an increase of the 11.26% per quarter), there is still a great distance with the software and tools utilized in other sectors. However, we have seen that many different technologies have started to be applied in this sector, increasing the level of technological disruption. For example, Artificial Intelligence (AI), Virtual Reality (VR), Augmented Reality (AR) and analytical tools are the most used technologies at this time. In fact, thanks to this phenomena in the first quart of the 2019, the Retail Sector, has increase its growth in the utilization of technology, reaching a 17% growth (with an average growth of 19% across all the markets).

Nevertheless, we must remember to differentiate the "Fast Fashion" brands with the Luxury ones, as even if they are players in the Retail sector, they are competing with a complete different set of product and customers.

Luxury firms has started moving their first steps in the field, and they are trying to adapt their heritage with the innovations required by the customers and by the shareholders. The difficulties here arises because combining heritage and technology is not easy, as the purchasers could perceive the presence of technology as a lack of luxury. However, instead of applying the Industry 4.0 new technologies and tools in the manufacturing processes, it would be better to first develop a series of processes aimed for obtaining information from the end-consumers, in order to drive the production by increasing the profits and reducing the leftovers in the warehouses.

The potentiality of this Revolution in this sector are extremely significant, as it could be possible to obtain important competitive advantages against the competitors, that can lead a luxury firm to increase the value of the brand for both the end-consumers and the shareholders.

The peculiarity of the adoption of the Industry 4.0 in the Fashion & Luxury Sector relies on the fact that, nowadays, there is not a real "leader" that has already implemented a complete and functional strategy built around this new technological trend.

Summarizing the whole analysis, we can consider the Industry 4.0 as a vital revolution that is not just irreversible but is even necessary for the companies that would like to be considered as technologically advanced. The costs and the strategy needed for the implementation represent the only real difficulties that a company must face at the beginning. However, the benefits that its adoption brings to the firm are significant in terms of incrementing the capabilities of adopting functional strategies (taking into consideration the future's forecasting) and the quality of the

product and services delivered to the end-consumers. The 4.0 Revolution has already brought many different advantages for both companies and customer in general, even developing new industries that are changing or destroying other industries that have been very profitable for several decades. The advantages that will bring in the future years will be greater and more impacting in the customers' daily routines, answering the needs imposed by the market.

However, we cannot know right know which will be the futuristic technologies that will reshape our lives. We just know that some great changes will occur, in every sector.

Industry 4.0 represents the revolution of the future. Nothing but the best.