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TESI DI LAUREA

"FROM DATA TO BIG DATA: THE ROAD OF SMES TOWARDS ARTIFICIAL INTELLIGENCE"

RELATORE:

CH.MO PROF. BETTIOL MARCO

LAUREANDO/A: BONOLLO MARTINA

MATRICOLA N. 1163071

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Firma dello studente

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“In God we trust, all others bring data.”

- W Edwards Deming

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INTRODUCTION

"Information is the oil of the 21st century, and analytics is the combustion engine"

- Peter Sondergaard[1]

Alongside the scarcity of natural resources, data seems to be an ever-growing asset that modern companies can exploit in order to gain competitive advantages. The world of the XXI century is producing more and more data thanks to the technologies that are pervading the day-to-day lives of its inhabitants. Smartphones, social networks, smart products, smart factories and IoT are just examples of sources of the so-called "Big Data" phenomenon.

Nowadays companies, from the smallest to the biggest ones, find themselves in an economy which is characterized by a stagnating phase and where every product and every service they provide has become a commodity. The only chance for firms to differ themselves from their competitors and getting the upper hand is to have an innovative and open mentality towards new technologies and opportunities. In fact, Industry 4.0, with all its corporate technologies it brings, has been a getaway for those companies who would otherwise affected by the economic crisis of 2008.

The aim of this Master Thesis is to analyze how Industry 4.0 is impacting Italian small and medium enterprises focusing on the increasingly importance of Data inside them and on the value it is bringing to them. We'll try to walk together with them the road of the phenomenon known as "Datafication": starting from the acknowledgment of the importance of Data for their business purposes, we'll see how companies are coping with the increasing amount of information (i.e. Big Data) produced by the introduction of IoT and other technologies into the plant floors and, finally, we'll see whether and how they're moving towards Artificial Intelligence technologies.

The first chapter is meant to give an overall picture of the Fourth Industrial Revolution. We'll make first a brief historical excursus describing the former three Revolutions analyzing the main steps that brought us to what we call today Industry 4.0. In the second section of the chapter, we'll proceed with the description of the evolution of latter, studying its development in Italy and the linked incentives system that companies willing to adopt I4.0 could exploit. We'll finally make a brief introduction to the technologies introduced by the latest Industrial Revolution, the so-called "enabling technologies".

[1] Peter Sondergaard , Senior Vice President of Gartner Research

In the second chapter we'll analyze the enabling technologies of Data, Big Data and Artificial Intelligence. After having defined what we mean by Data and having quantified and explained theoretically the ever-growing amount of data, we'll proceed by classifying and analyzing the Big Data phenomenon. We'll see how firms can generate value from the introduction of analytical tools inside their plants and what data-related organizational roles are emerging thanks to the Datafication. In the third section we'll explain what we mean by Artificial Intelligence and Machine Learning and we'll see how they have developed over time impacting the global economy.

In the third and last chapter of this dissertation we'll analyze the role of Data and Artificial Intelligence in the Manufacturing Industry. In the first two sections of this chapter, after having explained the sources and the economic value of these technologies, we'll outline the state of art of the introduction of Big Data Analytics and AI inside Italian companies (with a special focus on SMEs). The last section shows the results of a Qualitative Research carried out by the undersigned, under the supervision of Professor Bettiol of the Department of Economic and Business Sciences of the University of Padua, aimed at assessing how Italian companies are coping with the topics of Big Data and AI. Abovementioned Research took the form of a set of interviews taken with a selection of Italian SMEs that, in a previous research made by the Department of Economic and Business Sciences of the University of Padua, have declared to use technologies linked with Big Data.

CHAPTER 1 – The Fourth Industrial Revolution

Throughout this chapter we will analyze the different industrial revolutions and the linked major changes which led to the fourth one, which today is actively taking place and influencing all the industries and all the countries of the world.

Firstly we need to explain what an industrial revolution is: according to the Marriam Webster dictionary[2], an industrial revolution is a "rapid major change in an economy (as in England in the late 18th century) marked by the general introduction of power-driven machinery or by an important change in the prevailing types and methods of use of such machines".

1.1 Historical excursus on the first three Industrial Revolutions

Before deepening our dissertation in the explanation of the concept of the fourth industrial revolution, it's important to recap briefly the historical grounds on which the Industry 4.0 is currently standing on. Indeed, what we are experimenting today in terms of state of art of the industry is the result of what people have made in the history of the industrialization.

Historians classify the past changes in the productive system by finding three main historical periods called first, second and third industrial revolutions. Hence, we will briefly analyze them all by studying the context in which they happened and the corresponding effects on social and economic fabric of each era.

1.1.1 The First Industrial Revolution

The First Industrial Revolution set the change from an agrarian and handicraft economy to one dominated by industry and machine manufacturing. Such revolution lasted from the mid of the XVIII century to the first half of the XIX century and it was mostly confined to Britain. The location of this revolution was helped by a series of preconditions of the territory: public institutions promoted individual initiative, advanced scientific research favored technological breakthroughs, capitalistic agricultural and manufacturing industries were dynamic and had high investment capacity, there was an excellent transport network and a high urbanization rate and, finally, UK could exploit a well-developed commercial fabric thanks to its colonial empire.

[2] https://www.merriam-webster.com/dictionary/industrial%20revolution

The British forbade the export of machinery, skilled workers, and manufacturing techniques and, hence, at the end of the XVIII century, England was the only country affected by such flow of innovation. However, the British monopoly couldn't last long, since some Britons saw profitable industrial opportunities abroad. The first countries affected by the first industrial revolutions were, in chronological order, Belgium and France. Other European countries, due to their different political contexts and the respective minor role played in them by the bourgeoisie class, remain behind in this industrial expansion.

The creative genius typical of this era led to a series of breakthrough inventions which would have changed every aspect of the industry making them take a noteworthy quality leap. Some of the most important inventions who played a crucial role in 1.0 Industry are depicted in the following picture:

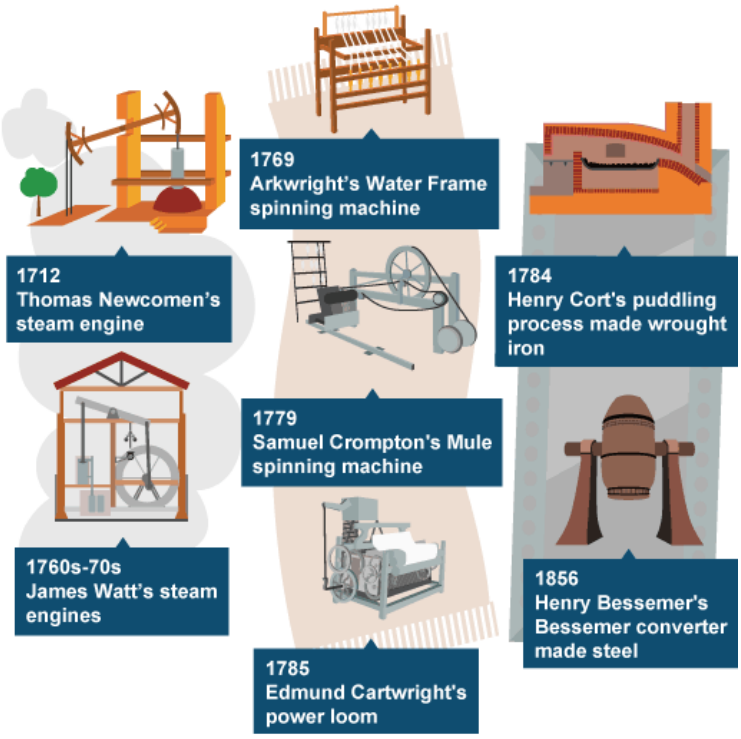

Fig. 1.1: Inventions of the First Industrial Revolution.

Source: https://schoolworkhelper.net/economic-changes-during-industrial-revolution/

The two main industries that were influenced by such inventions were the textile business and the iron industry. Innovations like the flying shuttle, the spinning jenny, the water frame and the power loom made weaving cloth and spinning yarn and thread much easier. The iron and steel production was rather conditioned by a new technique which was the smelting of iron ore with coke (a material made by heating coal) instead of the traditional charcoal. The most important discovery of all was made by J. Watt, who invented and perfected the steam engine.

Watt later collaborated with Matthew Boulton to invent a steam engine with a rotary motion, a key innovation that would allow steam power to spread across British industries, including flour, paper, and cotton mills, iron works, distilleries, waterworks and canals. Another industry which was radically impacted by this invention was the transports industry, which developed at the beginning of the XIX century and in 1830 George Stephenson made the first railways connecting factories with areas of extraction of raw materials.

This revolution impacted not only the industry itself but also the working conditions, the infrastructures and the geographical allocation of both the workers and the factories. Indeed, Britain could assist to the formation of the first industrial districts, which are geographical areas where many companies of the same sector are concentrated and which can benefit from agglomeration economies such as specialization and knowledge spillovers. Accordingly, there was a strong migration of workers from the rural areas to the urban ones, shifting from a domestic system (where craftspeople worked in or near their homes) to a factory system of industrial production. In these decades we can, in fact, allocate the birth of the factory system, which concerned the production factors and two main actors: on the one hand there were the owners, who owned the capital required for investments and salaries, on the other hand there were the workers with their workforce.

This polarization of the production factors together with the increasingly usage of machines in the mass-production, led to the a work organization based on rational criteria with the introduction of business functions, timetables and work paces defined on the needs emerged with the division of labor, which allowed the worker to learn rapidly few activities and to carry them out quickly and without wasting time. New machines, new power sources, and new ways of organizing work made existing industries more productive and efficient. This productivity led to an overall increase in wealth that benefitted primarily the upper classes of the British society. On the other hand, workers, which included also women and children, got very unstable employments, detrimental working conditions and very low retributions.

The first industrial revolution left some European countries entirely transformed both on the social and the economic side. Many new technologies and industries emerged, laying the foundation for the next industrial revolution.

1.1.2 The Second Industrial Revolution

The Second Industrial Revolution is generally dated between 1870 and 1914. This historical period was characterized by the affirmation of the State-nation, the consolidation of a public

demand of infrastructures and weaponry and surfacing of a private demand of homogenous goods at low price. This industrial revolution brought out mass advancements in agriculture, manufacturing and transportation that, as for the former revolution, started in Britain but it would soon have made its way to Europe and North America and then quickly to the rest of the world. A century after the end of the First Industrial Revolution, the world witnessed a rapid shift from the conventional forms of the previous innovations. New innovations in steel production, internal combustion engine, petroleum and electricity led to the introduction of public automobiles and airplanes. All of these novelties needed some new kind of sources of energy and this was solved by the ever-increasing utilization of the power of electricity, oil, and gas.

Steel replaced iron, and it was utilized for infrastructures, industrial machines, ships and, most importantly, railroads. This alloy of iron and carbon enabled rail lines to be built at competitive cost reinforcing the railways-building trend emerged during the former revolution. The infrastructural network was extremely impacted by the adoption of the steel. Many trans-continental railroads, as well as the first subways, were built, facilitating the movement of people in urban areas besides lowering the costs of transportation of cargo. Also the shipbuilding business was influenced: some transatlantic liners were built thanks to such technical improvements and many marine channels, inter alia the Suez Canal in 1869, were constructed. Another amazing invention was in 1903 when the Wright brothers had their first powered piloted plane flight.

Another breakthrough invention was the electricity, which changed the way people worked and lived. Faraday was the first mover towards the idea of electricity which culminated, a few years later, thanks to Edison and Swan, in the perfected design of a lightbulb which was practical for home use. Electricity became also a matter of public interest with the appearance of the first efficient commercial electrical generators in the 1870s, which made public electricity possible. Electricity was used for transportation and communication, as well. The development of electrical and internal combustion engines allowed transmission of power even outside factory centers. Communication was made easier thanks to the inventions of telegraph and telephone, making it possible for people to communicate all over the world instead of having to travel days.

Electricity impacted also the way the production was considered starting from the time Sebastian de Ferranti thought of high-voltage alternating current. De Ferranti's idea enabled the assembly line and mass production and one of the most influenced industries was the

automotive one. During the XX century, owning a car was a privilege that only the wealthiest could afford. Henry Ford decided to turn the tables by introducing the Model T. The introduction of the assembly line brought down the cost considerably and made cars available also to lower social classes of the American society.

Accordingly, a new management approach concerning the production began to spread, which was formalized by the American mechanical engineer Frederick Taylor. In his first paper, "*A Piece Rate System"* (1895), Taylor gave shape to the scientific organization of labor which envisaged that every complex productive phase was broken down into individual tasks which were linearized until an assembly-line was formed. The Fordism was, indeed, an expression of this new approach, where long assembly lines were set on very simple but timed tasks.

Even though the overall economic prosperity was increasing, the old world had to face the overproduction issue and the upcoming world wars.

1.1.3 The Third Industrial Revolution

The Third Industrial Revolution took place in the 1970s mainly in the western countries, particularly in the USA, but, at the end of the century, it spread also to other realities such as China and India. We can identify this industrial revolution with the groundbreaking introduction of the modern information and communications technology (ICT). Before describing the innovations of the 3.0 Industry, we have to step back and draw a larger picture of the state of the world right after the two world wars.

Right after the Second World War, the world finds itself split into two main poles: the first, under the aegis of United States of America, was characterized by a socialist economy and, the latter, under the political and military auspices of Soviet Union, was actually that enormous residual area that was called Third-World. These two, other than facing themselves during the Cold War, they also fought over the primacy in the space race. Thanks to this rivalry many key inventions were made in the following decades: artificial satellites, space shuttles, radar and lasers.US wasn't battered by the World War II, on the contrary, it witnessed a period of well-being thanks to the war production also during the conflictual period. On the contrary Europe had to face a strong period of reconstruction. On the basis of certain prerequisites (such as fixed labor cost, stable price of raw materials, low price of money due to the absence of inflation and the fixed exchange rate regime), many countries achieved full employment and lived a new political and economic phase during the 60s.

After that, the world had to face a period fraught with uncertainty: Nixon's declaration of non-convertibility of the American dollar in 1971 put an end to currency stability, the first oil crisis eliminated the stability of the price of raw materials and triggered processes of inflation all over the western countries which, in turn, inevitably made the wages to lower and, hence, fueled the wave of workers' and students' uprisings and mobilizations. This instable context pushed a new type of market to life, characterized by a competition based on the concepts of market penetration and production differentiation. The result was a strong process of automation of the production lines (which kept under control not only the labor costs, but also industrial disputes) and a process of reorganization aimed at differentiating products. Fordist approach toward production was juxtaposed by new production models: on one hand there was the automation of the fordist production line through the introduction of robots which allowed more flexibility and product differentiation, on the other hand, networks of companies took at first the form of industrial districts, then they developed into clusters and industrial groups. The developed economies moved toward the tertiary sector and the industrialization on a global scale. The engineering of the products become increasingly important to such an extent that companies start to have their own research and development departments.

After the fall of the Berlin wall, the developed countries assisted to the opening-up of international trade and the downsizing role of the State in the economy in favor of a liberalized market. The value chain became more and more fragmented, the manufacturing phases allocated in several countries according to the labor, different for each local context. Indeed, new countries entered the scene of the global trade: nations under the process of industrialization, especially China, became the manufacturing hub of the world while the developed countries shift further toward the third sector.

In the 80s, with the digital revolution, we entered in the so-called "post-industrial" era (Bell, 1976). New technologies aimed at the elaboration of information had significant effects on the organization and the quality of the work in most of the production processes. Such technologies (brought together as ICT) were: computer science, electronics, telematics, telecommunications and multimedia. The third industrial revolution brought semiconductors, mainframe computing, personal computing, and the Internet. The move from analog electronic and mechanical devices to pervasive digital technology dramatically disrupted industries, especially global communications and energy. Electronics and information technology began to automate production and made supply chains global. Mechanical

technologies' development intersected with the progresses made in the ICTs, managers and entrepreneurs started using increasingly powerful computers in order firstly to manage internal flows of production of automatized firms and secondly to organize flows of goods among the suppliers of the industrial district.

The Industry 3.0 faced a sudden slowdown with the crisis began in 2007 with the default of the Lehman Brothers which transformed the productive systems of all the countries of the world. What was perceived at first as a catastrophe, it has conversely been the incubator of the Fourth Industrial Revolution.

1.2 The Fourth Industrial Revolution

1.2.1 Origins and developments of Industry 4.0

"We must (...) deal quickly with the fusion of the online world and the world of industrial production. In Germany, we call it Industrie 4.0."

– Angela Merkel, German Chancellor[3]

What we are experimenting today is the fourth industrial revolution which is better known as Industry 4.0. This term was coined in 2011 at the Hannover fair in Germany for a strategic project proposal, called "*Industrie 4.0*", which formed part of the more general "*High-tech Strategy 2020*" plan that was designed by the German government through the Ministry of Education and Research (BMBF) and the Ministry for Economic Affairs and Energy (BMWI). The government launched abovementioned plan in 2006 to coordinate research and innovation actions aiming to preserve competitiveness and to drive forward technological innovation to facilitate Germany's position as a leading provider of technology, science and innovation in e.g. climate, mobility, health and security. Then to promote the German industrial development through the mass personalization and the connection and integration of the whole value chain with the final aim of establishing Germany as a lead market and provider of advanced manufacturing solutions. One of the result of the "*Industrie 4.0*" project was a workshop made in collaboration between the multinational Robert Bosch GmbH, leaded by Siegfried Dais, and the German Academy of Science and Engineering, represented by Henning Kagermann. This teamwork resulted firstly in a series of recommendations addressed to the German Government for implementing the 4.0 industrial plan and, secondly,

[3] Angela Merkel, German Chancellor, quote from a speech made at the World Economic Forum in Davos, January 2015

in a final report concerning all the investments required (in terms of infrastructures, schools, energy supply systems, research institutes and companies) aimed at refurbishing and renewing the German productive ecosystem. The Industry 4.0 strategy aims to ensure an industry fit for future manufacturing in Germany. It supports the integration of cyber physical systems (CPS) and Internet of Things and Services (IoTS) with an eye to enhance productivity, efficiency and flexibility of production processes and thus economic growth. "Smart production" becomes the norm in a world where intelligent ICT-based machines, systems and networks are capable of independently exchanging and responding to information to manage industrial production processes.

Even if the birthplace of Industry 4.0 is located in Germany, this technological phenomenon quickly influenced many industrialized countries of the world. Some of them, which are depicted in the following picture, adopted an Industry 4.0 plan at a national level.

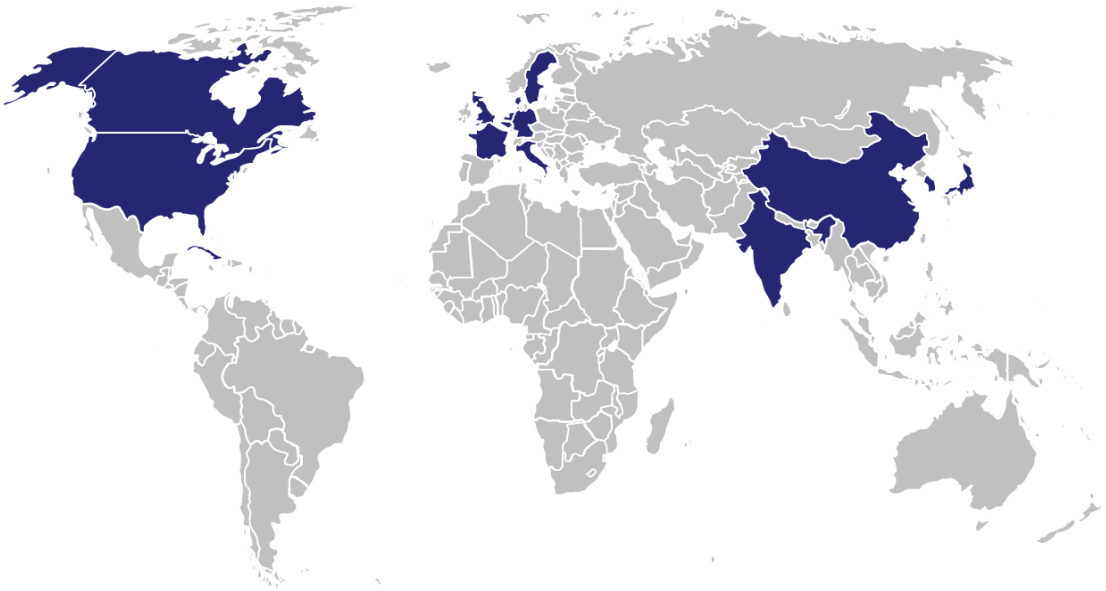

Fig. 1.2 – Countries that adopted an Industry 4.0 plan

Source: own elaboration from "Piano Nazionale Industria 4.0" – Ministero dello Sviluppo Economico

Focusing on the European context, we'll briefly discuss some national 4.0 industrial plan adopted by the other main European countries who decided to follow the example set by Germany.

The British government together with Cambridge University's Institute For Manufacturing developed the "*CATAPULT – High Value Manufacturing*" plan involving both universities and main industrial companies financing company planning and applied research centers.

In France we have the "*Industrie du Futur*", a reindustrialization and investment plan in technologies 4.0 lead by the French government providing for tax incentives for private investments, subsidized loans for small, medium and mid-tier enterprises, tax credit for research, financing of "*Industrie du Futur*" and "*Invest for the future*" projects. In the Netherlands there is the "*Smart Industry*" plan which focus on the "network centric" approach involving the FME (largest organization in the Netherlands representing employers and businesses in the technological industry), the TNO (Netherlands Organization for Applied Scientific Research, a nonprofit Dutch company that focuses on applied science), VNO-NCW (Confederation of Netherlands Industry and Employers), the Ministry of Economic Affairs and the Chamber of Commerce.

1.2.2 Industry 4.0 in Italy and its legal framework

We'll now focus on the Italian context within the broader phenomenon of the Fourth Industrial Revolution. The 21st September of 2016, the Ministry of Economic Development Carlo Calenda presented the "*Piano Nazionale Industria 4.0 – 2017-2020*", an industrial plan that provides for norms and suggestions aimed at favoring investments for innovations and competitiveness. Such plan aimed at injecting in 2017 private investments worth 10 billion euros, € 11.3 billion of private expenditure in research, development and innovation focused on 4.0 technologies and 2.6 billion for early stage private investments[4]. The measure provided for set of financial incentives, support to venture capital, ultra-wideband diffusion, a training plan from schools to universities with the final aim of pushing companies to embrace the fourth industrial revolution. This national plan is based on the following principles:

1. Technological neutrality: guarantees that any process can be implemented through standardized and cross-sectional platforms in order to manage each procedure with the same tool.
2. Horizontal actions: rather than focusing on sectorial actions, the government interventions should focus on those activities that have a broader spectrum of potential benefits on a plurality of companies and sectors such as research and development, competition et cetera.
3. Focusing on Industry 4.0 drivers

[4] https://www.economyup.it/innovazione/cos-e-l-industria-40-e-perche-e-importante-saperla-affrontare/

4. Use already-existing tool to push towards technological leap and productivity
5. Coordinate main stakeholders without playing an interventionist role

The main strategic guidelines under the Italian Industry 4.0 plan are summarized here below:

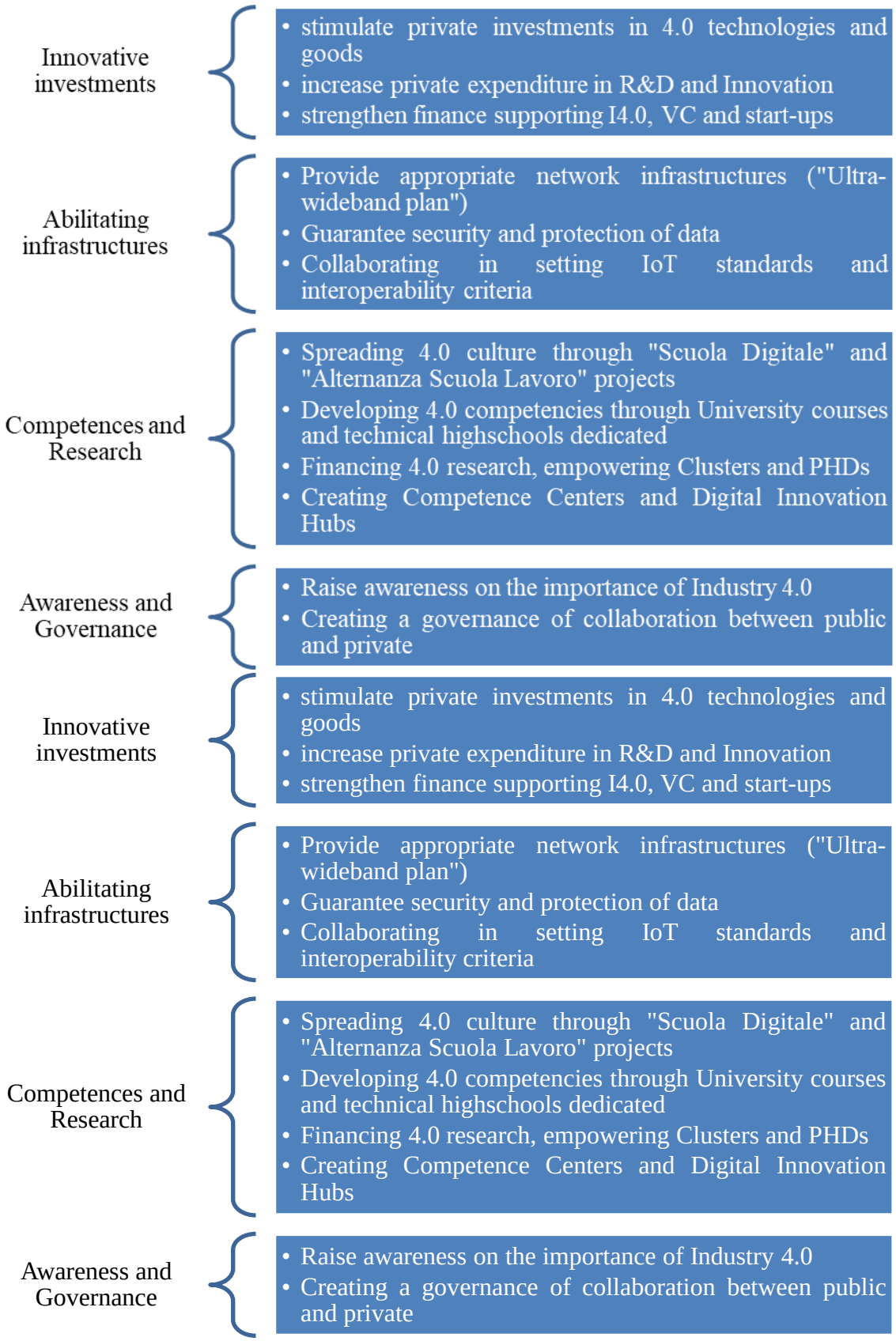

Fig. 1.3 – Strategic guidelines of the Italian Industry 4.0 plan

Source: own elaboration from "Piano Nazionale Industria 4.0" – Ministero dello Sviluppo Economico

The main tools used by the Italian Government to push companies towards the adoption of Industry 4.0 mindset and technologies are: Hyper- and Super-Depreciation, the "Nuova Sabatini", tax credit for R&D investments, "Patent Box", Startup and innovative SMEs.

Enterprises that invest in new capital goods, in tangible and intangible assets functional to the technological and digital assets can benefit from an overvaluation of their investments for a prefixed rate according to the kind of assets they're buying: firms that buy new tangible assets, devices and enabling technologies for Industry 4.0 indicated in Annex A contained in the Stability Law 2017 can benefit from hyper-depreciation at a 250% level while the firms that already benefit from the hyper-depreciation (i.e. they already bought a capital good set out in Annex A) can buy all the intangible assets such as software and IT systems inserted into Annex B of Stability Law 2017 and avail of super-depreciation at 140%.

The "*Nuova Sabatini*" tool is aimed at facilitating the access to financing to micro, small and medium firms for buying new machines, plants and equipment through a contribution to cover the interests on bank loans amounting from 20 thousand to 2 million euros granted by banking institutions affiliated to the Ministry of Economic Development.

The third abovementioned tool is the tax credit, which aims to stimulate the private expenditure on Research and Development to innovate processes and products and to guarantee firms competitiveness. This tax credit of 50% on incremental expenditure on R&D activities can be used to cover taxes and contributions up to an annual maximum of 20 million euros per year.

All of the following expenditures are eligible for aid: basic research, industrial research and experimental development, hiring highly qualified and technical people, research contracts with Universities, research institutes, firms, startups and innovative SMEs, depreciation charges on lab instruments and equipment, technical competencies and exclusive industrial rights.

The "Patent Box" tool consists in concessional taxation on income coming from intellectual property such as industrial patents, registered trademarks, industrial designs, know-how and software covered by copyright. It was thought to make Italian market more attractive for in-house and foreign long-term investments, to encourage the allocation on the Italian territory of tangible goods currently held abroad by Italian or foreign companies and, finally, to support the retention of intangible assets in Italy, avoiding their reallocation outside the national boards. This facilitation consists in the reduction of IRES (a proportional corporate

income tax) and IRAP (regional tax proportional to turnover) rates of 50% since 2017 on business incomes related, directly or indirectly (i.e. under license), to the usage of intangible assets vis-à-vis third parties and related counterparties such as intra-group companies. This benefit is given as long as the contributor carries out R&D activities related to the development and retention of intangible assets.

Finally, the last instrument is the one dedicated to innovative startups and SMEs that can benefit from an entirely dedicated framework concerning the administrative simplification, the labor market, tax benefits, and insolvency laws. The final aim is to build a dynamic and innovative national entrepreneurial ecosystem through a series of advantages in order to sustain innovative companies at any stage of their lifecycle. Some examples are the new free and digital methodology of constitution of the company, incentives to invest in venture capital through IRPEF (personal income tax, is a direct, personal, progressive and general tax) and IRES deductions, free, easier and prioritized accesso to the guarantee fund for SMEs, equity crowdfunding to collect new venture capital.

One year after the adoption of the "*Industria 4.0"* plan, the Minister Calenda showed the results achieved during the implementation of the aforesaid plan based on the data of *MEF*, *Istat* and *Banca d'Italia*. Broadly speaking, Industry 4.0 had positive effects on all fronts and the main ones are: an increase in orders of capital goods on the domestic market (+ 11,6% in the first semester), an increase in the number of firms willing to spend more on R&D, €3.5 billion-worth of public investments were allocated on the ultra-wideband, the guarantee fund increased the amount guaranteed by 10.7% in the first 8 months, the benefits granted were worth almost € 1.9 billion thanks to development contracts and more than 53 thousands jobs were created or preserved. The main problems emerged during this period were the delay of the constitution of the so-called Competence Centers (on which we'll discuss later) and the low growth rate of early-stage investments that amounted to +2% and, with respect to the other European countries, was considered insufficient.

Having assessed the efficiency of the maneuver, on 21st September 2017 the Minister of Economic Development presented the second phase of the national plan called "*Impresa 4.0"* that, rather than focusing on the manufactural world as the *"Industria 4.0"* plan did, it extended to all of the Italian enterprises and to look also at the services, which has high potential of digitalization. The 2018 Government decided to put emphasis on such evolution by changing the text of the *DEF* ("*Documento di Economia e Finanza*", economic and financial planning document) and focusing on supporting the SMEs rather than bigger

companies, which were the main subject of the incentives set by the first wave of the national plan.

To partially compensate the non-extension of the super-depreciation policy to the second phase of the industrial plan, the government introduced the mini IRES, where the rate goes from 25% to 15% for the firms that invest in new plants, capital goods or hire people. The hyper-depreciation tool was kept and reorganized to incentivize SMEs with the provision of decreasing incentives: 170% for investments up to € 2.5 million, 100% for investments that are worth between 2.5 and 10 million euros and 50% for investments estimated to be between €10 and €20 million worth. The tax credit decrease while the "*Nuov Sabatini"* is extended To solve the low growth-rate of early-stage investments the Minister, together with the "*Cassa Depositi e Prestiti*", used funds coming from the Minister itself to take corrective measures.

Having assessed discrepancies in digital competencies with respect to Europe, especially with UK and Germany, in 2018 a tax credit on 4.0 training is given to the firms that make incremental expenditures on training on subjects (sales, marketing, IT, productive methodologies and technologies) focused on at least one technology 4.0 and that have agreed upon by trade union agreements. The tax credit reaches different rates according to the size of the company: 50% of eligible expenditures up to a maximum of 300 thousand euros for small enterprises; for medium-sized firms the rate decrease to 40% and keep the same ceiling of 300'000 euros; for larger companies the tax credit has a ceiling of €200 thousand for a 30% rate.

The Budget Law of 2019 introduced a grant of a total worth of 75 million euros[5] for 2019, 2020 and 2021 in order to facilitate the introduction of the role of the Innovation Manager within the SMEs. The Innovation Manager is a qualified consultant, independent and integrated in the organizational structure with a consulting contract for at least nine months. Such figure should be registered in the public register established by the Minister of Economic Development, or being part of a company registered in the aforesaid register or appearing independent with respect to the firm or network of firms that are applying for the grant.

[5] https://www.mise.gov.it/index.php/it/incentivi/impresa/voucher-consulenza-innovazione

The consultancy activity shall be aimed at guiding and supporting the innovation processes, technological and digital transformation of the firms and network of firms through the implementation of one or more enabling technologies provided for in the "*Piano Nazionale Impresa 4.0"* among different strategic sectors such as big data, data analysis, cloud, cyber security, virtual reality and augmented reality, integration of technologies belonging to the Next Production Revolution (NPR) into business processes, robotics, IoT, et cetera. Other activities that can benefit from this grant are the ones aimed at guiding and supporting processes in the refurbishment of managerial and organizational structures through the implementation of new organizational methods in business practices and in strategies of operational management as long as the bring a significant process of organizational innovation of the firms, or through the implementation of pathways aimed to listing in regulated or non-regulated markets, to the opening up of the venture capital to independent investors or to the usage of the new tools of alternative- or digital-finance (such as equity crowdfunding, invoice financing, or mini-bonds).

1.2.3 Enabling technologies of Industry 4.0

Industry 4.0 is based on the technological development that transform every aspect of the company: from enabling greater efficiencies during the productive phase to changes to traditional production relationships among suppliers, producers, and customers as well as to the relationship between human and machine. Enabling technologies changed the way of living, creating new business models and new ways of manufacturing. In this section we'll briefly introduce such technologies while in the next chapter we'll deepen the knowledge on some of them.

According to Boston Consulting Group (Gerbert et al., 2015) there are nine main foundational technology advances that transformed the industry into the one we are experimenting today. These nine technologies are depicted in the following picture:

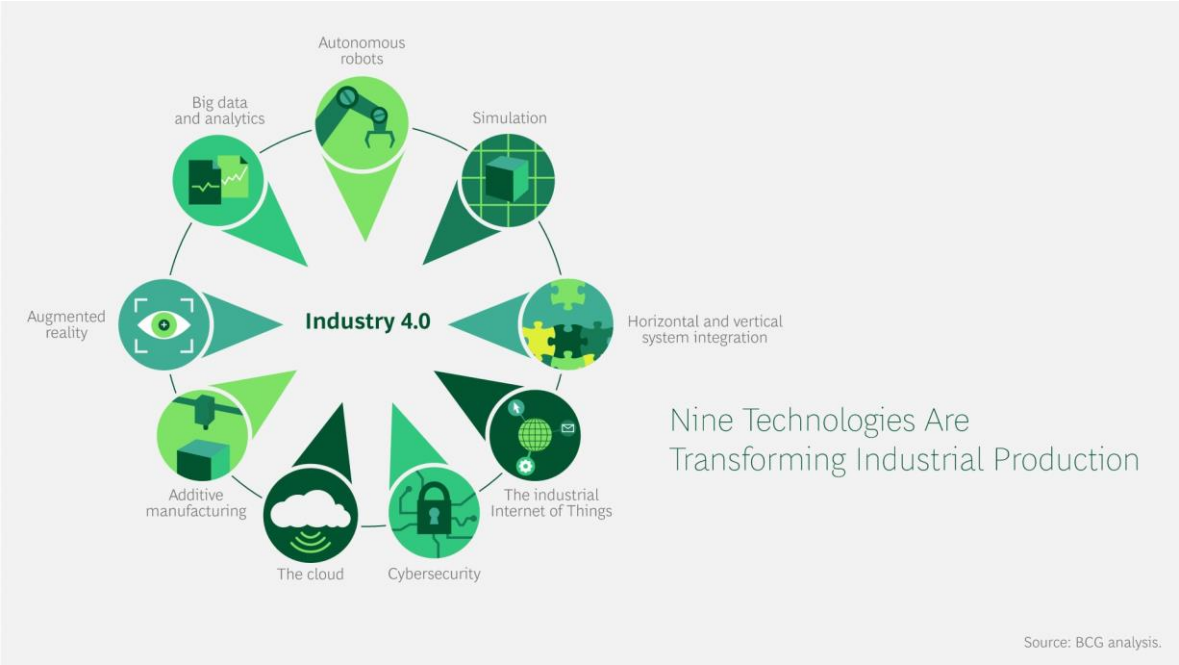

Fig. 1.4 – Nine technologies that are transforming Industrial Production
Source: Boston Consulting Group analysis (https://www.bcg.com/it-it/capabilities/operations/embracing-industry-4.0-rediscovering-growth.aspx)

Even if some of these technologies were already used during the Industry 3.0 but, with the Fourth Industrial Revolution, they shift from being "isolated, optimized cells will come together as a fully integrated, automated, and optimized production flow"[6].

We'll now briefly analyze each of them in order to understand what they are and how the firms can benefit from their adoption:

1. *Big Data and Analytics:* a huge amount of structured, semi-structured and unstructured data can be described as Big Data (BD) and, without the linked activity of data analysis, BD wouldn't have much value. The increasing volume of data generated by the new technologies and the improvements on technological capabilities is used within 4.0 firms for such a variety of purposes that should and will be dealt with separately in the second and third chapter of this dissertation. However, we can rapidly summarize the benefits of implementing such technologies in the purpose of improving and optimizing processes and services accelerating firms' competitive advantage by increasing productivity, innovation and competition. Another benefit

[6] Gerbert P. et al.; 2015; *"Industry 4.0: The Future of Productivity and Growth in Manufacturing Industries.";* Boston Consulting Group; www.bcg.com/it-it/publications/2015/engineered_products_project_business_industry_4_future_productivity_growth_manufacturing_industries.aspx

achievable through the gathering and analysis of data is the solution to problems related to the firm organization by monitoring, measuring and managing in a better way while support real-time decision making processes.

2. *Autonomous Robots*: the first industrial robot which was digitally operated and programmable was invented in 1954 by George Devol and Joseph Engelberger and was later sold to General Motors in 1960, who installed installed the first industrial robot in its production lines. Since then, several innovations followed. Even though industrial robots have been performing complex and repetitive assignments on production lines for years, with the Industry 4.0 they are evolving for even greater utility, becoming more flexible and autonomous, having a greater range of capabilities with compare to the ones used before while becoming more and more cheaper. The so-called "CPS" (Cyber-Physical Systems) are taking place. Such systems consist in industrial robots equipped with sensors, microprocessor and integrated systems that allow them to perceive distance, dangers and to take decision enabling the collaboration with the operators. Robots are starting to interact with one another and work safely side by side with humans and learn from them. Indeed, what is going to be a trend in the field of the industrial robotics is the insertion of Collaborative Robots (Cobots) into the production lines. With recent advances in computer hardware and data management software, artificial representations of humans are also becoming widely spread, and artificial intelligence and machine learning are contributing to the development of modern flexible robots.

3. *Simulation:* 3-D simulations of products, materials and production processes are widely used in the engineering phase, with Industry 4.0 simulations of this kind will be used more extensively in plant operations as well to leverage real-time data and mirror the physical world in a virtual model, which can include machines, products, and humans. The usage of such simulations will allow operators to choose the optimal machine settings for the next product in line in the virtual world before the physical changeover. 3-D simulations cold also be used as a tool by companies that want to open new plants or logistics centers or to expand their current ones for designing and analyzing their projects. However, these tools are expected to be the key in designing and optimizing the operations of the future factories so that they are able to project the physical world into a virtual model from the real-time data. The final result of the simulation technology is the so-called Digital Twin: the concept of Digital Twin was invented by NASA from the need to have their systems "mirrored" so that they can

maintain and repair taking into account the difficulty of physical access of these systems. Nowadays, this technology is being used in the industry to create virtual models of any service, product or hyper connected process that enable the optimization of them from the information and intelligence gathered. An example of the use of this technology is the prevention of machinery failures also called Predictive Maintenance.

4. *Horizontal and Vertical System Integration:* thanks to the development of cross-company, universal data-integration networks and multi-purpose software, the companies living within the Fourth Industrial Revolution can become more and more integrated and cohesive. Prior to this integration, the entire value chain was broken up. Companies, suppliers, and customers were rarely closely linked. Functions and departments were not fully integrated, nor most of the IT systems or even engineering itself. Industry 4.0 provides for computer systems which turn out to be more integrated and connected all over the business areas, starting from production, moving on along the supply chain until reaching the end customer

5. *The Industrial Internet of Things (IIoT):* Internet of Things (IoT) refers to the technological revolution by giving solutions for computations, analytics etc, by relying on cloud based systems. The main task of IoT is to connect the Internet by collecting data from physical objects and by collecting data, computers or higher level devices make the decision about operations (Rahman and Rahmani, 2018). The Internet of Things allows the connection of devices through embedded systems in order to communicate and be able to interact with each other or with centralized devices. Industrial Internet of Things refers to the use of IoT technology in the industrial field. Today, only some of a manufacturer's sensors and machines are networked and make use of embedded computing. They are typically organized in a vertical automation pyramid in which sensors and field devices with limited intelligence and automation controllers feed into an overarching manufacturing-process control system. But with the Industrial Internet of Things, more devices—sometimes including even unfinished products—will be enriched with embedded computing and connected using standard technologies. This allows field devices to communicate and interact both with one another and with more centralized controllers, as necessary. It also decentralizes analytics and decision making, enabling real-time responses.

6. *Cybersecurity:* due the increased connectivity and use of standard communications protocols that come with Industry 4.0, the need to protect critical industrial systems and manufacturing lines from cybersecurity threats increases dramatically. As a result, secure, reliable communications as well as sophisticated identity and access management of machines and users are essential. The introduction of new technologies in the industrial environment based on the use of the Internet and Open Source software, made it necessary to adopt more reliable and robust information and communication systems (ICT) required to ensure the protection, privacy and security of the companies. The latest trends in the cybersecurity include new technologies such as Quantum Encryption or Blockchain as an alternative to the current technology used in Cybersecurity, which has shown on more than one occasion that it is not impenetrable. Cybersecurity is one of the issues that most concern companies and multinationals when start the journey towards to the digital transformation.

7. *The cloud:* Cloud Computing (CC) is the way of virtualizing the resources and services and combining client/server based system. CC includes pools of IT resources that offer storage and processing capabilities in virtual system by serving multiple users. Cloud computing was born in the 2000s, when Amazon launched Amazon Web Services: Amazon built massive data centers in order to comply with its web scale requirements and decided to rent its spare capacity in the form of "leasing compute" and its storage resources on an "as-used basis". Nowadays, cloud services providers are still using the "pay-as-you-use" formula like Amazon: this feature makes cloud computing solutions attractive to even SMEs (Gilchrist, 2016). The increasing volume of data coming from productive assets require increased data sharing across sites and company boundaries making it necessary to improve the performance of cloud technologies, achieving reaction times of just several milliseconds. As a result, machine data and functionality will increasingly be deployed to the cloud, enabling more data-driven services for production systems.

8. *Additive Manufacturing*: Additive Manufacturing, also defined as 3D Printing, refers in producing customized goods for the requirements of customers. The most common way is the prototype and 3D printing methods in order to produce small batches by gaining advantage of having less stock on their hand and overproduction. Companies have just begun to adopt additive manufacturing, which they use mostly to prototype and produce individual components. The Additive Manufacturing by a means of 3D printers allows the production of complex parts in a record time at a

competitive cost, reducing logistical costs and facilitating the production of small series or prototypes.

9. *Augmented Reality (AR):* in Virtual Reality (VR) both the environment and the information displayed are graphics processed by a computer, on the other hand, the Augmented Reality uses the real physical environment to provide us with data and information in real time. Indeed, AR comprises all devices that can enhance the information that is available to the user in physical environments and it is defined as "the process of overlaying animations and graphics on actual scenes in real time" (Turner et al., 2016). Even though that these systems are still in their infancy and their application are still limited and experimental, the opportunities that these devices offer are potentially disruptive. This technology could be used to support production processes, in particular in settings like inventory management, logistics management and maintenance (Magone and Mazali, 2016) and could improve also the decision making process based on the information that it provides.

CHAPTER 2 – Data, Big Data and Artificial Intelligence

Data is the most important commodity of our era and have become a torrent flowing into every area of human life and of the global economy.

In the first part of this chapter we'll analyze what data is and how much data it is currently produced, then we'll proceed with the analysis of the main theoretical laws that fall behind the digitalization of the world, explaining why the volume and value of data produced worldwide is continuously increasing.

In the second part we will look deeper into the subject of Big Data, giving a proper definition and a classification of this phenomenon and finding its main sources. We'll explain how firms can generate value from understanding and exploiting the right data among the heap and we'll describe briefly the new organizational roles data-related that are emerging inside 4.0 companies.

The third and last section of this chapter is devoted to the Artificial Intelligence and Machine Learning. We'll discuss what AI and ML are, how they have developed over the years and how they are impacting the global economy.

2.1 Data

Data is a set of raw, unorganized facts that need to be gathered, processed, organized and translated in order to obtain something useful, which is information. Data can be any character, spacing from text to pictures and sounds that, if not put into context, means little or nothing to a human. Information is data formatted in a manner that allows it to be utilized by human beings in some significant way. Hence, information is composed of data, and knowledge is made up of different information.

From a computer perspective, data is an aggregation of bits (binary digits taking the value of zero or one) and the multiples of such bits take the prefixes reported in the following picture:

Abbreviation	Unit	Value	Size (in bytes)
b	bit	0 or 1	1/8 of a byte
B	bytes	8 bits	1 byte
KB	kilobytes	1,000 bytes	1,000 bytes
MB	megabyte	$1{,}000^2$ bytes	1,000,000 bytes
GB	gigabyte	$1{,}000^3$ bytes	1,000,000,000 bytes
TB	terabyte	$1{,}000^4$ bytes	1,000,000,000,000 bytes
PB	petabyte	$1{,}000^5$ bytes	1,000,000,000,000,000 bytes
EB	exabyte	$1{,}000^6$ bytes	1,000,000,000,000,000,000 bytes
ZB	zettabyte	$1{,}000^7$ bytes	1,000,000,000,000,000,000,000 bytes
YB	yottabyte	$1{,}000^8$ bytes	1,000,000,000,000,000,000,000,000 bytes

Fig. 2.1 - Prefixes used to measure digital data

Source: https://www.weforum.org/agenda/2019/04/how-much-data-is-generated-each-day-cf4bddf29f/

The Central Processing Unit (CPU) is the electronic circuitry within a computer that carries out the instructions of a computer program by performing logical operations to convert the source data (or input) into new data (output). Today's algorithms and powerful computers can give us entirely new insights and new information that would otherwise have remained hidden.

From a managerial point of view the value of information can be defined according to the following five parameters (Thakur):

- *Timeliness:* information is valuable if it can result in some timely decisions, if the reaction time is not there then the information loses its managerial value;

- *Presentation:* information should be presented in such a way that facilitates the decision-making processes;

- *Accuracy:* relates to "the correctness of the output information" (Bailey & Pearson, 1983), being true or correct is a key characteristic for information to be valuable;

- *Context:* information is valuable to a manager only if it has a decision-making connotation to it;

- *Expectation:* information is generally more valuable if it breaks an expected view or result or an expected reaction.

Data and information have always been a key resource in the economic world. As we have seen in the first chapter of this dissertation, having a lot of information has inevitably incentivized any breakthrough innovation regarding the productive systems and has shifted the productive paradigm accordingly: in the 20th century the introduction of telegraph and telephone enabled the communication among individuals and the result of this load of information supported mass production; today the availability of abundant data enables companies to supply smaller niche markets allocated all over the world.

2.1.1 Computed Data Eras

IDC (Reinsel et al, 2017) found three main eras in which computed data was created and used in different ways, as reported in figure 2.2.

The first era is dated before 1980s where data produced resided almost exclusively in purpose built datacenters and the processing ability remained centralized in mainframes. Data was generated and used mainly for business-related purposes. If people wanted to access data from remote, they had to use terminals with low or non-existent computing power.

The second era covers the period that goes from 1980 to 2000. Personal computers took hold and the distribution of data and computing powers began to spread like wildfire onto the popular masses enabling the creation of an increasingly wider network of digital devices. Datacenters shifted from being mere data containers to centralized hubs that managed and distributed data. Data creation and usage was not exclusively related to business purposes anymore. Digital devices gained the ability to store and manage data for purely personal use by consumers, and a digital entertainment industry of music, movies, and games emerged.

The third and last era identified by IDC is the one that goes from 2000 up to the present day. As we will see in the next section, data exploded thanks to the wireless broadband and fast networks and the adoption of increasingly communicative devices such as phones, wearables and gaming consoles. Datacenters expanded into cloud infrastructures, requiring less and less physical local storage.

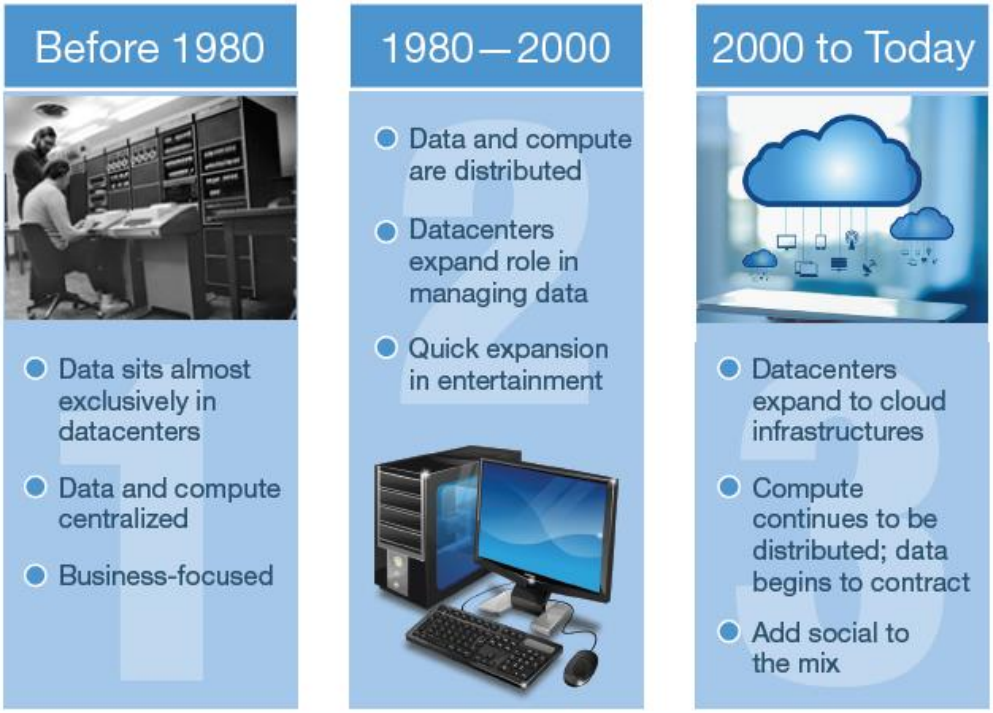

Fig. 2.2 Data storage and aims

Source: Data Age 2025, IDC, 2017

2.1.2 How much data we produce?

Quantifying the amount of data and, hence, information that exists in the world is very hard, its annual growth rate reaches the 60%[7] and it's rapidly increasing. We have recently witnessed the exponential growth of the volume of data and there are many reasons for such information explosion. Among all the possible causes for this phenomenon, the most obvious one is linked with the advances in technology. Indeed, digital devices are more and more complex and capable of doing an increasing variety of things thanks to the multiple sensors and gadgets which enabled the digitization of lots of information that was previously unavailable. The prices of abovementioned digital devices have plummeted and, consequently, many more people have had access to far more powerful tools.

The internet diffusion enabled the ever-increasing amount of data to happen. Indeed, the number of internet users grew exponentially: in 2014, there were 2.4 billion internet users, reaching 3.4 billion by 2016. As of June 2019 there were a total of over 4.4 billion internet users, growing by 83% with respect to the internet users of five years before.[8]. According to a study (SINTEF, 2013) in 2013 alone 90 percent of the data in the world was generated in the

[7] https://www.economist.com/special-report/2010/02/27/all-too-much

[8] https://blog.microfocus.com/how-much-data-is-created-on-the-internet-each-day/

previous two years. By 2020 there will be forty times more bytes of data than there are observable stars in the universe.[9] This result is confirmed by predictions about the amount of data came from IDC's study – "The Digital Universe in 2020". According to the source, next year, we should have around 40 trillion gigabytes of data, i.e., 40 zettabytes. The same study suggested that the big data size in 2010 was standing at 1.2 zettabytes. By 2020, every person on the planet should generate 146,880 GB a day[10]. If we take into account that the world population will reach 8 billion people by that time, it's easy to conclude the amount of data we'll create on a daily basis will rise dramatically. Moreover, IDC forecasts that the global "*datasphere*" will be producing 165 zettabytes per year by 2025, which is ten times the data generated in 2016 which amounted to 16.1 ZB of data (Reinsel et al., 2017).

The IoT, 5G, cloud, mobility, social and analytics made the data explosion accelerate. There are 2.5 quintillion bytes of data created each day at our current pace, but that pace is only accelerating with the growth of the Internet of Things (IoT). Information created by machines and used by other machines will probably grow faster than anything else and the exchange of such information will be database to database, involving only marginally people (Short et al., 2011). We'll analyze more in detail the magnitude and the importance of IoT-generated data later in this dissertation.

Adam Smith, David Ricardo and other classical economic theorists found three primary productive factors which are essential for the production of any good or service: land, labor, and capital. These kinds of productive factors are now antiquated and many find that the new kind of inputs are: time, information and capital (Gentile, 2011). As we have just seen, the world is producing an unimaginably vast amount of digital information which is getting ever vaster ever more rapidly. Data are becoming the new raw material of business and this makes it possible to find new sources of economic value other than for other social and technological purposes. Companies are collecting more data than ever before and thanks to the technology they can integrate all the functions and divisions of the company through data-mining techniques. That allows firms to operate more efficiently, pick out trends and improve their forecasting.

[9] "Data Never Sleeps 7.0", Domo, https://www.domo.com/learn/data-never-sleeps-7

[10] "Data Never Sleeps 6.0", Domo, https://www.domo.com/learn/data-never-sleeps-6

2.1.3 Rules behind Digitalization

Literature provides for three main rules (Shapiro and Varian, 1999) behind the disruptive digital transformation we are witnessing today: Moore's law, Metcalfe's law, Gilder's law.

Before describing the aforesaid laws we need to explain some technical words we're using in this chapter. An Integrated Circuit (IC), better known as microchip, is "a small semiconductor module of packaged computer circuitry that serves a specific role in relation to other microchips in a computer hardware system". A microprocessor is an electronic component that that executes and manages the logical instructions and tasks involved in computer processing. It is a central processing unit on a single integrated circuit chip containing millions of very small components including transistors, resistors, and diodes that work together. Transistors are semiconductor device with the properties of a switch, allowing or blocking the flow of electrons. They are used for amplifying, controlling, and generating electrical signals. Ethernet is a set of networking technologies and systems used in local area networks (LAN), where computers are connected within a primary physical space. Bandwidth is the bit-rate measure of the transmission capacity over a network communication system.

The first law we're discussing about in this paragraph is the Moore's law. It is based on an observation that Gordon E. Moore, Fairchild Semiconductor and Intel co-founder, published in April 1965 in *Electronics* magazine. He carefully observed the emerging trends and deduced that computers would dramatically increase in power and exponentially decrease in relative cost. Moore observed that the number of transistors on a computer chip was doubling about every 18–24 months, estimating that microcircuits of 1975 would contain an astounding 65,000 components per chip.[11]

[11] https://www.britannica.com/technology/transistor/Transistors-and-Moores-law

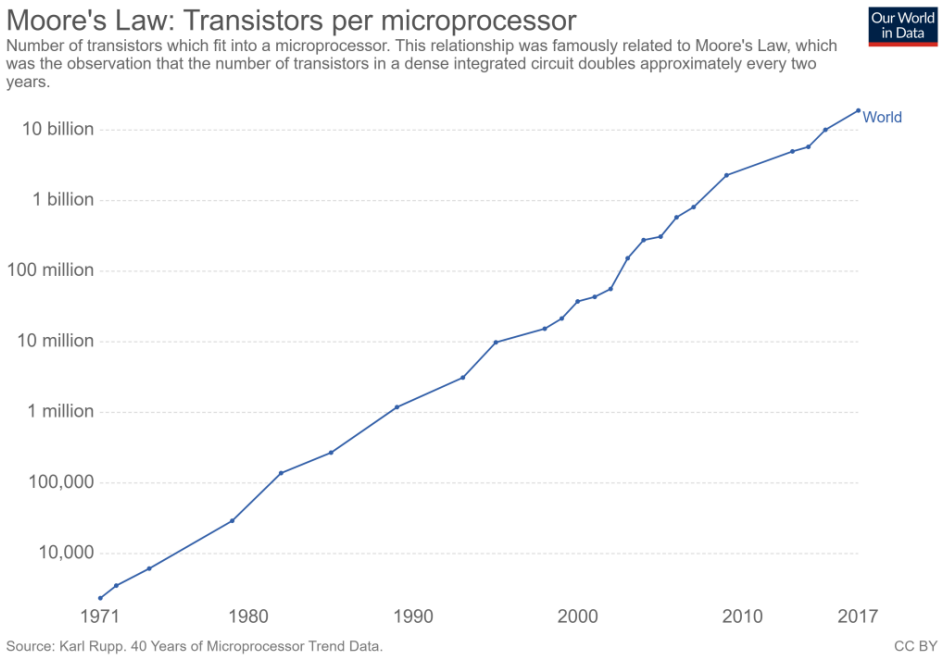

Fig. 2.3: Moore's Law Transistors per microprocessor (1971-2017)
Data published by: Karl Rupp. 40 Years of Microprocessor Trend Data.
Source: https://ourworldindata.org/grapher/transistors-per-microprocessor?time=1971..2017

The first Intel microprocessor, Intel 4004, had 2'300 transistors, each 10μm in size. As of 2019, a single transistor on the mass market has on average over 100 million transistors per square millimeter, with size down to 1 nanometer. If you compare the first microprocessor (Intel's 4004) to today's 14 nanometer processors, the performance is now 3'500 times higher, energy efficiency is improved 90'000 times and the price per transistor has fallen by over 60'000 times. Gordon Moore has recently said during an interview the following thought: "No other technologies that I can identify have made progress at that rate, nor has any had such a profound effect on societies throughout the world"[12]. Even if the trend is flagging and Moore's law is slowing down, we can still see consequences of the ever-increasing power and to the decreasing relative price of microchips. Indeed, the main consequences of such rule are that the local computing power is augmenting further and further, digital devices are getting accessible to many more people and we're experiencing the shift towards ever more digital features in products and machines. These explain why we're living in a vaster and vaster ocean of volume of data produced.

The second law behind this digital transformation is the Metcalfe's law. This law was first articulated in the early 1980s by George Gilder and named after Bob Metcalfe, the inventor of the Ethernet. The quantity of communication flows hosted by a network is reflected in its

[12] https://www.intel.com/content/www/us/en/silicon-innovations/moores-law-technology.html

value, which rises exponentially while the number of nodes increases. Assuming that there are n people in a network, and the value of the network to each of them is proportional to the number of other users, then the total value of the network is proportional to n*X*(n - 1) = n^2 - n (Shapiro and Varian, 1999). In other words, increases in network size leads to a quadratic increase in network value. This is an example of the so-called network effect bringing increasing returns thanks to the wider adoption of a technology. We can say that, given that more and more people are adopting digital devices and machines are building a denser network of communication among them and with humans, the value of exchange of data and information is increasing.

The third and last law behind the digital disruptive revolution is the Gilder's Law, which is closely linked with Metcalfe's law. This is a productivity law states that the total bandwidth grows at least three times faster every year (at constant prices) than computing power. Indeed, according to Moore's Law, computer power doubles every 18 months while, according to Gilder's Law communications power doubles every six months. This allows content produced to be richer and having higher value per data produced.

2.2 Big Data and Data Analysis

With the evolution of storage and data processing systems, new technologies such as cloud computing and supercomputers enabled data produced to reach the volume of petabytes and zettabytes. Indeed, the volume of data produced has increased so much that this phenomenon took the name of Big Data. There isn't an unambiguous definition of this term; however we can identify Big Data with all digital data produced by the use of new technologies for personal or professional purposes.

Big Data concept has undergone advanced evolution. This term might have been coined in the 90s by John Mashey, chief scientist at Silicon Graphics, a company which dealt with lots of data and that was devoted to computer graphics used for special effects in Hollywood and for video surveillance by spy agencies. However the first documented use of the term "Big Data" dates back to 1997, when some scientists at Nasa described in an article (Cox and Ellsworth, 1977) the issue they had visualizing some very large data sets with the name of "the problem of big data".

According to the McKinsey Global Institute (Manyika et al., 2011), Big *Data "refers to datasets whose size is beyond the ability of typical database software tools to capture, store, manage, and analyze. […] we don't define big data in terms of being larger than a certain*

number of terabytes (thousands of gigabytes).[…] Also note that the definition can vary by sector, depending on what kinds of software tools are commonly available and what sizes of datasets are common in a particular industry."

Big data was once a theme confined solely to research and science. Today even companies are the recipients of the flourishing volume of data, capturing trillions of bytes of information about their whole value chain that includes customers, suppliers, and operations. This was also facilitated by the advent of the so-called Internet of Things (IoT) where millions of networked sensors embedded in almost every device, from the mobile phones to industrial machines, sense, create, and communicate data. Digital data is now everywhere—in every sector, in every economy, in every organization and user of digital technology. Nowadays the ability to manage the enormous amount of data plays a key role in having a competitive advantage in an economic climate that plods along. The possibility of taking reliable decisions based on updated information and analysis is extremely important to leaders across every sector, and consumers of products and services stand to benefit from its application.

In 2001 Doug Laney, Gartner analyst, described the three "V" characteristics of Big Data:

- *Volume:* enterprises gather more and more data coming from a greater variety of sources such as financial transactions, social media or machine-to-machine. The benefit of gathering large amounts of data includes the creation of hidden information and patterns through data analysis. However, the main problems of having such a huge amount of data are connected with its storage and with having the ability of choosing and extracting the most appropriate and useful information from it;

- *Velocity:* data is produced, collected and analyzed in real time thanks to the increasingly common use of technologies such as Tag RFID (radio frequency identification), sensors and smart metering. The rapidity of processing data is of the utmost importance to conduct real-time analysis in order to give relevant projected results back to companies;

- *Variety:* each gathered data can be useful to achieve the objectives, spacing from texts to videos, from personal data to metadata et cetera; data can be classified into structured, unstructured or semi-structured. We'll discuss in the next sub-section what we mean by this kind of classification.

Over the years the original three Vs of Big Data have made way to other additional features:

- *Value:* probably the most important characteristic of data is the possibility to extract information with economic value;
- *Veracity:* to what extent a data set is accurate or truthful, it's not just the quality of the data itself but also of its source, type and processing of it; having so much data available, it's fundamental to filter through what is important and what is not in order to make successful use of big data. Veracity can be improved by removing things like bias, abnormalities or inconsistencies, duplication, and volatility.

2.2.1 Data Classification

In order to understand what kind of data is important to enterprises, we have to distinguish among structured, unstructured and semi-structured data:

- *Structured data:* data stored in databases, an electronic system that allows data to be easily accessed, manipulated and updated, organized in schemes and tables. It usually resides in the so-called relational databases, which are able to recognize relations between stored items of data. Databases of this type are typically managed via a Relational Database Management System ("RDBMS"). The benefit of structured data is its labelling to describe its attributes and relationships with other data. This data structure is easily searchable using a human or algorithmically generated query.

- *Unstructured data:* data with internal structure of bits and bytes that are stored without any pre-defined data models or schemes. Unstructured data is not organized and labelled to identify meaningful relationships among data. It can consists of textual or non-textual data and it can be human- (text files, emails, social media, mobile data, media, business applications et cetera) or machine-generated (satellite imagery, scientific data and digital surveillance data). Unstructured data is increasingly coming from sources outside the organization, usually in the form of social media data, or real-time streaming data from IoT 'smart' devices. These data types create a unique challenge for organizations struggling to analyze data beyond their traditional structured stores. Data of this kind can also be stored within a non-relational database and such databases are managed through the Information Retrieval Model. According to Djoerd Hiemstra (2009) information retrieval system is a software program that stores and manages information on documents, often textual documents but possibly multimedia. This system help users in finding the desired information they need

informing them on the existence and location of documents, called relevant documents, that might contain them.

- *Semi-structured data:* form of structured data with no formal structure of data models associated with relational databases or other forms of data tables, but nonetheless contains tags or other markers to separate semantic elements and enforce hierarchies of records and fields within the data. The definition of a schema is optional; it can change and can also be defined ex-post according to already existing instances. The types of semi-structured data instances may be defined for a part of the data and it is also possible that a data instance has more than one type (Sint et al.; 2009). Some examples of semi-structured data can be emails, social media and website related data. They abovementioned data have, indeed, some internal structure thanks to their metadata (recipient, sender, date/time, author, number of likes, et cetera) but contains also unstructured data such as the message body.

Even if there are different estimations on the percentage of structured and unstructured data on the total of data produced, they all agree that the majority of it can be defined as unstructured. According to the Economist (2010), only 5% of the information that is created can be defined structured. Other sources[13] finds that, on average, unstructured data makes up more than 80% of today's enterprise data, 80 percent of worldwide data will be unstructured by 2025[14] and the amount of such data is growing at an average rate of 55% – 65% per year. According to IDC, unstructured data grows at 26.8% annually compared to structured data, which grows at 19.6% annually. This remarkable growth rate can be explained by the three rules we have described in the previous section and their main results: decreasing costs of data storage, increasing processing power, ever-widening use of technology and ever-increasing interconnectedness of devices and data.

As stated in the Harvard Business Review's article "What's Your Data Strategy?" (DalleMule and Davenport, 2017), most of the companies don't make great use of the data they produce or collect. It has been shown that, cross-industry, on average, less 50% of an organization's structured data is used in decisional processes and less than 1% of its unstructured data is analyzed or used at all.

[13] https://lawtomated.com/structured-data-vs-unstructured-data-what-are-they-and-why-care/

[14] "80 Percent of Your Data Will Be Unstructured in Five Years", Timothy King, 2019, https://solutionsreview.com/data-management/80-percent-of-your-data-will-be-unstructured-in-five-years/

Managing unstructured data requires a different approach: while it's easy to search and modify a relational database and understand what data you have when dealing with data represented by numbers and strings; meanwhile, it's not so easy to search for and categorize files such as images or videos and updating unstructured data may require replacing the entire file. As well as data management, data protection strategies differ for structured and unstructured data. Nowadays enterprises are focusing on locking down sensitive information mainly in structured systems. It is getting harder for hackers to get to the data they want and they are finding the weakest path to that data and evolving their attack vector. Unstructured are the easiest way for hackers to obtain access to sensitive data contained in a file share or cloud storage systems increasingly used by companies for easier cross-company sharing and collaboration.

2.2.2 Main sources of Big Data: IoT

Big data is mainly generated by three primary sources: social data, transactional data and machine data. Data coming from public web and social media platforms, such as Tweets, Likes, Comments and general media which is uploaded and shared on such platforms, provides insights on consumers' behavior and plays a key role in marketing analytics. Transactional data is generated from all the daily transactions via invoices, payment orders, storage records, delivery receipts that take place both online and offline. The third and last category of data sources is the data coming from machines, which is generated by industrial equipment and sensors that are installed in machinery. This type of data is expected to grow exponentially thanks to the diffusion of the Internet of Things and, hence, deserves a specific and detailed discussion.

The term Internet of Things (IoT) was coined back in 1999, as the result of a research of the Massachusetts Institute of Technology (MIT) regarding networked radio frequency identification (RFID) and emerging sensing technologies (Evans 2011). However, the very first application of the IoT was most probably a modified Coke machine at Carnegie Mellon University, which was the first connected appliance to the Internet back in 1982. The vending machine was capable of sensing and reporting through the Internet its inventory and the temperature of the drinks.

According to the Cisco Internet Business Solutions Group (IBSG), the modern concept of IoT is to be dated between 2008 and 2009, when for the first time more objects were connected to the Internet than the world's population (Evans 2011).

IoT relies on Internet-connected sensor technology for the creation of data about things, i.e. about an action that happens in the physical world: checking whether if the door is open or closed, finding where the car is at a certain moment, checking what the temperature of the piece during a mechanical processing is at a precise step of the productive process.

Data can be produced and gathered by different sensors and devices and can be heterogeneous (e.g. temperature, video, images, sound et cetera). These sources are characterized by an heterogeneous, ubiquitous and dynamic nature, and the generated data covers a wide range of kinds. This makes the discovering, accessing, processing, integrating and interpreting the physical world data on the Web a challenging task (Barnaghi et al.; 2013). The collected data can be shown in real-time and stored temporarily or stored and published with a metadata-enriched representation of the data

The Internet of Things, connected "smart" devices that interact with each other and us while collecting all kinds of data, is exploding (from 2 billion devices in 2006 to a projected 200 billion by 2020) and is one of the primary drivers for our data vaults exploding as well. The number of devices connected to the Internet, including the machines, sensors, and cameras that make up the Internet of Things (IoT), continues to grow at a steady pace. A new forecast from International Data Corporation (IDC) estimates that there will be 41.6 billion connected IoT devices, or "things," generating 79.4 zettabytes (ZB) of data in 2025.[15]

Given that the amount of data produced is reaching an incredibly large amount, assessing the quality, validity and trust of data are among the key issues in Big Data collections from the physical world. Indeed, the business value of the IoT stands in the discrimination of valid and trust-worthy data from the pile of raw data and in the transmission of such data. This allows aggregation and operations on such information with the aim of extracting meaning and informing future actions.

One possible strategy consists in exploiting the IoT ecosystem to enhance workers capabilities. The generated information in this case augments the human knowledge, empowering more effective decision-making processes.

Similarly, data gathered by IoT devices and sensors can provide data-driven insight for the transformation of business processes. Core systems can be re-designed into automated processes in which events monitoring, combined with other technologies such as Artificial

[15] https://www.idc.com/getdoc.jsp?containerId=prUS45213219

Intelligence, that we will cover more intensively later, can be used to determine a course of action to optimize the process itself.

Acting based on the information can be either centralized or decentralized. Centralized management consists into creating an orchestration of events sensing and decision-making across the whole network to generate high level responses. Decentralized approaches instead concentrate lower level decision-making into multiple nodes, each of which are empowered by its own sensors and do not communicate with other nodes for making its own choices.

2.2.3 Big Data Value Chain

As we have seen throughout this dissertation, the economic value of having Big Data stands in the capabilities of managing it and extracting information from it through the process of data analysis.

The value chain of Big Data (Hu et al.; 2014) can be described into four main phases:

Fig. 2.4: Big Data value chain, own elaboration based on "Toward Scalable Systems for Big Data Analytics: A Technology Tutorial", Hu, Wen, Chua and Li, 2014

The first phase of Big Data Generation, which concerns how data is generated, has been already covered in the previous section.

The second one is the Acquisition phase and refers to the process of obtaining information and includes data collection, data transmission, and data pre-processing. Once having acquired information, it has to be stored inside the companies that are, indeed, equipped with complex information systems including operational databases with different aims.

The third phase, Big Data Storage, can be subdivided into two parts: hardware infrastructure and data management. By hardware infrastructure we intend a pool of shared ICT resources that should be able to scale up and out and to adapt to different situations. By data management we mean software deployed on top of the hardware infrastructure with the aim of maintaining large-scale datasets provided with several interface functions, fast querying and other programming models. Employees can use these systems to insert data or to query for specific data through some tools as the On Line Transaction Processing (OLTP) which is

based upon the Structured Query Language (SQL), a standardized language enabling to communicate, manage and administer different databases. There are also NoSQL (Not only SQL) models that, not having a rigid scheme, are more suited to greater volume of information. Once having stored data, they require further elaboration in order to get the maximum value from it and to use it as a support for decisional strategies inside the companies.

The fourth and last phase is the Big Data Analytics, which leverages analytical methods or tools to inspect, transform, and model data to extract value. In this phase, enterprises try both to decode and clean out the database (the so-called data mining) and to obtain a final output that could be used inside the decisional processes of the enterprise itself. This phase is also known as Knowledge Discovery in Databases (Azzolini and Scarpa, 2009) and it consists of the three main steps. The first one is linked with the creation of strategic databases, called Data WareHouse (DWH), where data that has been filtered and cleaned up from redundancies, incomplete or incongruent data in order to reach the desired strategic objective while minimizing the storage space needed and facilitating further elaborations. DWH are usually built by aggregating smaller electronic archives focused on specific items, called Data Mart, and are continuously updated with data coming from operational databases. The second step is the On Line Analytical Processing (OLAP), where a first descriptive analysis is carried out thanks to the usage of a multiple entry table. In the third and last step there are the analytics and more complex elaboration.

There are several types of Big Data Analytics that can be aggregated in some categories that we're now listing in order of complexity:

1. *Descriptive Analytics:* they summarize or describe raw data and make it something that is interpretable by humans by using aforesaid data to answer the question "What has happened". It analyzes past events providing trending information on current or past events using key performance indicators. Descriptive analytics are used as a primary analysis of Big Data and are useful as they allow organizations to learn from past behaviors, and help them in understanding how they might influence future outcomes. The targeted information to extract are usually the frequency of events, the cost of operations and the root cause of failures and it typically displays information within a report or dashboard view. It's the most common type of analytics used by organizations. In 2016, according to the "*Osservatorio Big Data*" by the Polytechnic

of Milan, 89%[16] of the companies investigated adopted Descriptive Analytics solutions and it reached 100% of the sample by 2017[17].

2. *Predictive Analytics:* allow enterprises to answer the "What could happen" question, using descriptive data accumulated and forecasting and predictive models for predicting events. They use trends of time-series data and correlations to identify patterns, estimating the likelihood of a future outcome by applying advanced statistical analysis and data mining. This type of analytics is usually used to assess the potential out-of-stock or over-stocks in parts inventory evaluate asset failure and productivity history to anticipate the likelihood of failure in a particular timeframe. They help managers to move beyond historical data by anticipating likely scenario in order to plan ahead, rather than reacting to situations that have already. This enables them to make more informed decisions, from daily operations to major business action. One common application of predictive analytics is to produce a credit score. These scores are used by financial institutions to determine the probability of customers making future credit payments on time. According to the "*Osservatorio Big Data*" by the Polytechnic of Milan in 2016 only 30% of the sampled companies used predictive analysis, reaching the 73% in 2017.

3. *Prescriptive Analytics:* help decision-makers to answer the "What should we do?" question, suggesting a set of possible actions and advised actions based on descriptive and predictive analyses. Prescriptive analytics examine potential outcomes while taking uncertainty into account, make recommendations helping managers make decisions when the data environment is too large or complex and finding ways to mitigate the risks that can result from it. This kind of analytics uses optimization and mathematical models trying to provide a reliable path to follow in order to get an optimal solution for business needs or resolution of operational problems. They reveal not only recommended actions but also the reasons of such suggestion, along with any implications the actions might have quantifying the effect of future decisions in order to advise on possible outcomes before those decisions are taken. It is used, for example, to identify inventory that should be re-ordered now, that should be moved to a different distribution center or that should be disposed of. It is used by companies to deliver the right products at the right time, consequently optimizing the customer experience. This kind of analytics is complex to administer and most companies are

[16] https://www.osservatori.net/it_it/pubblicazioni/big-data-guidare-il-cambiamento-liberare-valore

[17] https://www.osservatori.net/it_it/pubblicazioni/big-data-is-now-tomorrow-is-too-late-1

still not using it. In 2016, according to the "*Osservatorio Big Data*" by the Polytechnic of Milan, the 23% of the sampled companies used this kind of analytics, reaching a percentage of 33% in 2017.

4. *Automated Analytics*: it's the most complex kind of analytics and it's adopted by few companies because it involves the adoption of Artificial Intelligence and Machine Learning. This kind of analytics let technologies to autonomously take decisions based on the former types of analytics. Automated Analytics had 10% rate of diffusion in 2016 and it's slowly increasing, reaching a percentage of 11% in 2017 as found by the Polytechnic of Milan in its "*Osservatorio Big Data*". We will further explain the benefits of adopting this kind of analytics in the third part of this chapter.

2.2.4 New organizational roles data-related

Data and big data have increasingly taken a leading position inside the companies and in their value chains. Hence, it should not be surprising that organizational roles related to data have completely transformed inside the organizational structure. Chief information officers (CIOs) have become somewhat more prominent in the executive suite, and two new kind of professional have emerged, the Data Scientist and the Chief Data Officer (CDO). The Chief Data Officer is a managerial role that has to define, present and implement the strategies related to Data Driven Innovation, Data Analytics and Big Data. The CDO has to define the Data Driven Strategy of the company and has the objective of increasing the value of the data meant as an asset. He is usually the Chief of a team of people (CDO Team) which includes the so-called Data Scientists. The "Data Scientist" term was coined in 2008 by D.J. Patill and Jeff Hammerbacher, heads of analytics and data at LinkedIn and Facebook respectively, to describe the emerging field of study that focused on teasing out the hidden value in the data that was being collected from touchpoints all over the retail and business sectors. A data scientist is an individual, organization or application that performs statistical analysis, data mining and retrieval processes on a large amount of data to identify trends, figures and other relevant information. A data scientist performs data analysis on data stored in data warehouses or data centers to solve a variety of business problems, to optimize performance and to gather business intelligence.

2.3 Artificial Intelligence and Machine Learning

Artificial Intelligence (AI) is not a new phenomenon as it existed both as concept and in action for decades, however, the small pool of data available stymied its growth. Big Data and

Artificial Intelligence have a strong interconnection: as the availability of data of all types widens, the adoption of technologies such as AI and Machine Learning (ML) seems a natural consequence adopted by companies in order to unlock the potential in their data stores.

Artificial Intelligence is spreading beyond the technological field and is affecting every aspect of the economic world. Before delving further into the topic of the usage of AI and ML within the companies, we'll try to give a proper definition to these disruptive technologies and we'll analyze briefly how they have developed over the years.

Today, modern dictionary definitions focus on AI being a sub-field of computer science and how machines can imitate human intelligence (being human-like rather than becoming human). The Marriam-Webster dictionary defines Artificial Intelligence as follows[18]:

1. a branch of computer science dealing with the simulation of intelligent behavior in computers
2. the capability of a machine to imitate intelligent human behavior

Artificial intelligence is the technology that allows computers to do things that were once only the domain of humans. For example, computers have always been able to calculate. With AI, they can learn and draw conclusions. Machine Learning (ML) is a subset of Artificial Intelligence where the system gets trained by itself using algorithms with large amount of data to work or make prediction based on patterns. The further step would be the Deep Learning (DL) which is a subset of ML that uses a set of algorithms inspired by the structure and function of the brain called "neural networks".

2.3.1 History of Artificial Intelligence

The first step towards AI was taken in 1945, when Vannevar Bush (an American engineer, inventor and science administrator, head of the U.S. Office of Scientific Research and Development during World War II) published a seminal work entitled "As We May Think" where he proposed a system which amplifies people's own knowledge and understanding. Then, in 1950, the young British polymath Alan Turing wrote the paper "Computing Machinery and Intelligence" suggesting that machines could have been able to use available information as well as reason, simulating human beings in order to do intelligent things, to solve problems and to make decisions, such as in playing chess. In his dissertation, Turing developed the well-known "Turing test", which tests machine's ability to exhibit intelligent

[18] https://www.merriam-webster.com/dictionary/artificial%20intelligence

behavior equivalent to, or indistinguishable from, that of a human. Turing proposed that a human evaluator would judge natural language conversations between a human and a machine designed to generate human-like responses. If the evaluator cannot reliably tell the machine from the human, the machine is said to have passed the test. In 1952 Marvin Minsky, a graduate student in mathematics at Princeton University, built SNARC (Stochastic Neural Analog Reinforcement Calculator), the first artificial neural network computer that simulated a rat finding its way through a maze. Notwithstanding the earlier developments in this field, the *Artificial Intelligence* term was coined in 1956 by J. McCarthy, an American computer scientist and cognitive scientist, in occasion of a summer workshop called the "Dartmouth Summer Research Project on Artificial Intelligence" to discuss what would ultimately become the field of AI.

In the following 20 years, AI flourished thanks to the spread and improvements of computers as well as to improvements in machine learning algorithms. General Problem Solver or G.P.S. was the first useful AI program created in 1959 by Herbert A. Simon, J. C. Shaw, and Allen Newell intended to work as a universal problem solver machine. In 1966, at the MIT Artificial Intelligence Laboratory, Joseph Weizenbaum created one of the first AI programs that passed a restricted Turing test for machine intelligence. This natural language conversation program called ELIZA was created in order to demonstrate the superficiality of communication between humans and machines. ELIZA featured a conversation between a human user and a computer which mimicked a Rogerian psychotherapist. An example of such conversation is given below.

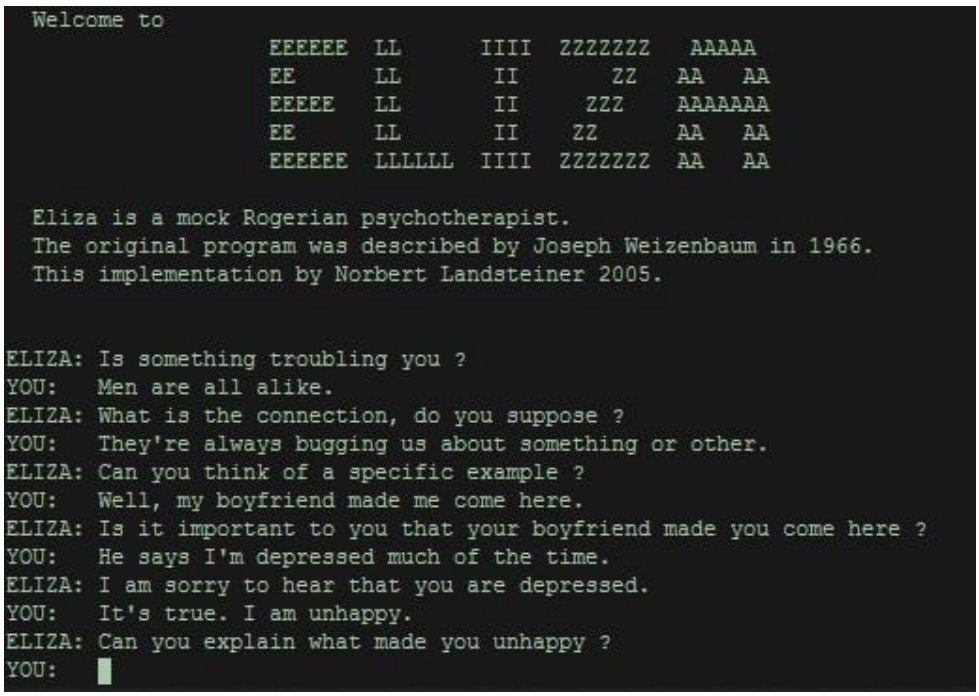

Fig. 2.5: Example of a conversation with ELIZA chatbot

Source: http://www.le-grenier-informatique.fr/medias/images/eliza-title.jpg

Edward Feigenbaum and Joshua Lederberg of Stanford University in California introduced in 1965 the first Expert System, a computer program that uses artificial-intelligence methods to solve problems in a way which mimics the decision making process of a human expert. An expert system relies on two components: a knowledge base (an organized collection of facts about the domain of the system) and an inference engine (which interprets and evaluates facts in order to provide an answer). The program would ask an expert in a field how to respond in a given situation, and once this was learned for virtually every situation, non-experts could receive advice from that program.

In the 1980's, AI was influenced by the popularization of "deep learning" techniques (allowing computers to learn using experience) thanks to John Hopfield and David Rumelhart. In 1982 Hopfield published a paper where he developed associative neural networks (more commonly known as Hopfield Networks) that simulated the ability of the human brain to remember things or to reconstruct distorted images. Rumelhart developed computer programs that roughly simulated perception and he finally devised an algorithm that allowed computer programs to learn how to perceive.

During 1990s AI became more and more complex and "intelligent". In 1997 IBM's Deep Blue defeated the reigning world chess champion and grand master Gary Kasparov. In the

same year, Windows implemented a software able to recognize human speech, which was developed by Dragon Systems.

The Dot-com bubble burst slowed down the development of AI in the early 2000s by reducing its funding. Nevertheless, computer processing power and storage ability grew at exponential pace, enabling corporations and governments to store vast quantities of data for the first time and to implement ML methods in narrow domains. The emergence in the past 15 years of digital giants such as Amazon, Google, Baidu, and others, led to the usage of Machine Learning methods to their huge commercial advantage and, as a result, today, the technology sector drives the American stock market.

In the last years we have witnessed the spread of the so-called "smart" things in every aspect of human life. Robots, drones and autonomous vehicles are just examples of the development of intelligent devices that are pervading our society. AI is one of the main drivers of this new IoT deployment paradigm, as it provides the means for understanding and reasoning over the context of smart objects. The integration of intelligent objects within conventional IoT/cloud systems signals a new era for IoT applications that deliver the power of AI-enabled systems everywhere.

2.3.2 Economic impact of AI

Artificial Intelligence is slowly spreading beyond the technology sector and in the next year it will impact strongly the whole economy. Nearly every sector and industry will be impacted by the introduction of Artificial Intelligence:

- *Banking and Finance*: AI and ML techniques could model real-time transactions or help banks and financial organization to prevent fraudulent actions based on predictive models. There is a whole new branch of Finance, the so-called Fintech that involve the use of technologies such as AI and ML.

- *Retail and e-commerce*: AI technology is already a fact for what concerns e-commerce as most of the online shoppers have already experienced chatbots, personalized shopping experiences, and curated product recommendations. There is however room for improvements such as the possibility to streamline operations and giving retailers the ability to manage better inventory planning and purchasing and predicting costs through the prediction of upcoming customer orders.

- *Digital Marketing and Content:* as well as any other traditional type of marketing, digital marketing is most effective when it's targeted to the right audience and uses the right content. AI can help marketers both in the creation (facilitating the access to necessary data or even writing articles on various topics) and personalization (customizing email contents, identify the right topics and analyzing the result of previous marketing campaigns) of contents.

- *Automotive:* AI technology is pushing the transportation sector towards both partially and fully autonomous vehicles. However, the applications of Artificial Intelligence in this industry is not limited to autonomous driving as it also helps with keeping us safe and connected. The software controlling intelligent vehicle relies on IoT technologies and other technologies embedded in the cars such as radar systems, lane control features, accident avoidance features, cameras, GPS, and others.

- *Smart Home Assistants:* voice search is taking thanks to AI and the significant improvements in natural language processing and voice recognition. As a result, smart home speakers and other digital assistants (such as Amazon Alexa, Microsoft Cortana, Google Assistant and Apple Siri) are becoming more accurate in their ability to understand commands and queries.

- *Healthcare:* AI is an important technology behind several important healthcare developments. According to PWC (Wilson, 2017) AI is changing the healthcare eco-system by helping people stay healthy through technology applications and apps; by detecting diseases (cancers and heart diseases), more accurately and in their early stages also thanks to the proliferation of consumer wearables and other medical devices combined with AI. AI technologies can help doctors use big health data in making faster and more reliable diagnosis and taking appropriate and timely decisions. Artificial Intelligence is also used in virtual diagnostics, in training future doctors and in participating in robotic surgery.

- *Industry and Manufacturing:* AI stimulates growth and innovation especially in the manufacturing industry. Robotics, product testing and maintenance are just examples of what AI can bring inside manufacturing companies. This topic deserves a specific and detailed discussion and it will be examined in more depth in the third chapter of this dissertation.

McKinsey (Bughin et al., 2018) studied how Artificial Intelligence is impacting the global economy and found out two evidences: first of all, Artificial Intelligence has the potential to play a significant role in the economy and, secondly, AI may contribute to widening gaps that already exist between nations, workers, and businesses. This study foresees that, by 2030, 70 percent of companies might have adopted at least one type of AI technology and that Artificial Intelligence could bring an added value to the global economy worth 13 trillion dollars.

The adoption and absorption of Artificial Intelligence is taking the pattern of an S-curve: we're now witnessing a slow start due to costs and investment associated with learning and deploying these technologies but, in the near feature, the pace of adoption will accelerate thanks to the cumulative effect of competition and to the complementary capabilities emerging alongside process innovations. The main issues that might hinder AI's rapid adoption and absorption are the following: whether people will be able to work alongside robots and how quickly organizations can redefine business processes in order to reap the benefits. Early movers' benefits will build up in later years and will be ahead of the curve at the expense of firms that are investing little or nothing in AI technologies. Countries like China that have a strong economic plan and infrastructure for AI development are likely to reap economic benefits. Those companies and countries that are not able to, or that choose not to invest in AI and ML may have difficulties catching up the ones that are investing. As a consequence, current disparities between companies and nations are likely to be further deepened. For what concerns AI-driven productivity growth, companies and institutions must take into account several factors, including labor automation, innovation, and new competition. Micro factors, such as the pace of adoption of AI, and macro factors, such as the global connectedness or labor-market structure of a country, both contribute to the size of the impact.

CHAPTER 3 - The Role of Data and Artificial Intelligence in Manufacturing Industry

As we have seen in the previous chapters of this thesis, data is one of the most important resources of the fourth industrial revolution and there is a generally acknowledged understanding that knowing how to properly use it can provide a competitive advantage. Nowadays it's no longer a question of whether enterprises should engage with data and big data, but how.

In the first part of this chapter we'll analyze how firms in the manufacturing industry generate data and big data and how they can extract an economic value from them. We'll see then how Italian firms are coping with the larger and larger amount of data produced having a special focus on small and medium enterprises.

We'll then proceed with studying the usage of AI and ML inside manufacturing companies always with special attention to the Italian context in general and the state of art of SMEs.

In the third part of this chapter we'll show the findings resulting from a qualitative research conducted by the undersigned on the adoption of I4.0's technologies by some Italian manufacturing companies. One of the aims of this research was to investigate how Italian manufacturing SMEs are coping with the advent of the Big Data phenomenon and whether and how they're preparing for the adoption of AI and ML inside their plants.

3.1 Data and Big Data inside Manufacturing Firms

The Industry 4.0 phenomenon made the ordinary manufacturing factories, including also small and medium enterprises, turn into the so-called "smart factories" through the productive digitalization. In fact, a smart factory is a company that transformed its internal ecosystem towards automatization and Artificial Intelligence, opening their plants' doors to robotized machines operating autonomously and interacting with their surroundings. This is made possible thanks to the Cyber-Physical Systems (CPS), information systems that mean that make machinery communicate and operate in close contact with the "real" world. IoT objects and Big Data are two of the key elements of Industry 4.0 that are interconnected between them and strongly linked to CPS. The convergence between the physical world and the virtual world (i.e. Internet), called Cyber-Physical Convergence, foresees the interaction among smart objects and human beings that takes place in the cyberspace thanks to sensors and mobile devices that produce a vast amount of data. Productive plants are increasingly

introducing IoT features in their machines and this implementation allows companies to keep real-time track of all their business processes and to gather data and use it for multiple uses.

3.1.1 Big Data and its sources and uses in the Manufacturing Industry

Manufacturing companies are getting more and more complex manufacturing processes. Many industrial machinery and products are equipped with software and sensors and data produced inside manufacturing firms is consequently increasing. Data is not only produced within the walls of the productive plant but there is also a matter of data produced externally along the whole supply chain of these companies. Data produced and made available to these companies is so vast that it's no longer a matter of data, but rather it's a matter of Big Data.

As we have seen in the second chapter, we can identify three primary sources of Big Data:

1. *Social Data:* data coming from social networks or from the public web and search engines.

2. *Transactional data:* data generated from all the daily transactions taking place both online and offline. Data coming from outside partners, vendors or customers

3. *Machine Data:* data generated from other software machines such as assets through the integration of software and sensors into manufacturing machinery

Manufacturers use multiple manufacturing software within their company like the Enterprise Resource Planning (ERP), the Manufacturing Execution Systems (MES) and Computerized Maintenance Management Systems (CMMS). Each of the abovementioned software produces a large amount of data and they're often not well integrated and it is difficult to get a big picture of how a factory floor is running.

Firms are producing more and more data and the ones that implement big data analytics methods have an important key resource to get competitive advantages and benefits. Within the manufacturing industry big data analytics can improve manufacturing processes, customize product design, ensure better quality assurance, manage better the supply chain and evaluate for any potential risk. The larger and larger amount of sensors integrated into the products and their internet connection enables product owners to monitor the status of these products from afar, creating the possibility for introducing concepts such as predictive maintenance, predictive quality and other supply chain applications.

The whole manufacturing supply chain can be optimized, according to the laboratory "Research & Innovation for Smart Enterprises" (RISE) of University of Brescia (Bacchetti et al., 2017), mainly with respect to the following four categories:

1. *Quality:* Big Data analytics allow the development of product with augmented functionalities, with excellent performances and with aesthetic improvements. There is also the possibility to have a greater customization thanks to the information given by the integration of the Customer Relationship Management (CRM) software o the Sales and Marketing departments within the IT architecture of the productive pant. The increased personalization along with the other general product improvements allows the manufacturer to differentiate from its competitors and to beat them to the target market.

2. *Time:* having an integrated system to assess the real-time status of development of the products and the health of the machinery allow manufacturers to synchronize production lows with the logistic flows thus reducing transportation and delivery timing. An advanced utilization of data concerning the diverse phases of the business processes can also lead to the reduction of the time-to-market and the time-to-develop.

3. *Costs:* in the Smart Manufacturing ecosystem the manufacturing firms can control their costs using smart technologies that allow them to optimize raw materials, reducing the production waste and increasing the efficiency of energy consumption.

4. *Flexibility:* having a solid database on the dynamic of customers' behaviors allow manufacturers to personalize the production according to customers' taste and to adjust the volume of the production accordingly. A more accurate forward planning represents a relevant competitive advantage. This can be reached by having many homogenous and aggregated data and, therefore, reducing the errors related to the production planning.

Capgemini (2018) finds also four different main advantages brought to manufacturing industry by Big Data.

1. *Optimize production and enhance efficiency:* as we have seen before, manufacturing plants that have adopted Internet of Things technologies adding connected assets and sensors enable manufacturer to have access to machine logs containing data on asset

performance. Data analytics can be used to capture, refine and analyze machine data and information with the aim of improving performance while reducing costs.

2. *Predict machine failure and reduce downtime:* the manufacturing industry relies mainly on the machines detained by the companies belonging to this sector and any problems or enhancement affecting them should be prioritized by such companies. Forbes (Columbus, 2016) reports that Big Data Analytics can reduce unforeseen downtime by 23 percent and breakdowns by up to 26 percent.

3. *Optimize the supply chain:* supply chain has developed quickly and data produced along the whole chain has become massive and a challenge for companies that want to organize them. Data produced by the supply chain is coming from the ERP systems within the enterprise, orders and shipments, RFID and recorders and mobile devices. Companies adopting Big Data Analytics can leverage such data to get an overall examination of the customer and predict their needs and preferences, thus giving them a more personalized experience. Big Data Analytics benefit the whole supply chain, from supply network planning to procurement to end to end execution of the supply chain.

4. *Enhance product quality and cut manufacturing cost*: sensors and big data analytics allow manufacturers to control better the quality of their products and reduce the costs related to the quality tests. Having sensors inside the machines allows manufacturers to control power, water, air and other resources required for the machine to run. Industrial manufacturers also have the opportunity to use these vast data resources to control costs, optimize consumption of resources and manage sustainability efforts.

Data can be used to make thoughtful managerial decisions while controlling manufacturing costs. Big data allows organizations to better understand the constantly changing market conditions. Analyzing what people are purchasing helps companies plan ahead and produce what its customers want.

Big data software can help companies improve their processes and customer service. This increased effectiveness can have a big impact on reducing cost. The high speed at which Big Data Analytics tools operate allows businesses to make quick decisions. The big data statistics show that Big Data Analytics increase both employees' personal productivity and the effectiveness of operations in larger structures within companies.

Data analytics systems allow also manufacturer to handle their business intelligence needs ensuring faster operation speed and lower costs aiming to facilitate a built-in scalable query mechanisms enabling to run individual workloads. Another goal for Big Data Analytics is price optimization: analysis can provide companies with insight about the best pricing method and allow companies to build predictive models for dynamic pricing according to the ever-changing circumstances.

The use of Big Data Analytics appears as a development lever that supports important phenomena such as Industry 4.0, Digital Banking, Smart retail, or to support compliance processes such as GDPR and, in the case of banks, like all the obligations of the Open banking related to PSD2 regulation. All with the aim of identifying new forms of data-based value generation also in terms of Data Monetization.

Among the phenomena that characterize this sector there are also the so-called "fast data" where the requests for data analysis are in real time. This is a topic that must be read in relation to the developments of the Internet of Things in particular, or in relation to needs and needs that also pertain to new phenomena such as predictive maintenance and new product development in the context of Industry 4.0, such as real-time advertising in Internet Media or as fraud detection in Risk Management.

3.1.2 Italian State of Art of Big Data and Big Data Analytics in the Manufacturing Industry

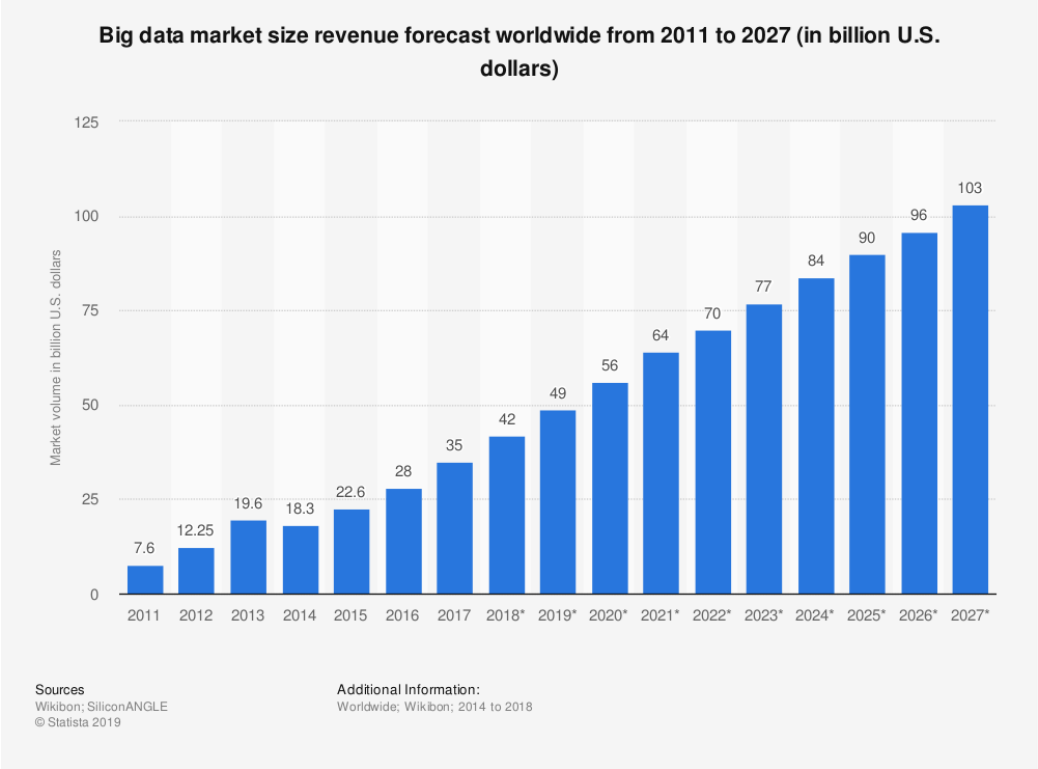

Fig. 3.1 Big Data market size revenue forecast worldwide from 2011 to 2027 (in billion U.S. dollars)
Source: Statista, data from Wikibon, SiliconANGLE
https://www.statista.com/statistics/254266/global-big-data-market-forecast/

As we can see from fig. 3.1, the Big Data market is expected to experience an exponential growth in terms of market size revenue. How is Italy placed inside this vibrant market? In this section we'll analyze the state of art of the Italian Big Data Market, focusing on the status of the complex ecosystem of small and medium enterprises present on the Italian soil.

According to the "Osservatorio Big Data Analytics & Business Intelligence" of the Management School of Milan Polytechnics[19], the Italian Big Data Analytics market has reached in 2019 the value of 1.7 billion euros, with a growth rate of 23% of 2018 and has doubled the market value of 2015 which was worth 790 million euros. The market is mainly driven by software, weighting 47% of the total value, aimed at finding solutions for the visualization and analysis of data but including also data ingestion tools, integration,

[19]https://www.osservatori.net/it_it/osservatori/comunicati-stampa/mercato-big-data-analytics-italia-valore-trend-comunicato

preparation and governance. Software personalization, integration with business systems and consultancy for process redesign constitute 33% of the expenditure. 20% of investments are dedicated to infrastructure resources, the systems to enable Analytics and provide computing and storage capacity to business systems, first of all the cloud. For what concerns the sectors of application the banks are the first in place for market share with 28% of the expenditure, followed by manufacturing (24%), telco and media (14%), services, retail (8%), insurance (6%), utility (6%) and public administration and healthcare (5%).

Almost every big company (according to the Observatory 93% of the total number of big companies) is investing in Big Data Analytics. The big Italian companies are investing especially in data analysis projects, in infrastructures to increase the level of data integration and in actions to improve its quality. As regards the Italian small and medium enterprises, only 62% of them are investing in Big Data Analytics. They are focusing mainly on the integration of internal data among all the platforms adopted, in training for the management of internal data, in the integration of data from external sources and are increasingly investing in solutions for predictive analysis. SMEs have focused above all on optimizing the supply chain, in manufacturing and in the analysis of competition and marketing. As reported by figure 3.2, according to the Observatory "Big Data & Business Analytics" of the Polytechnic of Milan, many SMEs are still not investing in Big Data Analytics (38%). For what concerns the companies that have already undertaken the road towards Big Data Analytics: few of them are still working on the enabling phase of these technologies (4%), some (18%) are investing in descriptive analysis and many of them (40%) are adopting also predictive analysis methods.

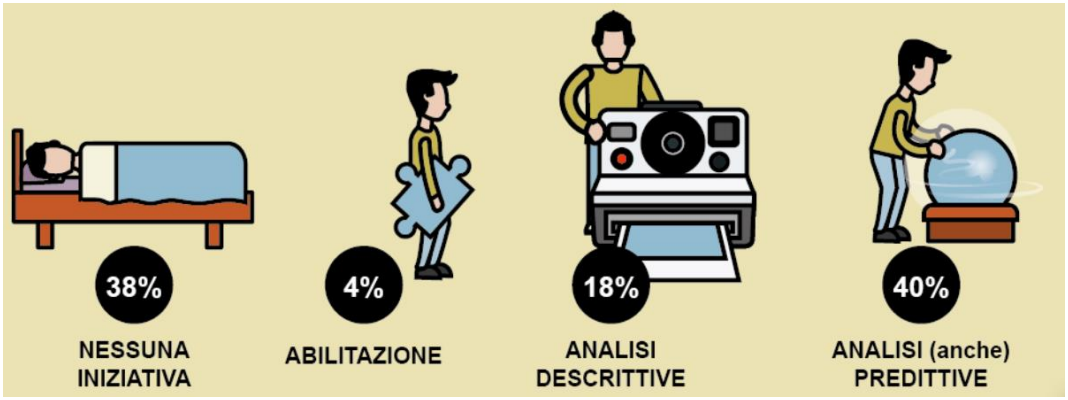

Fig. 3.2. Kinds of Big Data Analytics adopted by Italian SMEs (sample: 518 SMEs)
Source: "Strategic Data Science: Time to Grow Up!" Big Data & Business Analytics Observatory https://www.osservatori.net/it_it/pubblicazioni/strategic-data-science-time-to-grow-up-infografica

This gap between big and SM enterprises can be mainly attributed to the lack of specific competences and organizational and structural deficiencies. SMEs are a step behind the bigger companies because they lack the capabilities related to professional roles specifically related to the Big Data phenomenon such as Data Analysts and Data Scientists. A way to get around this issue could be to rely mainly on external partners for the implementation of Big Data related projects but, unfortunately, the Italian labor market seems to be not yet prepared to make up for these needs.

3.2 AI and ML in Manufacturing Industry

Today, while increasingly recognizing the potential of AI, most organizations are in the early stages of implementing and committing to this largely unexplored technology. Even those with the most advanced technologies in place are still working out how to use it. In this section we'll focus mainly on the AI and ML and how they could be useful inside the manufacturing companies.

As we have seen in section 2.2.1, most of the data produced and gathered can be traced back to the unstructured classification. Unstructured data is hard to be processed with traditional programs and requires different approach. Machine Learning and Artificial Intelligence appear to be the only technique able to gain insights into such enormous and unexploited amount of unstructured data which were previously impossible to derive and to make it understandable and ready to be furtherly processed. It's important to understand that an AI solution is only as good as the data it receives. Hence, companies and leaders need to focus not just on quality of data at the time of implementation, but on the data quality processes that are built into their organization. Accordingly, data-related organizational roles such as data scientists and statistics are now more than ever important inside the firms.

As for any other investment, organizations should consider AI's benefits and costs before investing in this technology. In fact, investing in AI means investing significant time, money and effort and the will and the reasons behind the adoption of this technology must be fully understood at any organizational level. AI is not about blindly putting in place technology that replaces human labor. It is rather about adding value and efficiency to operations by creating smoother, faster or more accurate processes. The costs related with the adoption of AI are not only linked with the mere cost of the technology but they should also include those hidden costs such as the skills that will need to be developed (not only by the IT staff but also by the blue-collars workers), the organizational changes that may be required and also potential changes of the business models that the company have currently in use.

There is a saying for what concerns the adoption of any kind IT inside the firms: “IT plus an old organization is an expensive old organization”[20]. In fact, in order to successfully implement AI technology, companies need to adopt a holistic approach. Manufacturers that want to undertake the AI road inside their firms need to integrate these new technologies in every business processes, products and services. Other than worrying about equipping themselves with the technological infrastructure they should also focus on creating an innovative culture based on data literacy and best practices, trying to align the capacities of new technologies with the needs of the core business.

Besides the difficulties linked with its implementation, AI can bring many benefits when adopted inside the companies in a rational way. In the next section we will briefly discuss how the manufacturing industry can benefit from the adoption of Artificial Intelligence technologies.

3.2.1 Artificial Intelligence in the Manufacturing Industry

With the support of IoT and Big Data, the manufacturing industry can gain several benefits from the adoption of Artificial Intelligence technologies inside the firms. First of all they can reduce mindless and repetitive tasks and increase the productive capacity of the human workforce. Thanks to the insights they can get from Big Data, managers can take better business decisions in all areas, from logistics to budgeting. Artificial intelligence is not synonymous with complexity but it mainly means optimizing and making more efficient the value chain, acquiring the possibility of having timely suggestions from your data that can potentially lead to new sales strategies, production, customer support, etc.

We’ll now analyze some of the potential uses of AI inside the manufacturing firms.

- *Predictive maintenance:* production equipment needs maintenance services which are often scheduled in advance regardless from the real conditions of the equipment. Studies show that unplanned downtime costs industrial manufacturers an estimated $50 billion annually, and that asset failure is the cause of 42 percent of this unplanned downtime[21]. This type of intervention implies unnecessary stops and the risk of damaged workings. Once having retrofitted the machines through the installation of sensors and connection with the plant’s network infrastructure, the device and systems

[20] https://knowledge.insead.edu/blog/insead-blog/preparing-your-firm-for-ai-12581

[21] https://partners.wsj.com/emerson/unlocking-performance/how-manufacturers-can-achieve-top-quartile-performance/

can be tested and monitored for specific stressful situations and operation through the modeling of the so-called "digital twin" of the aforesaid machine which aims at predicting its behavior during its whole lifecycle. The company can shift from a preventive maintenance system (which envisages prescheduled and periodic operations) to personalized maintenance operation on a single piece of equipment, reducing useless and time-wasting interventions and the stops due to early degeneration of some devices. Predictive maintenance is one of the most used Artificial Intelligence applications in the industrial sector and it is based on algorithms and on machine learning. The AI system identifies behavioral patterns of the machines through the analysis of Big Data gathered through IoT and sensors.

- *Automated Quality Control:* having a fast feedback system allow companies to deal more effectively with unexpected stops, unusual low productivity and abnormal low quality level. Quality control is a key issue when dealing with customized production or products with a high technological complexity feature. Quality and productivity seems to be opposite targets: the faster the production (and, hence, the higher the productivity) the less accurate and the lower quality is the production itself. One way to get around this polarized targets issues is to use computer vision algorithms (algorithms that teach a computer to make meaning of the physical world through vision, including methods for acquiring, processing, analyzing and understanding digital images in order to produce information and take decisions) to monitor high-speed production lines and identifying any defects as soon as possible thus granting a faster, more flexible and more effective control system. An even more advanced method to make automated quality control foresees the usage of Artificial Intelligence technologies in order to analyze data gathered from PLC (Programmable Logic Controller) and SCADA (Supervisory Control And Data Acquisition) systems and acquired on the production line via sensors (not only images as in computer vision systems, but also exploiting temperature, humidity, pressure sensors). AI aims at identifying the patterns that lead to defects in the production and use them to activate alarms on the production line in order to act preemptively.

- *Adaptive manufacturing*: nowadays robots installed inside the manufacturing are efficiently performing complex tasks inside the assembly lines, but they often are programmed to perform one single duty and reprogramming, if possible, has a very high cost. The first adaptive collaborative robots are still being developed and they should be equipped with an AI, enabling them to learn different tasks through learning

by demonstration, and expanded flexible hardware able to adapt to the dynamism and variability of the activities. In order to implement such technologies, the productive plants should have an integrated and monitored supply chain, R&D department, productive plant and quality control through an AI system supervising and analyzing the whole productive process. It should be therefore necessary to revise the company's physical infrastructures and make them more flexible and independent in order to actually benefit from AI. AI provides the brain, and robotics provides the brawn. Thanks to new developments in technology in both areas, there is increased ability to develop robots that can perform tasks that were impossible just a few years ago. These new robots are no longer limited to repetitive tasks. Instead, they can move throughout warehouses and production lines interacting with and collaborating with people.

- *Demand-driven production*: the ability to connect apps and consumer IoT in real-time with companies' demand management systems would drastically reduce profit losses resulting from overstatement or underestimation of product requests.

3.2.2 Italian manufacturing SMEs and the adoption of Artificial Intelligence

According to the Observatory "Artificial Intelligence" of the Polytechnic of Milan[22], the AI market (including hardware, software and services related to AI and with exclusion of drones, intelligent robots, smartphones and smart home speakers) was worth 85 million euros in 2018.

Currently only 12% of companies have brought at least one artificial intelligence project up to speed, while almost one in two has not yet moved but is about to do so (8% is in the implementation phase, 31% has ongoing pilot projects, 21% have allocated the budget). Among those who have already implemented a project, 68% are satisfied with the results and the most common are those of Virtual Assistant / Chatbot. Depending on the level of dissemination and expected introduction achieved, it is possible to identify as "emerging" - with good current diffusion and further expected future adoption - the solutions of Language Processing, Demand Forecast, Predictive Maintenance, Image Processing, Fraud Detection, Recommendation and finally Virtual Assistant / Chatbot, which stands out in both dimensions. The solutions of Intelligent RPA and Pattern Discovery are "mature" - good

[22] https://www.osservatori.net/it_it/osservatori/comunicati-stampa/intelligenza-artificiale-un-mercato-con-grandi-prospettive

diffusion, but with a lower expected adoption. The solutions of Churn Prediction, Dynamic Pricing, Autonomous Robot, Intelligent Object, Content Design and Autonomous Vehicle are still "unknown".

Among those who already have AI projects in progress, 50% of companies have the objective of improving process efficiency, i.e. reducing costs, 37% increasing revenues and 13% developing solutions for decision support. Only 4% of the projects did not achieve the objectives, while 68% say that the initiatives have achieved the desired result and, of these, half call it "very successful" or "disruptive". The remaining 28% are not yet able to make a judgment

3.3 Qualitative analysis on the road of SMEs towards Artificial Intelligence

In order to investigate the Italian state of art for what concerns the adoption of the technologies we have formerly deepened, we have interviewed three companies that are somehow facing topics such as Big Data and Artificial Intelligence. This Qualitative Research was carried out by the undersigned under the supervision of the Professor Bettiol from the Department of Economic and Business Sciences "Marco Fanno" of the University of Padua.

I first contacted some companies belonging to the category of Champion companies (500 Italian companies with a turnover between 20 and 120 million that didn’t succumb to the crisis that took place between 2010 and 2016, but, instead, have had a positive growth both in terms of turnover and in employment) by e-mail, explaining the aim of this thesis and sending them the request to collaborate for this empirical part. The targeted companies were previously interviewed for a research made by the Department of Economic and Business Sciences of the University of Padua through the Digital Manufacturing Laboratory with the collaboration of ItalyPost. In this research these companies have declared that they were using technologies associated with Big Data and IoT. Among all the firms contacted, only the following three made themselves available for an in-depth interview:

- *IMAL SRL:* a manufacturing company based in Modena that produces machines for the manufacturing of woodfibre manufactures.

- *Tecnau SRL:* manufacturing company based in Ivrea (TO) producing industrial machinery for finishing digital printing.

- *Cromaplast S.p.A:* manufacturing company based in Valdagno (VI) making plastic molding and chromium plating

IMAL SRL was interviewed through a telephone call with Mr. Lauro Zoffoli, Management Director of the company. Tecnau was reached through a Skype call with Mr. Salvatore Caronia (Project Engineer), Mr. Maurizio Gianetto (Marketing Manager) and Ms. Giada Grimaldi (Software Engineer). The interview with Cromaplast S.p.A. was taken on site with the CEO Raffaella Culpo. I realized, under the supervision of the Professor Bettiol, a general questionnaire with the aim of having a guideline to follow during the conversation with the interviewed. The key points of the questionnaire (which script can be consulted in the Appendix A) are:

1. Brief description of the activity of the company, its products and its reference market. .
2. Technologies of the Industry 4.0 adopted by the company.
3. Reasons why the company decided to invest in Industry 4.0.
4. Results achieved through the adoption of I4.0 technologies.
5. Organizational changes related to the adoption of the abovementioned technologies.
6. Importance of internal skills and competences for the introduction of Industry 4.0 inside the company.
7. How the firm manages innovation.
8. How the Industry 4.0 have impacted the supply chain.
9. Importance of previous investment in the ICT for the adoption of Industry 4.0.
10. Whether the Industry 4.0 has changed the company's business models.
11. Whether the company has applied for regional and/or governmental incentives.
12. How the company manages data gathered thanks to the IoT and how IoT is changing the company's business models.
13. Whether the increasingly amount of data is pushing towards the adoption of Artificial Intelligence technologies.

14. Whether the company knows the Competence Center.

3.3.1 Cromaplast S.p.A.

As reported in their website, Cromaplast S.p.A. is a company founded in 1967 and currently based in Valdagno (VI). In the latest years the company has witnessed an incredible growth in the last three years, doubling its employees and its plants. Nowadays Cromaplast counts 208 employees working on a covered surface area of 28.500 square meters. The company is involved in the automobile market and its main processes are:

- *Injection molding:* the modern and well-equipped (14 injection presses) molding department is dedicated to the production of automotive parts that subsequently are galvanically treated (chromium plating). Furthermore, the company can count on a reliable network of subcontractors for other types of injection molding such as multi-component and vertical press molding.
- *Galvanic treatments:* it represents the real core of the company and it is composed of two lines that are completely automated and monitored by a PC. One line is totally devoted to the manufacturing of medium-small parts, with polished finish and micro-cracked chrome plating technology. The second line is specific for the manufacturing of large sized parts, with both micro-porous and micro-cracked chrome plating technology, in both polished and glossed aesthetic finishes. The standard of their processing includes aesthetic monitoring of the parts after chrome plating.
- *Assembly of automotive parts:* assembly of chromed and non-chromed parts in order to optimize costs and logistics of its customers by the supply of a controlled finished product without imperfections. This processing covers simple assembly to complex adhesive processing using mono-adhesives and bi-adhesives.

The company offers services like co-design and industrialization of the product, construction of the injection molds and metrological analysis (for the dimensional measurements of its

products; the constructed molds are then objectively certified by measuring the pieces produced. The clippings, deformations and tolerances of the pieces are also verified and analyzed).

The Qualitative Research concerning Cromaplast has been done through an interview and discussion taken on-site with Ms. Raffaella Culpo, CEO of the company from 2016 (entire interview is visible in Appendix B). Cromaplast has always been a company that has always welcomed and looked for innovation. Consequently, despite the economic crisis, the company has witnessed an incredible growth in terms of plants and workers in the last few years which has led Cromaplast to "have a huge set of information to be shared but also to be read in a single way in order to avoid confusion". This manufacturing firm has always been on the cusp of innovation and updated technological equipment (Wi-Fi, tablets and pc) has always been a priority for the management board. The introduction of technological tools such as pc and tablet in all machines and in all procedures allowed the company to treat the data in a unique way, to have access anywhere to the same information and to make a thorough analysis of the whole productive process. The non-talking machines were equipped with software enabling them to "talk" with the whole company's network and to be monitored and controlled remotely.

Data is a key resource for Cromaplast and its management and protection are relevant issues for the company. The company uses two servers where they store backups every fifteen minutes and the external partners supply the IT infrastructure to manage data while the data itself belongs to Cromaplast. Twice a year the firm runs a simulation of a cyber-attack in order to verify that the security measures for data protection are running and well developed.

With the introduction of Industry 4.0, Cromaplast had to hire an internal IT manager specialized also in 4.0 themes and it also impacted the relationship with external collaborators: the company had to change its IT partners towards external collaborators specialized in cyber-security and integration among software. Regarding the latter, the company has pledged, in collaboration with its IT partner, to reduce the number of software adopted and the linked customizations. Cromaplast's CEO says that "customizations must be limited to that percentage that I need in order to collect that information that I cannot extract from something that I already have. The more customized I am, the more I become the victim and hostage of my IT supplier." The company shifted from having a lot of software to detain only three software: an ERP, management manufacturing software integrated with the main ERP and design software. The reduction of the set of software in use by Cromaplast has led to

a significant expense due to compatibility and transferability issues linked to the transition of data from one software to another. In order to prevent as much as possible aforesaid issues, Cromaplast and its IT partner created a “digital twin” of the company which has been made run for several months simulating the change of partners and the relative software bundling and in which they prevented and solved potential errors before the actual shift to the new set of software adopted by the company itself.

The digitalization process was internally pushed rather than externally pulled by Cromaplast’s clients. Industry 4.0 was introduced in this company in order to reduce the number of claims related to product defects issued by Cromaplast’s clients and, as a consequence, to build a better customer loyalty and retention. The other reason behind the digitalization of the company was to follow the single item along its whole productive process, from its genesis to the shipment. There was the need of identifying the singles cost item, as Ms. Culpo said during the interview “if you do not know where the costs are generated in the company, you can only do two things: you either close down the company or you cut people’s heads to reduce costs. Since neither of the two options, in my opinion, in the long run, leads to really efficient and effective solutions, it was necessary to understand what happens within the process”. Industry 4.0 was undertaken in order “to be more competitive. Not being the fastest, because not always speed means quality. But certainly to make efficiencies.”

Having access to Big Data Analysis tools enable the company and those who are in the quality and selection department to have access to details related to individual lots and pieces thus enabling them to identifying bottlenecks and critical points in the production process. This resulted in the introduction of the so-called “talking warehouse” which foresees the introduction of technology, sensors and devices inside the warehouses in order to simplify and optimize the logistical management of the company. The identification of the single items was made possible through a codification system based on barcodes able to identify the real-time status of each item. This “talking warehouse” needed changes both in the warehouse operators’ training (internal training course managed by the IT manager) and in the warehouse infrastructures. In fact, the plants had to equip themselves with barcode readers and the connection to an intranet network.

Having mapped the whole productive process allowed Cromaplast to “transform information into value”: identify what each workspace does and its respective energy expenditure and enable Cromaplast to make efficiencies. It also helps the pricing process: thanks to the identification of the items, the company can get information about the raw material and the

equipment needed, timings of production, treatments and selection, energy expenditure, delivery methods and timings. The connection of the machinery and the items to an intranet network allows the company to control the rate of production rejects and the optimization of raw material required by the productive process.

The combination of I4.0 technologies implemented inside the plants allowed Cromaplast to improve the managerial control of the productive process. Big Data Analytical tools allowed the company to implement a better management of the warehouse, from the optimization of raw materials to the emergency supplies, and to simplify the communication among the thirteen warehouses scattered all over the world. Digitalization influenced also the relationship with external suppliers: "external suppliers who do activities for us, such as selection activities, have been trained by us, they work solely for us; they are organized internally as our plants". Cromaplast suppliers undergo an assessment before becoming suppliers, in terms of digital skills, of ethic and of business organization methods. As Ms. Culpo says "In my world, it is more essential to have certain certifications, and therefore having an organizational model that goes in a certain direction, rather than being too technologically advanced but not being able to respond on a portal". Even though 4.0 capabilities are not fundamental in the suppliers choice, having an identification system and being able to control also the suppliers' actions remotely allow Cromaplast to attribute responsibilities to the single external collaborator.

Industry 4.0 allowed the company to reduce the costs related to the quality test: having a real-time access to the information of each item can reduce the needs of randomized quality test thus allowing a higher quality level and the adaptation to regulatory changes of the industrial sector.

The technological equipment allows managers to have knowledge of the processes and operators' timings and their subsequent needs including possible improvements in operators' training. Ms. Culpo thinks that the I4.0 technologies will never substitute human resources. For instance she says that "our pieces, according to the target market, for example, cannot be selected by robots, lasers or optical scanners, but must still be selected by a human". Human resources have a key role inside the 4.0 companies nonetheless the widespread belief of the threatening of computers substituting human capital inside the firms. In fact, as reported by Ms. Culpo, companies can't buy the "4.0 technologies bundle" without worrying about the implementation and acknowledgment of the human resources. Implementing 4.0 activities without updating human resources can be more hurtful than helpful and the managing board

should invest in the schooling and training of its human capital. Cromaplast has trained every operator to use the new technological equipment and has elected some people in order to supervise and solve any problems arising from the misuse or misunderstanding of the aforesaid technological equipment. The preliminary phases of Industry 4.0 implementation inside the companies should focus primarily on the HR because, ad Ms. Culpo says, “the personnel management process of making everyone aware and unified with respect to what is the final result is not as fast as it may seem. There’s a much finer activity that needs to be done internally”. Indeed Cromaplast organize updating course for its workers twice a year.

To the present day, the adoption of 4.0 technologies has not yet positively impacted Cromaplast’s turnover since the expenditure related to the update and the adoption of the infrastructures and skills required by the digitalization process are very high. However, the company has received very positive feedbacks from its clients because they can get detailed information about each item and batch. Industry 4.0 allowed Cromaplast to shorten the hierarchical pyramid ascribing responsibilities and assigning competences to managers and to allocate human resources in a more rational manner. I4.0 made the management more aware of how the process is developed, its activities, its criticalities and its cost centers.

Cromaplast is thinking of adopting Artificial Intelligence inside their plants but in due course. It’s working on the predictive maintenance and has trained 3 people on this topic and hired an IT expert in charge of managing in this sense all the machines detained inside the company and responsible for potential audit on the status of the technological apparatus.

3.3.2 IMAL S.R.L.

IMAL SRL is a company located in Modena belonging to the IMAL- PAL Group producing machines for production of wood fiber artifacts. IMAL counts around 120 employees equally divided in two main areas of expertise: a technical, plant and mechanical office and a technical, electronic, electrical and software office.

The Qualitative Research concerning IMAL SRL has been done through a telephonic interview and discussion with Mr. Lauro Zoffoli, Management Director of the company. As reported in the interview (the complete transcription is visible in Appendix C), IMAL is still at the embryonic stage of implementation of the Industry 4.0, the project 4.0 started in January 2019 and is not yet fully implemented. The IoT and cloud technologies adopted by IMAL are implemented solely on four of the testing and monitoring machines detained by the company. The final stage of this project is coming with the adoption of a new ERP software that will allow IMAL to manage the production process in a digital way.

IMAL decided to invest in Industry 4.0 in order to control in greater detail the quality of the process and to manage and control remotely the machines produced by IMAL and installed and used by the customer. Mr. Zoffoli says that "we have an electronic department within a service consisting of about ten people who intervene when a customer's machine stops working.". Therefore, I4.0 was used by IMAL in its servitization process in order to give a more complex and complete service to its customers.

The company has had some issues related with the training of its employees when they had to insert tools such as sensors and optical reading systems in some of their machines. For what concerns the network of suppliers they're not selected on the basis of technological knowledge. As Mr. Zoffoli says "We're not we try to change our suppliers, we try to make them (the current suppliers) grow, to get used to technologies such as cloud management of the orders".

The IoT features of the newest machines produced by IMAL and installed at the customers' plants allow the company to gather a huge amount of data which is managed internally or externally according to the customer's will. The customers that allow IMAL to have access to data produced by the IoT let the company understand better how the machine works, what are the main problems and how to prevent damages. Hence, data gathered is mainly used in order to give preventive maintenance as a service to IMAL's customers.

3.3.3 TECNAU S.R.L.

The Qualitative Research concerning Tecnau SRL has been done through a telephonic interview and discussion with Mr. Salvatore Caronia (Project Engineer), Mr. Maurizio Gianetto (Marketing Manager) and Ms. Giada Grimaldi (Software Engineer). The transcription of the interview can be found in Appendix D.

Tecnau SRL is a multinational company based in Ivrea (TO). The company has about 50 distributors and six operational sites across the globe: three production sites (Italy, United States, Sweden), two training and service centers (Belgium, Singapore) and one sales center in China (Shanghai). Tecnau engineers, manufactures and sells machines and solutions for digital printing finishing. The company produces the so-called unwinding machines and those machines that are used to cut, accumulate paper and make finished or semi-finished products of the cycle of paper-based production. With its 30-year-old company history, Tecnau has witnessed a strong and rapid growth: in 1998 Tecnau was a local company composed of 18 people; in 2013 it became a multinational enterprise acquiring a company in Sweden and a company in USA and turning them into external production sites. Nowadays the company can count on around 300 employees dislocated among the six abovementioned operational sites.

Two of the most important I4.0 projects on which Tecnau is currently working on are Data gathering and a preventive maintenance project that will hopefully lead to predictive maintenance. The company is collecting data coming from their machines and, with the preventive maintenance project, is giving “a useful life to the pieces that make up our machine and advise the customer to change a certain piece every certain time”. The technicians and the customers can save these maintenance operations and their details on a database thanks to the software embedded in the machines thus being “able to give increasingly targeted and more appropriate advice” to the customers. Tecnau is currently investing in a big on-going project involving the predictive maintenance: the desired results would be that “the machine itself that, through the control of parameters (which can be frequency, temperature, sound, et cetera, et cetera), indicates itself, through the use of software, the problem that it is facing and finds the best solution to that specific problem”.

The final aim of these Big Data Analytics and the implementation of AI in the near future is to give a better customer service.

The company strongly believes in innovation: according to Mr. Gianetto, the company invests more than 23% of its turnover in R&D in order to innovate. Tecnau decided to adopt I4.0 in order to respond to the changes of the target market. In fact, the traditional market of paper and digital printing is a decreasing and fewer and fewer quantities and batches are being produced. On the other hand, the digital printing market is shifting towards the sector of variable-format printing. Nonetheless the depressed market, which has reached peaks of up to -20%, Tecnau has registered a growth rate of 10-12% per year. "It is important to analyze the data when you have highly variable productions" says Mr. Gianetto. Data analyses allow the customer to optimize those processes allowing it to maintain a higher performance through a better organization of the orders' agenda and the optimization of the usage of the machines. Mr. Gianetto says "the more data we can collect and, above all, organize, the more, especially in the variability of the product, we remain competitive in the market." Being able to supply flexible machines to the customers allow Tecnau to remain the market leader of its sector but also helping its customer to reduce costs and slowdowns while optimizing their productive processes.

Mr. Caronia and Ms. Grimaldi think that informatics skills are important for the adoption of 4.0 technologies, not only from the point of view of software infrastructure endowments but also from the point of view of a data-driven culture. As Ms. Grimaldi says, "Industry 4.0 should be seen not only as a tool, as a software infrastructure, which, however, unfortunately, it has to be said, is a bit at the base of everything. But in reality the user base it gathers is the whole company." In order to make the best from the aforesaid projects, there is the need to get the information and the knowledge from every department: from technicians working directly on the field and giving instant feedbacks, to the mechanics' department which know the machines better than anyone else and to the customers themselves who should allow Tecnau to gather and use data coming from machines installed inside their plants.

The company has to manage a big amount of Data. Tecnau employs external partners to support them in the infrastructure while the software development is entirely produced internally. For what concerns data management they're not currently using cloud technologies, they rely on a series of physical machines. The company has three main servers: one in Italy, one in Sweden and one in America. The servers are connected to each other via VPN connection. Each site, as Mr. Gianetto states, has more or less 15/20 virtual machines

acting like real servers. The biggest part of data management is located in Italy because the whole IoT project is developed and managed there.

As we have just seen, human resources are still relevant inside Tecnau despite the introduction of Industry 4.0 technologies. Mr. Gianetto says that it's not right to say that "it's all automated and human work doesn't exist anymore. No, it does exist." In fact the company produces highly customized and flexible machines and, hence, for their production they have to work often closely with suppliers producing ad-hoc components. As a consequence, Tecnau is not changing their suppliers based on their predisposition to the Industry 4.0 but they try to remain attached to the supply chain they have created over time. This supply chain is made of local suppliers which are considered as an "extended family" able to help them during emergencies and providing them with components which are qualitatively superior because of the long-lasting business relationship.

Industry 4.0 has changed the way of doing services starting from the organization of the plants; in fact the American plant is almost entirely dedicated to service providing. Thanks to the IoT technologies implemented in their machines, Tecnau is able to maintain a daily contact with their customers and giving them direct and timely feedbacks after having analyzed the big amount of data they gather from the sensors. However services, as Mr. Caronia says, are "an added value that we have implemented over time. The core business is the sale of systems for production. Everything else […] is aimed to develop and optimize the machines that are produced and sold by use".

The introduction of Industry 4.0 technologies hasn't yet brought relevant effects on Tecnau's turnover, however it enabled them to achieve a high level of customer satisfaction: the customers have obtained a higher speed rate of the overall line and, in case of errors or malfunctions Tecnau can give the customers timey feedback and helping them to solve these issues remotely.

CONCLUSIONS

This thesis aimed at highlighting the economic value of data and showing how companies that try to make great use of it (through analysis and Machine Learning and Artificial Intelligence tools) can gain a competitive advantage towards their competitors and live a positive economical phase even if immersed in a depressed market.

From the first chapter of this dissertation we have learned that information has been an increasingly important resource that has pushed toward - and made happen - the four Industrial Revolutions. The fourth Industrial Revolution increased the interconnection among firms and a tighter relationship between producers and clients through the integration of internet into the productive machines and into the products (i.e. Internet of Things). Italian Government, acknowledged that its territory was pervaded by small and medium enterprises, decided to help abovementioned firms through a financial and incentive system that allowed them to keep up with bigger and more global-oriented firms.

In the second chapter we have seen that the world is producing more and more data thanks to smartphones, smart devices and fast internet connection. This has brought us to the so-called Big Data phenomenon, which means that, as we have seen in the first section of this chapter, each individual is currently producing more than 140 GB of data per day. Not only humans contribute to this phenomenon, in fact a large part of the total amount of data produced is generated from industrial equipment and sensors that are installed in machinery thanks to their connection to internet and intranet and thanks to the introduction of IoT on the plant floor. The economic value of Big Data stands in the capabilities of managing it and extracting information from it through the process of data analysis. However, most of the companies don't make great use of the data they produce or collect. This can be explained by the lack of skills and competences which are data-related inside these firms: in fact, Big Data requires the introduction of new organizational roles (such as Data Analysts and Data Scientists) in the company staff. Another reason for the underuse of Big Data could be that the majority of it is made of unstructured data which can be difficult to be managed. The solution to this problem is represented by Artificial Intelligence and Machine Learning.

In the third chapter we discussed more in detail how manufacturing companies produce and can make use from Big Data. What emerges from a comparison between SMEs and larger companies is that the first ones are still stuck at an early stage of Big Data implementation due to lack of specific competences and organizational and structural deficiencies. For what concerns Artificial Intelligence adoption inside the Italian manufacturing world, which is

strongly tied to the Big Data topic, we can say that it is still underdeveloped but has all the potentialities to provide great opportunities in order to improve the flexibility and personalization of industrial production.

Even though the rate of firms that have fully adopted IoT and AI technologies is still very low, what emerges from the Qualitative Analysis set out in the third chapter is that Italian Companies are slowly understanding the disruptive value of Data and Big Data and that they are taking some steps towards the adoption of Artificial Intelligence inside their plants.

Once Mr. Warren G. Bennis said: "*The factory of the future will have two employees: a human and a dog. The task of the human will be to feed the dog. The dog will have the task to dissuade the human to touch the automated systems.".* Despite the widespread fear of computers and technology substituting the human capital, it resulted, through the interviews with some Italian SMEs, that human labor is still the most important resource for factories. The key to success for a company wanting to implement the abovementioned technologies within their walls is to make an integrated and harmonious system from the human and the digital ones. To ensure the adoption of AI, companies need to educate everyone, from the top leaders down. Companies should train and entrust every worker that their role will be on one hand supportive and, on the other, supported by Big Data and Artificial Intelligence. Creating a data and technology-driven culture is fundamental for those companied who are willing to innovate and therefore survive and flourish in an increasingly competitive and global environment.

To sum up the road of Italian SMEs towards Artificial Intelligence it's still very long but those who are willing and committed to take it will get numerous benefits.

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APPENDIX

Appendix A: Questionnaire (English Version)

1. Could you briefly describe the activity of the enterprise, its products and the target market?
2. Could you please indicate which technologies of Industry 4.0 have already been adopted by your company?
3. What are your reasons for investing in Industry 4.0 technologies?
4. What results, if any, have you achieved from the use of Industry 4.0 technology?
5. Has the introduction of Industry 4.0 technologies led to internal organisational changes?
6. How important are internal competences for the adoption of technologies 4.0? Are they specific or general competences?
7. How is innovation handled within the enterprise? Is there a dedicated internal department or is it left to the creativity of individuals in the company? How much annually do you invest in innovation in terms of percentage of turnover? Which are your main innovation partners?
8. Has the introduction of Industry 4.0 technology led to changes in the management of relations with suppliers and the supply chain in general?
9. How past investments in ICT (management software, website, social media, ecommerce, digital infrastructure of the company, etc.) have proved important in exploiting the potential of Industry 4.0 technologies?
10. Investments in Industry 4.0 technologies have changed your business model?
11. Has your company used or intends to apply for government and/or other regional incentives?
12. How do you manage the data generated by IoT, if present (in the company or in the cloud, independently or relying on external companies)? How is it used? (for example to do maintenance, to improve the product) How is IoT modifying the business model of the company?

13. The production of big data within your company is pushing you towards the adoption of technologies related to Artificial Intelligence? If so, what technologies will you adopt and by when?
14. Are you aware of the competence Center formed by the north-eastern universities with the aim of spreading the 4.0 industry in small-medium enterprises through training activities and interaction laboratories enterprises/universities? What do you expect from this competence center?

Appendix A: Questionnaire (Italian Version)

1. Può descrivere brevemente l'attività dell'impresa, i suoi prodotti e il mercato di riferimento?
2. Potrebbe cortesemente indicare quali tecnologie dell'Industria 4.0 sono state adottate dalla sua azienda?
3. Quali sono le motivazioni che vi hanno spinto ad investire nella/e tecnologia/e Industria 4.0? (Ad esempio richiesta di un nuovo servizio/prodotto da parte di un cliente, essere più veloci sul mercato, curiosità, in seguito all'adozione di tali tecnologie da parte dei competitor)
4. Quali risultati, se raggiunti, avete ottenuto dall'utilizzo della/e tecnologia/e Industria 4.0? (In termini di fatturato, clientela, costi di produzione, velocità di consegna, time to market, innovazione di prodotto, nuovi servizi)
5. L'introduzione delle tecnologie Industria 4.0 ha comportato dei cambiamenti organizzativi interni? (Riorganizzazione dei processi produttivi, dei processi di marketing, nella gestione del personale)
6. Quanto sono importanti le competenze interne per l'adozione delle tecnologie 4.0? Sono competenze specifiche o generali?
7. Come viene gestita l'innovazione all'interno dell'impresa? C'è un reparto interno dedicato o è lasciata alla creatività dei singoli in azienda? Quanto investite annualmente in innovazione in termini di percentuale sul fatturato? Quali sono i vostri partner principali per l'innovazione?
8. L'introduzione delle tecnologie Industria 4.0 ha comportato cambiamenti nella gestione delle relazioni con i propri fornitori e con la filiera in generale?

9. In che modo gli investimenti pregressi in ICT (Software gestionale, sito web, social media, ecommerce, Infrastrutturazione digitale dell'azienda, ecc.) si sono rivelati importanti per sfruttare il potenziale delle tecnologie Industria 4.0?
10. Gli investimenti in tecnologie Industria 4.0 hanno modificato il vostro modello di business? (Ad esempio il passaggio dal vendere prodotti al vendere servizi legati ai prodotti)
11. L'azienda ha usufruito o perlomeno fatto richiesta degli incentivi governativi e/o di altri regionali, o intende richiederli?
12. Come gestite i dati generati dall'IoT, se presenti (in azienda o nel cloud, autonomamente o affidandovi ad aziende esterne)? Come vengono utilizzati? (ad esempio per fare manutenzione, per migliorare il prodotto) Come l'IoT sta modificando il business model dell'azienda?
13. La produzione di big data all'interno della vostra azienda vi sta spingendo verso l'adozione di tecnologie legate all'Intelligenza Artificiale? Se sì, quali tecnologie adotterete ed entro quando?
14. E' a conoscenza dell'esistenza Competence Center formato dalle università del nord-est con obiettivo di diffondere l'industria 4.0 nelle piccole-medie imprese attraverso attività formative e di laboratori di interazione imprese/università? Cosa si aspetta da tale Competence Center?

Appendix B: Interview with Cromaplast (English Version)

Firm: Cromaplast S.p.A.
Contact person: Dr. Raffaella Culpo (CEO)
Website: www.cromaplast.com
Business: Plastic molding and chromium plating
Location: Valdagno (VI)
4.0 technologies adopted: Robotics and Big Data

Raffaella Culpo: On the 4.0 topic, we are one of those companies that have made activities in the world 4.0, for sure. As far as the big data theme is concerned, we are a little behind because, in reality, it is not something that you buy and then do not use if you do not have to extract a series of useful and indispensable information. Also because this is a company that, despite having 50 years of history, has grown a lot in the last 3 years because it has more than doubled the number of people, it has doubled the plants and therefore found itself having a huge set of information to be shared but also to be read in a single way in order to avoid confusion. So, just to give you an idea, in 3 years we have abandoned all forms of paper notebooks (except for the meetings or for those who, like me, is not so young and therefore still likes to write) because we have installed, in all machines and in all procedures, PCs or tablets. This allows us to treat the data in a unique way, to have the same information and this, starting from a very approximate knowledge of what could trivially be process timings, operators timings et cetera, allows us to make a very refined analysis and hence to understand if the product A needs N seconds rather than N minutes, If the operator B, that is not linked with rewarding him or punishing him because he's slower but maybe it is simply more meticulous or, in fact, he has not been trained well to do his job... so this allows me to put in place a series of different actions. And then it allows you to capture all the efficiencies that can be done along the whole process. Also because our activity is quite complex, the industrial process consists of: a granule as big as a grain of rice enters a heater, this puts it in a press and, from the mold, it comes out an aesthetic object for cars which is first selected and then it is subjected to an additional aesthetic treatment, that can be galvanic treatment or painting. This is just to summarize the process: it actually takes days, hours, and hand-to-hands. Each hand change evidently increases the cost that a piece can have. Also because there are pieces that have a very high intrinsic value, others that have a very low intrinsic value. It is true that maybe millions of them are produced, but our pieces, according to the target market, for example, cannot be selected by robots, lasers or optical scanners, but must still be selected by a human. This obviously means that the selection department is made up of trained, attentive people… they are all women because it has been shown that it is an activity where constancy is typical of the female gender and yet even in all this activity we have made a great path of digitization. I strongly wanted it, I am here only from 2016, precisely because even those who are in selection could then give answers related to individual lots as well as to the various pieces precisely because there are, in the panoply of defects, some that are accepted and others that are unacceptable. When the pieces are shipped with unacceptable defects, in addition to being charged for additional fees, the so-called "claims" could be submitted, that, on dedicated portals, do nothing but light red traffic lights, but, actually, no longer allow you to access subsequent projects. This becomes particularly

dangerous and important for us. This kind of needs. The other need that was born linked to, let's call it with this great, perhaps trivial, word “digitalization”, “4.0”, was to follow the item along the whole process: from when its genesis really begins, from the choice of material chosen to produce it, until it is loaded on the truck and ready to be shipped.

Martina Bonollo: How do you manage to find an item? By barcode?

Raffaella Culpo: Yes, exactly. We have created a whole series of codes according to the steps in which the items are. Because defining different finishes... however, when you have more than a thousand pieces in production at the same time, the recodification is far from being trivial. Identifying that that barcode contains a number where, for example, it says that it was Martina, rather than Maria, who took charge of the piece, this obviously allows me to collect a lot of information. This information, then, help me also with the management control, because it gives me back what I can also reach goals in terms of efficiency. So, since the customer's order is launched, after the appointment, it allows me to put the purchasing office into action, which knows that for 5 years we will produce that piece, so it proceeds to buy the material, raw materials, at different times, with different budgets, with perhaps different prices that may be on the market, because some of the materials we use, alas, are subject to speculation. We also use precious metals, such as copper and nickel, and therefore, at this time, for example, copper has fallen and nickel has had a very strong upward speculation. This, rather than the whole supply chain within the chain. So you can work on the subject of emergency stocks, warehouses ... Because we have a warehouse here, in this plant in particular, but then we have twelve warehouses around the world and then, even the management of these, obviously, really needs the Industry 4.0. We started from what was our process at the end of 2017 when we decide to implement 4.0 technologies and make a great mapping of the process. This site becomes fully operational in 2017 for some of the activities; at the end of 2017 we make a large mapping of all those that are the sub-activities of the activities and we decide that, in some way, we should trace them. Because, it may seem trivial, the distance between this and the other site, it is around 800/900 meters; there are actually many hand-to-hands. Then we also have a network of external suppliers, some who do activities for us, such as selection activities, they have been trained by us, they work solely for us, they are organized internally as our plants. But, obviously, if a piece was selected by the company X rather than by a man of my own company... not because it prescinds quality, but I must understand it, because, if I have a claim, then I must understand to whom to attribute this thing. So, mapping these activities and sub-activities, we said: "we need to somehow make sure that they return information that translates into value". We started from the most critical activity, which is precisely the so-called "galvanic" aesthetic treatment, which makes the pieces silvery, for the non-experts. From there we have... since we have two plant lines, one that we call “small” but it is as large as our competitors’ one, then we have a larger one, that is currently one of the largest in Europe, where we have hundreds of stations. We needed both to find out what each station was doing and, not trivial, to find out how much energy was being spent. We consume a few tens of thousands of kilowatts of energy a year, we are the so-called energy eaters. It was also about making efficiencies in that regard. So we made a big investment in equipment that would allow me both to lead the plant both towards the goal of energy efficiency but also towards making it talking me back, that is why we introduced the 4.0.

Martina Bonollo: Was it also a choice pushed by the client?

Raffaella Culpo: No, not really. It was internally pushed because, at that time, I was looking for a different CFO to meet a need that was obviously linked to a theme of governance of cost items. Because, if you do not know where the costs are generated in the company, you can only do two things: you either close down the company or you cut people's heads to reduce costs. Since neither of the two options, in my opinion, in the long run, leads to really efficient and effective solutions, it was necessary to understand what happens within the process. There is the plant where we consume 80% of the electricity, because the galvanic plant is on 365 days a year, 24 hours a day, even when it does not produce anything. So it consumes energy even when it does not produce any items because it is an electrolytic chemical process, which must always have a certain temperature, so the tanks must always be kept at a certain temperature, so, in fact, always uses energy. Obviously, then, when I put large pieces or small pieces inside the tanks, to be able to lift them, to make sure that there is this treatment that sticks to the pieces and that then remains the silvering, it takes further energy. So we needed to understand that too. So dedicated software, all this energy-efficient equipment... then there was obviously the intervention of an expert because the investment was significant, which has sworn the characteristics of this activity and gave me the first part of a set of important information. The other part, moreover, is in the molding department, where there are also presses that, on the other hand, obviously work conditioned by the production moment, but, depending on the size of the items or the complexity of the item's mathematics, I use more or less energy accordingly and I still need to get back information. When I want to estimate how much an item costs me, at what price I can sell the item… Then I have a 3D drawing of the item, this allows me to say "well, this piece has a surface of..., an inclination of..., et cetera, et cetera". So, it's a first estimate that allows me to determine, for example, in terms of weight, how much material we need to produce that item. And this is the first one. The second is the production of the equipment to make that item, such as for example, the mold. Parts are becoming more and more complex, so even the mold needs a certain type of approach engineering to be able to operate for N years, to produce N thousands of items. So I have another set of information there. Then the mold has to tell me how many items it has made per second, minute, hour, how many good pieces have come out from it in order to estimate the scrap. This also explains the introduction of 4.0. The scrap is, in fact, production that I do not sell. It is worth as much or as little as it can be, even depending on the material used. ABS costs a lot... however, the waste is unsold production.

Martina Bonollo: And can you recycle this waste?

Raffaella Culpo: Well, we do a recycling activity but the recycled material we get we can’t use it in the automotive sector because we make aesthetic items. For example, in the bumper there is a percentage of recycled material allowed. Right now, everything I recycle becomes the shells of the coffee machines. However, I do a recycling activity that I have already been doing for almost two years because I believe that waste can nearly always have a second life. There is very little waste that cannot have a second life. It is also possible to extract part of the precious materials that deposit in the sludge that comes out from the concentration of the water coming from the galvanic process and, therefore, it is no longer a waste but a resource. Actually, this thing happened. Then, as I was saying, it helps in setting the cost of the item

and, hence, in understanding when I'm in a break-even or not, if I'm selling, if I'm earning or not earning it. Given the amount of material I need, the space it occupies and the analysis of the required equipment, how many seconds it will take to produce it, how much energy I use, and manpower. Then, it tells how long it takes to select the item. Then, it tells how long it takes for the galvanic treatment, how many steps of galvanic et cetera. Then, the selection and then all the study of the packaging. So, actually, it's a very intense process the pricing one. I don't produce bread: flour, water, salt and okay. A kilo of bread costs like this. I produce items that are made of more components and, above all, of many hand-to-hands, many treatments et cetera. So this was also necessary to be more competitive. Not being the fastest, because not always speed means quality. But certainly to make efficiencies, so also to define with the customer those defects that are related to design weaknesses, that are upstream, that are unavoidable. Moreover, the acceptance by the customer, defects that occur at some point related to the technology wear, the wear of the machinery used, which can, however, create those parts for the aftermarket where the quality standards are slightly lower than the first line. In this sense it was indispensable. What does the client ask us? The customer of the 4.0 industry, our type of customer at least (who, at 92% of our turnover, is abroad), is certainly more structured than the Italian company... but why? Because the size of companies locate outside the Italian borders is larger than the average size of an Italian company. We still have large companies, of course, but there are also some small/very small excellences where, perhaps, the 4.0 model has as its first need to make operators use the technology. Here nearby there is a very interesting company that someone told me that it has also done great activities concerning the 4.0., but it has an objective difficulty that is not trivial. 50% of their men are over 45 years old and have a very low level of education. Everybody has a smartphone today; do they know how to use it? No, they do not. Because most of the people can use WhatsApp and phone, period. That one it's not the use of the smartphone, it's something else. So, bringing 4.0 instrumentation or other technologies to the department can sometimes be more hurtful than helpful. In this sense, however, I feel lucky because the average age in my company is less than 40 years, which means that I have a very young population and, in the last 4-5 years, I have, in some way, invested in schooling. I encouraged those who dropped out of school, in their first, second or third year, to go back to night school or to take one or two years gap to complete their studies. According to the declaratory of some contracts, some roles can’t be covered in the absence of a high school diploma... Even for the role of a shift supervisor. I cannot ask a person, who does not have certain skills or knowledge, to adopt certain procedures if they have not been put in a position to do so. The new employees all have, even in the production department, at least the high school diploma. In the offices, however, people have either a bachelor's degree or a master's degree, so there are few who have not done this type of path. This, in my opinion, is the tiebreaker when it comes to 4.0 because for the company it is not an independent investment and period. "I became the role model company of 2025." I must also put myself in a position to think that operators would be able to... During this journey, the last effort will be the talking warehouse. Exactly because I have a warehouse here and 12 around the world, it's a warehouse... I'm talking in the singular because, for me, it’s a whole. It's a big warehouse, with branches, but it's still a big warehouse worth several million euros, which obviously has to be checked at all times. Firstly to understand if I always have security stocks and, therefore, if I have the luxury of letting my operators stay at home for the bank holiday on 1st November or letting them stay 3 more days

at home during Christmas' holidays because I have enough security stocks to cover different requests from customers or maybe strikes on highways, trucks, gas stations et cetera. Also to understand what is the turnover rate on certain items rather than on certain others. Also because, basically, I produce accordingly to customer demand because the contract is not written in stone. It's not that if he tells me "you will produce 5,000 items per year for 5 years" I will always produce 5,000 items. Because there is a delta of more or less 20% and it is no small thing. This means that I may have produced a little more by working on security stocks, but then he could always ask me for 4,000 and hence I could have excess products, or he could ask me for a little more items and then I always work frantically because I could never keep up with them. In this sense the talking warehouse...

Martina Bonollo: Does it already exist?

Raffaella Culpo: From a technological point of view, we have done everything. Every warehouse location has been equipped with technology and devices. We started in September with 4.0 training for all warehouse operators.

Martina Bonollo: Was the training managed internally?

Raffaella Culpo: Yes, it was managed internally by my IT manager. We have signed the agreement with the trade union representatives and have written this training plan, which will be completed by Christmas. They will all be equipped with devices that look a bit like barcode scanner "guns", that are actually PC terminals because they are a bit larger than a scanner "gun", they also work as a scanner "gun", but allow to produce a whole series of documentation that moves the item, that loads it, that controls exactly the positioning (warehouse X, shelf N, floor N). This is the... I'd like to say the completion, actually is like "the more you get, the more you want". New needs are constantly being generated. In terms of 4.0, so far, I cannot say that I have seen a positive impact on turnover because I am in the phase where I have spent a lot, especially in the last year and a half, so it is not so easy to translate the expenditure in advantage. Surely we have had a very positive feedback from customer, because, since we are all working with EDI, for example (which is the classic tool through which they communicate on dedicated platforms "deliver me N pieces, at the X day, at Y hour"), surely having all this series of information within the process it allows you to have recovered in terms of efficiency and then getting the well-known green lights.

Martina Bonollo: What about product innovation?

Raffaella Culpo: The 4.0 is also born, for what concerns the plant, also for process innovation, more than for the product one. Because, as far as the product is concerned, I actually feel like in the fashion world: where the designer designed the clothes, I have to create the clothes, I live constantly in the anxiety of the fashion shows, of the collection to be presented; once having presented the collection, or, in my case, presented the car on the market, I can relax. In the sense that the project goes into production, so it means that it has overcome everything it had to overcome. Bearing one thing in mind: once we have made the first items, those may seem aesthetically beautiful, and then you have to see if they pass the laboratory tests. Some tests take 8, 10 or 12 weeks. We have an accredited in-house laboratory where we do 80% of the tests. Other tests, however, the specifications require that

they must be carried out by external laboratories because they must be demonstrated by independent bodies. So, in this sense process innovation because somehow the aesthetic treatment that I do on the items (which is this decorative part that is the same that is done in the sanitary industry... I can think of the classic shower at home), in fact, there is an ongoing regulatory evolution where, precisely, the sunset date should be September 2023, the hexavalent chromium can no longer be used in the process, so you need to change. We have somehow tried to anticipate this change in part of the process because, again, the tests take very long, because it is a chemical process and, hence, it takes more and more months for it to be stable, so that the quality of the result is what you expect. Then, not trivial, a car on the Russian market, where they use snow salt that is very corrosive... the tests are very different from those, for example, taken for California, where the problem is the sun. Therefore, durability, resistance, peeling et cetera are very different and, within the processes, impact in a completely different way and sometimes even discontinuously.

Martina Bonollo: Have you made any organizational changes?

Raffaella Culpo: Yes, of course. Because, somehow, being able to map exactly times and methodologies allowed me to make efficiencies, so to save some time. Especially for what happens during the night shift. So, trying to anticipate what might one day have been a request to reconcile work and home life, this allows me to stress a little more the hardware production capacity (and not human one) during the day, so from 6 am to midnight, and to reduce a little the need for operators during the night shift. This because I created efficiencies during the working schedule, which became a little easier to manage.

Martina Bonollo: And what about your internal skills?

Raffaella Culpo: Basic computer skills that are not Windows, Linux or anything else. But just to understand... somehow we have trained all the operators and, to make sure that they don't get lost in the process, reducing to the minimum the information they need and have to give back, in order to avoid creating confusion. Then, in turn, in the various production areas, there are people who have been trained to act as supervisors/assistants/babysitters so that if the operator no longer remembers when this thing happens (even if, next to the machines, they have all the paper instructions to…) further assistance, at least until we are completely convinced that this goes well. The personnel management process of making everyone aware and unified with respect to what is the final result is not as fast as it may seem. It's not like "I shift from 3G to 4G" and okay, it works better. There's a much finer activity that needs to be done internally.

Martina Bonollo: Have you hired new qualified figures on Industry 4.0 issues or have you used the resources you already had?

Raffaella Culpo: An internal IT manager, also specialized in industry 4.0. Then an external company has formalized, which also deals with the subject of cybersecurity, because we are certified to share data, especially CAD, directly from OEMs. We can't afford to have the intrusion of an attack, a virus or anything else. We have this kind of assistance that we have also brought into the process, so even all the machines that were not speaking we have equipped them with software and that are also monitored remotely. Another important thing:

the 4.0 industry has pushed the need to change the IT partner. We had a lot of customizations, so the program for the part of project X was customized, where there was only one guy who could help you, program Y, program Z. We obviously use SAP as a management system, as well as all companies in the automotive world, and, for me that I do not like customization because I say that customizations must be limited to that percentage that I need in order to collect that information that I can not extract from something that I already have. I must always be put in a condition where the machine can restart; the more customized I am, the more I become the victim and hostage of my supplier. So we switched partners, it wasn't easy. We created the Cromaplast clone on a virtual level, a digital twin, from an administrative point of view... We made this clone work for 4 months and then we made the transition with the new partner. Today we shifted from don't know how many customized software we had, too many... At this moment we have 3 software in the company: SAP, a production management system developed by them that talks with SAP - so it returns all the information within SAP, so it is not even too customized, it is more customized relatedly to the production cycle, because a company producing "panettone" has different needs compared to us - and a specific software for the designing world. We took out everything that could have been different. This has been a very strong need and also a significant expense because changing partners is anything but a piece of cake. Because there is information that needs to be transferred, there are compatibility problems, data that could be lost, data that could be duplicated. Which in some moments, within the clone, has happened: information that duplicated, especially in the production process, 500 pieces that became 2500. So it was a really huge task and the IT manager was very good at leading the two partners, the old and the new one, because there were certainly many delicate stages.

Martina Bonollo: How do you manage innovation in your company?

Raffaella Culpo: We constantly innovate, so I say to my colleagues: "do you remember this thing we used to do? It's in the past.". Because even our product is innovated because, just to sum up in a few seconds what we did in the past, we made windows for washing machines, now we make fronts for cars worth 500'000 euros that are extremely complex, so we have changed also in that sense, I mean, okay? Ten years ago we mainly made door handles, frames, and headlights. So even the operator has also changed the item he handles, for sure. Very complex, complicated, beautiful, challenging. So what's the car of the future going to be like? I don't know. But I know that it will be full of sensors, so my pieces will change again because they will have to accommodate sensors inside, so we also have evolved in this sense. So optical scans, 3D, possibilities... precisely because the geometry has changed, to be able to determine precisely throughout this surface of the item, where I can propose to the customer "install the sensor that gives you this type of information rather than the other one, in this point instead of that" and, hence, study technologies that allow him to make an item like that. Within the company we have created both an academy unit where senior people (who are not necessarily senior in age but have reached a seniority working in our company) can transfer skills to the juniors, in order to have continuity, and also a research and development unit where we test completely different materials, we make some items test to see if, in the process innovation, different materials and different process can give different results and then communicate with the OEMs. Therefore, regarding innovation, if we want to call it like that in general, without splitting hairs, we invest several hundred thousand euros every year and

continuously, because obviously we never have to, even at this stage when the market is strange, interlocutory, in which there is a downturn, where you do really make less 20 as stated on the “Sole 24 ore”. In which we, already in a non-optimistic way, had written the budget that we are respecting, however, evidently, the stress and the confusion (because above all there is confusion at this time)... Diesel yes, Diesel no, electric car, 2030, 2040, 2025… Yeah, but if you do not know where to go to recharge it, it is useless that I buy the electric car. If every now and then some electric cars burst out (and nobody ever says so, but it happens), I wouldn’t be so calm in buying it one. So, even it doesn’t involve me, but, obviously, what could they ask me? To make lighter items, because we know that the electric car weighs more and then, to ensure performances, I will have to be able to respond to aesthetic challenges certainly greater than those to which I'm responding today. So we innovate all the time.

Martina Bonollo: Which are your main partners for innovation?

Raffaella Culpo: We can't say that there is a more important or less important partner or that there is one that meets this type of need more than others because, obviously,... The IT partner is the one that is obviously more and more aligned with respect to anyone else, that today is the company X that joined a couple of years ago and that collaborate with us, but, maybe, in 5 years time, it could be another one, so I would not like to mention it. There are certainly several partners because there are several actors who are involved. I also collaborate with Versalis, for example, because we offered ourselves as an alpha site to test different materials that they are currently producing in the laboratory and then introduce them to the automotive world. With the chemistry partner, for example, we will become a beta site for them for a novelty related to the process for a fully green aesthetic treatment. So there are a lot of partners involved.

Martina Bonollo: Do you also collaborate with Universities?

Raffaella Culpo: With the Universities of Padua and Florence in particular, we have written a project regarding the theme of the circular economy. By 2021 I would like to write down the sustainable budget and I would like to give value to the many virtuous activities that I do. I do them because Raffaella Culpo believes that it is important to do them but they must be valued somehow. Since July 1st, many car manufacturers have submitted a questionnaire to the entire supply chain on Common Social Responsibility, on all activities that are being conducted, are planned to be conducted or will have to be implemented by the date X to reduce CO2 emissions, rather than the waste control, the water consumption, the energy consumption et cetera, et cetera. Some things that I saw made me smile because I said: "look, we already do them". For example, the recycling of the waste that I produce today, I do with a friend of mine (who studied in Chemical Engineering in Padua and who has always remained very attached to the University as head of the Department of Engineering) who has set up an activity where he takes the waste and makes it become granules again, which, I repeat, are the shells of the coffee machines, rather than other activities and I do them with him. On the chemical side, for example, we work with the University of Berlin, because the world of cars in Europe is very strong in Germany. France itself is not equally strong in terms of study center because, somehow, it stands there, waiting to see what others are doing and then adapting. So we have not found such a strong partner in France as we have found with the University of Berlin.

Then we also do specific activities related to this world with the UK, because the British are actually very advanced in some contexts. As well as in finance, they were also great in this field and hence we do some activities specifically with them but they are dedicated to the UK world or in other countries where they are present. They are surely activities that have important feedbacks within our chain of activities, also because we are no longer sub-suppliers, we are tier-1 or tier-2 and therefore the chain is very short. We are often invited to technical tables where we try to think of different solutions together. Sometimes we meet innovation partners right there and we start some activities together.

Martina Bonollo: How have your past investments in ICT (management software, website, social media, e-commerce, digital infrastructure of the company, etc.) proved to be important to exploit the potential of Industry 4.0 technologies?

Raffaella Culpo: As far as investments in infrastructure within the company are concerned, we have to say that the General Manager, a great fan of information technology, had somehow already ensured that the company was far ahead from this point of view. We've increased this trend a bit, so starting from the Wi-Fi connection everywhere to tablets and PCs installed on the machines anywhere and everywhere. We have certainly technological instruments everywhere in our company; we have already talked about management software; we have the website, but it worths... Since we do not target the retail world, we do not have the issue of e-commerce, fairs ... It would be wasted money, as well as for the part related to social media. That is actually more local, really local, we can say related to Italy/Veneto for showing the activities I do with people. I use socials for that kind of activity, for human resources. Everything I do about welfare on human resources, I talk about it on social media. Because, in a company where there is also presence of the trade union, where, by definition, we think outside the box, where I think about my employees (who are more or less 40 years old) and who can have 3 cases: either they have no children, or they have children or have elderly parents. There are 3 needs that they want to meet: taking care of the elderly, the management of the elderly; taking care of the children, so, when the baby comes how much does he/she cost me et cetera; or, if I am alone, I may want to travel, go to the gym ... In my opinion, these are the needs to be covered, which are often far from what they think, but it is part of the roles that need to be represented. or sure, the site is mainly useful to our customers for what concerns the part related mainly to the code of ethics, a first brainstorming before they come to visit our company, to understand how we act, who we are, how big we are. Especially the foreign client has in mind that the Italian company is small and family-run, with few employees and located in the garage of a house.

Martina Bonollo: Have investments in Industry 4.0 technologies changed your business model?

Raffaella Culpo: It has certainly changed, this has allowed me to shorten the pyramid a bit, which I absolutely support; the hierarchy makes everything more complicated and removes responsibilities, which is never good. This allowed me to give the various managers some responsibilities and skills that they probably already had, but that, in some way, were not identified. In turn, they have reorganized their teams also assessing what are the specific characteristics of their operators. We discovered that in one department we had a very smart and very good girl who is currently working in the purchasing office, she was overqualified

for the former department. This has emerged during this type of activity. Another guy, very proactive, we put him in those teams that supervise and he continues to chase the IT manager, thanks to him we extract a number of information from the SAP in order to, for example, monitor if the scrap during a certain type of activity increase in this point here rather than in that and also to create efficiencies. Then it made the management board more aware of how the process is done, what the activities and criticalities are and, for what concerns the cost centers, make them all aware of everything. They're not company secrets. What are the secrets? My problem is how to finance all of these activities... but this should not be disclosed to anyone else, it's my problem. This part linked with, especially for production managers who have to reorganize shifts, who have to make efficiencies on one product rather than another, we need to try to make fewer ways to waste time. It was all crucial and fundamental information that everyone has really, really liked. They didn't hinder me, at all. Those who have not felt able to take up the challenge, have either stepped aside or have left or have chosen to step back, to have minority roles. Not everyone is willing to play solely to score goals. You can't ask everyone to perform in the same way if, by attitude, they can't handle stress, not everyone can play the same role.

Martina Bonollo: Has the company used (or at least applied for) government and/or other regional incentives, or does it intend to apply for them?

Raffaella Culpo: Governmental ones, so the theme of industry 4.0, yes... with all the trimmings. Hoping that no one will ever come and tell us that document A was missing, rather than document B. Also because there is a lot of bureaucracy, this, in my opinion, is a disincentive for the company, to be honest. For example, the expertise's cost was 25 thousand euros, which is the cost of a basic operator. I could have fed a person, just for 12 months, but I could have fed a person. The company that drafts the report on research and development asks you for a fee on the tax credit that you go to recover, and there go tens of thousands of euros. In reality, if you are not a structured company, it is almost better not to ask for incentives. I attended tables where I was ashamed to be there, where there was a master of all trades that sold the perfect recipe for "buy all the new phones you want, you have all the incentives you need" and someone was really excited, in fact, it is much less trivial than it is proposed. Or saying that the 4.0 model is good for everyone.. it is not applicable to everyone. Or at least it does not apply to everyone so easily. Taking again the example of the car: we can't all buy an electric car if we don't know where to go to recharge it. The same applies to the 4.0 model because there is a lot of technological investment before, there is a lot of training (before, during and after) and then there is a maintenance, in fact, it is a plant that needs to be watered continuously. It's not that I buy the 4.0 machine to get the incentive and then I don't make it work, otherwise I threw good money away, money that I could have used in other parts of the business.

Martina Bonollo: Going in depth, how do you manage the data?

Raffaella Culpo: We have two servers, back-up every 15 minutes, twice a year we have a simulation of cyber-attacks made by external bodies. There are a whole series of side activities that are anything but trivial; if you didn't have an IT manager within the company that plans and that takes part in such activities but you always had to employ external entities, it would become a further cost burden for the company. Today we surely live in a

technological world where information is money and time and is increasingly indispensable. I have customers all over the world where my only problem is to make a phone call at a time A rather than B because maybe it's not night there or it's not night here. This is my only problem, but, also through the portals that measure us daily, I had to, for example, hire an engineer who works all day long, 5 days a week, on such portals because you have to respond within 24 hours to what is asked of you, or to turn a red light into green rather than to complete the information. Because, often, on these portals, there are also things that are not caused directly by you, but that affects the quality of the final result. If it snowed at Monte Bianco and the delivery was delayed, the customer attributes this delay to me, you have to demonstrate a whole series of activities and have continuous feedback. For me, for Cromaplast, it was the starting point for a series of other activities because, as I said before, the more you get, the more you want. Surely it was the first revolution that, like every revolution, for example ... there were people who were very scared because they had to use a tablet instead of the notebook and felt maybe judged or evaluated. We have explained to them (because, in our case, it is part of the second level negotiations) that the tool that I use to measure if I do well or do badly my activity, is, in the end, if the customer does or does not submit me the claim. If I deliver a good product at the right time and in the right way. If in the box - I can think of the warehouse theme - there had to be 10 right pieces and there are 9 left pieces, obviously, something is wrong and it's a claim. If I sent the box to Argentina, apart from the fact that it took a month to travel by sea and that involves a series of costs, to get back the wrong box and send back the right one, another month passes. So I've created another problem, so it needs to be explained. That's why even people need to be constantly updated, it's not like you just give a person a tool, period. From time to time you have to check if people have the right tool or if it needs to be updated.

Martina Bonollo: Do you do updating courses? If so, are they programmed?

Raffaella Culpo: Yes we do. They are partly planned, we give ourselves two big deadlines, in spring and autumn, when we set a brainstorming et cetera. However, if you notice that during the course of the event there is a need to intervene, perhaps with a smaller group rather than another, because for some innovations perhaps you start from a smaller group made of those that you think they are a little more receptive. You start with a test group, then you measure where the inefficiencies are and, then, with the same group you will go to do another activity in order to understand if you can add a request or ask for an additional or different skill. Every two months there are more or less two or three per department, rather than one or two per shift (because the shifts are not so rigid and people move alongside) with whom I meet, I face and make a sort of balance on what went well, what we can improve, what is missing. I do the same, post industry 4.0, also related to the finance part of the company: what were my goals, where we have are, where we can get or where we can not get. Because the administrator asks me for such detailed information that I can not get it out of anywhere, but of course I have to give him time to get there too. That's why I say it's always an on-going activity.

Martina Bonollo: Are you aware of the existence of the Competence Center formed by the universities of the north-east with the aim of spreading the 4.0 industry in small-medium

enterprises through training activities and laboratories of interaction between enterprises and universities? What do you expect from such a Competence Center?

Raffaella Culpo: I read about it in March/April, the objective is absolutely interesting. It's an activity I've already heard about from the Politecnico di Milano because we talked about it several times with Professor Taisch, who is a big sponsor of the 4.0 industry in the world. In Italy, I'm following a path with big companies, 4.0 subject is one of the most addressed, where evidently ... Then, I repeat, it should be adjusted to the individual activities, because, I can think of, for example, that time when I went to IMA, where they do the thing to pack the medicine, apart from the crazy speed, there the 4.0 industry is more 6.0, because they have such a lot of information in just a few seconds. Surely, either within companies or maybe more small companies together, they should also have the will - because sometimes you have to overcome the fact of saying "but then they copy me", everyone copies everyone and no one copies anyone, because every company stands on its own - but, maybe, even creating laboratories of expertise, because not everyone has the opportunity to have people already able to respond. I have many figures able to... I have taken them from outside the company, so I have made never-ending scouting campaigns for finding, for example, the figure of the IT manager. We already had the IT manager, but, he could have been, by character, attitude or training, the classic technician for printers. Compared to the current one who, for example, is creating the intranet for me, which is the other need that I feel because there is some information 4.0 that must be visible in all departments and at all times. If the box X of pieces Y that was supposed to arrive in the department at 9 o'clock hasn't arrived, why hasn't it arrived? Because the truck driver fell asleep on his way or because it did not leave production? Or because they are re-selecting it because there's a certain kind of flaw? Or because the press stopped or...? There's N information they can give. Or you get pieces where you already know that there is a criticality to 5/6 mm of the version of the head of the piece. Training activities for sure, skills must be increased, as I said, in the example of a nearby company, where the owner says "you know, I made a big investment in 4.0 but I realized that I bought the machine before worrying about the users". And he said to me, "I have a big problem and I won't cover it with a course, two courses or three courses. Half of my operators are so old that they will not be able to get, to learn, to use the machine. At the moment when, because he is not able to read or write, he blocks everything and calls someone else". That is an intrinsic risk of this type of activity. In my opinion, collaborating with universities is essential. I have to say that, partly because of the activities I do with Padua, with the Polytechnic of Milan and Turin. Because in the automotive sector Milan and Turin are the two fulcrums (especially Turin) that bring some ideas or some skills that they have, probably in a smaller size as they are coming from universities, but that can be, for me, a first piece to try to do things. The problem is to find the time to do all these things, the important thing is to get organized. The 4.0 industry also allows you to get better organized if you're convinced that when you do it, it will help you. An entrepreneur should never think that the only inspiration to do the business is the government incentive. It must be the inspiration to say, as we did this year, with a market that is making less 20, we really do that extra mile and start doing, at least trying, to make the process entirely ecological. To go to the big names and say "look, I can give you the item with an entirely ecological finish. You can't use it in a car in Moscow, but, for a number of countries, you can use it. In this sense, you have to be greedy to do, to learn, to create something new. In turn, the Competence Center, in my opinion, in order

to really have a useful function, must work a lot with the company. It really must be a four-handed business. On their own, in both cases, there is a risk of inefficiency because (now the University has changed) the universities are generally far from the reality of the business. Sometimes you risk making the theoretical presentation beautiful, but then you have to translate it into substance when it comes to business, you have to make it feasible. In my opinion, the more you do the activities together, the more it is a win-win for both of you. I'm also saying this for my journey because I am the paradigm shift for this company, a company that was family-run, today it no longer is. I come from outside the family, I reorganize the business and there is no longer a multitude of family members but there is only one partner. I come as an element of change of the governance, the famous generational shift of which (because I have always dealt with finance in business) from a theoretical point of view there are encyclopedias. But every company stands on its own and this is always a difficult step. Both for the people who are around the managerial table, who evidently if they have arrived there is A) for a demographic factor (but not always) B) because not everyone is able to run the company and therefore they must find an agreement that does not hurt too much the part that is underneath, which is the company. The second thing, which is sometimes more difficult than the first one, is to make all operators feel that nothing dramatic is happening to them. But, rather, make them feel that this thing happens so that the company can move forward. Because the 70-75-80-year-old entrepreneur (with all due respect, because, if he has come so far, it is because he has had the courage at so many times in his life) faces three buttons: his personal recognition (which he is not willing to give up), the social recognition, (which he finds it hard to give up), and the family. When the family is involved in the company, he is afraid to choose which of the three buttons to press, which to make prevail, because he says: "if I choose the family then outside I won't no longer be the entrepreneur", rather than "I'm no longer wealthy because I no longer enjoy some things". So he thinks "do I put family members in every role? Do they all have the skills required? They were used to living as children of an entrepreneur and to being spoiled, and then, in the company, what could they do?". But the company, in turn, is made up of people who have their own connections, who have their own life projects related to whether the company exists or not. In a territory like this, for example, where there was the Marzotto that employed 3,500 people and now employs 1,200, where there is a migratory flow, morning and evening, that is scary, to exist or not to exist, where I call 80% of my employees "at 0 km", it obviously changes to exist or not to exist. Making them feel that all the activities you do, even in terms of 4.0, lead to the improvement of their work and is not a way to say "you are good, you are bad". I think that, perhaps, the political push to put the slogan into place, was, at some point, very strong. I received dozens of calls from more or less improvised consultants who came to sell you the 4.0 factory or the way to make tax credit. But you also need skills because there is always money at stake and spending it wrongly can be the lifeblood for some activities rather than others. I think that it's beautiful that the Competence Center was born, but it must adjust to reality, the company needs to know as well that it can find or ask for information. Not all those who are at the helm of the company have the same kind of open-mindedness that others may have, in order not to be afraid of change, because humans always tend not to prefer the uncertain over the certain and this becomes often a limit, a killer phase. Sometimes I, with my operators, even if they were young, had to force them to convince them that they would improve. Today they are happy but, in the short term, it has not always been so simple. I am a

supporter of the technology only if it improves the conditions, but it should not be exasperated as in saying “technology replaces humans”. Then what do the human do? Not everyone can be the IT manager or the cyber-man of the situation, not everyone has this kind of tendency. There will always be those who have more manual skills. In that sense, if technology kills humans’ work completely, then it is not at the service of humans, it is at the destruction of humans. At least as far as my generation is concerned, I don't know what will happen in the future.

Martina Bonollo: Do you choose your suppliers also based on their propensity towards 4.0 or this is not relevant in your choice?

Raffaella Culpo: No, let's say that my suppliers undergo an assessment before becoming suppliers, in the sense that they should generally have the digital skills required to be able to respond quickly to requests. They undergo an assessment from an ethical point of view and with regard to their ability to be organized. Also because I have suppliers that are extremely small but very 4.0 oriented, I have slightly larger suppliers that are slightly less 4.0. This must not become a limit, absolutely. In my world, it is more essential to have certain certifications, and therefore having an organizational model that goes in a certain direction, rather than being too technologically advanced but not being able to respond on a portal.

Martina Bonollo: For what concerns data management, is it managed directly by your IT partner?

Raffaella Culpo: We have an area where the data is saved within the company. We have two servers (the server and the encore-server, for any eventuality), where we backup data every 15 minutes and twice a year we simulate the cyber-attack by a certified external body, just to verify that everything is in place, that everything is working and running. The IT partner is mainly giving us the IT equipment to manage the data. But the data is ours. The only data that I do not treat inside is the sensitive data (of the GDPR just to clarify) because I do not process wages inside the company by choice, indeed I have it done by an external study. That type of data... I do not have an internal ODV because I did not need it because I don’t treat that type of data. Because of its limitations, the app from which employees, from PCs or tablets or smartphones, can download the coupon, the CUD et cetera, is accessible only for me and my assistant of the HR world, with a password that expires every month. It is somehow a sort of data protection. The data is, however, owned by the company and, as well, are the systems of cloud, of savings, of the remote control that happens continuously. As far as security is concerned, for accesses, as well as for the non-stop running of the machinery, we have a radio link with a company that alerts us if something has happened and we see if we can intervene remotely or if we have to go directly to the company.

Martina Bonollo: Are you planning to implement artificial intelligence in the future?

Raffaella Culpo: Yes, we will implement it. It will be implemented in due course, though. We obviously did a great job on the management of predictive maintenance, I trained 3 people on the subject of maintenance. I have hired another IT guy who manages all types of machinery within the company. Obviously he does not do the maintenance himself, of course, but he organizes and is responsible for all of these activities. When I undergo an audit, for

example, even a very trivial scale that I have in the laboratory... they go and check when I did the maintenance. Maybe the scale works, but if I forgot to do the maintenance in April and they came in June, it's a nonconformity. Even from that activity, you can get a lot of information. However, there are also various suppliers of maintenance activity, but this activity has been computerized and that is also managed in the form of intelligence in order to extract information.

Interview made by Martina Bonollo.
Department of Economics and Business Sciences "Marco Fanno" - University of Padua.

Appendix B: Interview with Cromaplast (Italian Version)

Azienda: Cromaplast S.p.A
Referente: Dott. Raffaella Culpo (CEO)
Sito: www.cromaplast.com
Business: Stampaggio materie plastiche e cromatura
Luogo: Valdagno (VI)
Tecnologie 4.0 adottate: Robotica e Big Data

Raffaella Culpo: Sul tema 4.0 noi siamo una di quelle aziende che ha fatto delle attività nel mondo 4.0, sicuramente. Per quanto riguarda il tema big data siamo un po' più indietro perché in realtà non è una cosa che compri e poi non usi se non devi evidentemente estrarre una serie di informazioni utili e indispensabili. Anche perché questa è un'azienda che, pur avendo 50 anni di storia, è cresciuta moltissimo negli ultimi 3 anni perché ha più che raddoppiato il numero di persone, ha raddoppiato gli stabilimenti e quindi si è trovata ad avere una serie enorme di informazioni da dover anche condividere ma anche comunque da dover essere lette in un unico modo per evitare confusione. Quindi, tanto per darle un'idea, in 3 anni abbiamo abbandonato tutte le forme cartacee di bloc-notes, giusto per intenderci (fatto salvo per le riunioni o per chi, come me, è diversamente giovane e quindi ama ancora scrivere), perché abbiamo installato in tutte le macchine piuttosto che nelle procedure, pc o tablet. Questo ci permette di trattare il dato in modo univoco, di avere la stessa informazione e, partendo da una conoscenza molto sommaria di quelli che potevano essere banalmente i tempi processo, i tempi uomo et cetera, ci permette invece di fare un'analisi molto raffinata e quindi di poter comprendere se il prodotto A ha bisogno di N secondi piuttosto che N minuti, se l'operatore B, che non è questione di premiarlo poi o punirlo perché più lento ma magari è semplicemente più meticoloso o in realtà non è stato addestrato bene per fare il suo lavoro… quindi anche questo mi permette di mettere in atto una serie di azioni diverse. E Permette poi di cogliere tutte quelle che sono le efficienze che si possono fare lungo il processo. Anche perché la nostra è un'attività piuttosto complessa, il processo industriale, volendolo banalizzare, è: arriva un granulo grande come un chicco di riso che entra in un termo riscaldatore che poi, a sua volta, lo mette in una pressa e, dallo stampo, esce fuori un'oggetto estetico per auto, il quale viene una prima volta selezionato, poi subisce un trattamento estetico ulteriore, che può essere il trattamento galvanico oppure la verniciatura. Giusto per ridurre così, in modo estremo, in realtà ci sono, insomma, giornate, ore, passaggi di mano. Ogni passaggio di mano evidentemente aumenta il costo che può avere un pezzo. Anche perché ci sono pezzi che hanno un valore intrinseco molto elevato, altri che ne hanno molto poco, molto basso. Vero

che magari ne vengono prodotti milioni numericamente parlando, però i nostri pezzi, proprio per il mercato a cui ci rivolgiamo, ad esempio, non possono essere selezionati da robot, laser o scansori ottici ma devono essere selezionati ancora dall'umano. Il che evidentemente comporta che il reparto di selezione sia composto da persone addestrate, attente… tutte donne nello specifico perché è dimostrato che è un'attività dove la costanza è tipica del genere femminile e, però, anche in tutta questa attività, abbiamo fatto un grande percorso di digitalizzazione. L'ho voluto fortemente, perché io sono qui solo dal 2016, proprio perché anche chi sta in selezione potesse poi dare delle risposte legate ai singoli lotti piuttosto che ai vari pezzi appunto, anche perché ci sono, nella panoplia dei difetti, alcuni che vengono accettati e altri che divengono inaccettabili. Nel momento in cui i pezzi fossero spediti con difettosità non accettabili, oltre a subire degli addebiti, si aprirebbero dei cosiddetti "claim" che su dei portali dedicati non fanno altro che accendere dei semafori rossi, ma che in realtà non ti permettono più di accedere a progetti successivi. Quindi diventa particolarmente pericoloso e importante per noi. Ecco, quindi questo tipo di necessità qui. L'altra necessità, in realtà, che nasceva legata a, chiamiamola con questa grande parola, forse banale, della digitalizzazione, del 4.0, era quella di percorrere insieme al pezzo tutta la strada che fa: da quando inizia veramente la sua genesi, quindi dalla scelta del materiale per produrlo, fino a quando sarà caricato sul camion per essere spedito.

Martina Bonollo: Come fate ad individuare il prodotto? Tramite codice a barre?

Raffaella Culpo: Sì, esatto. Ma abbiamo creato tutta una serie di codici a seconda degli step in cui sono. Perché definendo finiture diverse… però, quando tu hai più di mille pezzi in produzione nello stesso momento, la ricodificazione è tutt'altro che banale. Identificare che quel codice a barre lì all'interno contiene un numero dove dice che è stata Martina anziché Maria a prendere in mano il pezzo, evidentemente mi permette di avere una serie di informazioni. Tutte queste informazioni, però, mi aiutano anche all'interno del controllo di gestione, perché mi restituiscono poi quello che posso andare anche a prendere in termini di efficienza. Quindi, da quando si scatena l'ordine del cliente, dopo la nomina, mi permette di impegnare l'ufficio acquisti che sa che per 5 anni dovrà produrre quel pezzo lì, quindi potrà acquistare il materiale, le materie prime, in momenti diversi, con i budget che sono stati declinati, con magari prezzi diversi che possono esserci sul mercato, anche perché alcune delle materie che utilizziamo, ahimè, sono soggette a speculazione. Noi usiamo anche metalli preziosi, come il rame e il nichel, e quindi, in questo momento, ad esempio, il rame è caduto e il nichel ha avuto una speculazione al rialzo molto forte. Questo, piuttosto che tutta quella che è la filiera all'interno della catena. Quindi puoi lavorare sul tema delle scorte di emergenza, dei magazzini… Perché noi abbiamo un magazzino qui, in questo stabilimento nello specifico, ma poi abbiamo dodici magazzini in giro per il mondo e quindi, anche la gestione di questi, evidentemente, necessita davvero del tema Industria 4.0. Noi siamo partiti da quello che era il nostro processo alla fine del 2017, diciamo, quando decidiamo di implementare le tecnologie 4.0 e facciamo una grande mappatura. Questo sito diventa completamente operativo nel 2017 per parti delle attività; alla fine del 2017 facciamo una grande mappatura di tutte quelle che sono le sotto-attività delle attività e decidiamo che, in un qualche modo, dobbiamo tracciarle. Perché, può sembrare banale, la distanza tra questo e l'altro sito, perché sono insomma 8-900 metri, in realtà sono più passaggi di mano. Noi noi abbiamo, peraltro, all'esterno una rete di fornitori, alcuni che ci fanno delle attività, ad esempio, delle attività di

selezione, sono stati addestrati da noi, lavorano interamente per noi, si sono organizzati all'interno come i nostri stabilimenti. Però, evidentemente, se un pezzo è stato selezionato dalla società X anziché da un uomo mio… non perché prescinda qualitativamente, però devo capirlo, perché se poi ho un tema di "claim", devo capire a chi attribuire questa cosa. Quindi, mappando queste attività e le sotto-attività, abbiamo detto "dobbiamo in qualche modo far sì che mi restituiscano delle informazioni che si traducano in valore". Siamo partiti dall'attività più critica che è appunto il trattamento estetico cosiddetto "galvanico", quello che fa diventare i pezzi argentati, giusto per i non addetti ai lavori. Da lì abbiamo… siccome abbiamo due linee di impianto, uno che noi chiamiamo "piccolino" ma che è grande come quello dei nostri competitors, poi ne abbiamo uno grande, che al momento è uno dei più grandi in Europa, dove abbiamo centinaia di postazioni. Avevamo bisogno sia di individuare cosa facesse ogni singola postazione, sia, non banale, il dispendio energetico. Noi consumiamo qualche decina di migliaia di kilowatt di energia all'anno, siamo i cosiddetti energivori. Sia di fare efficienze, appunto, partendo da lì. Lì, quindi, abbiamo fatto un grande investimento in strumentazione che mi permettesse appunto di far muovere l'impianto in versione, diciamo, verso l'efficientamento energetico però che mi parlasse e quindi è avvenuta l'introduzione di una parte del 4.0.

Martina Bonollo: E' stata una scelta anche spinta dal cliente?

Raffaella Culpo: No, proprio no. Proprio interna perché, in quel frangente lì, io cercavo un CFO diverso che rispondesse a un'esigenza che era evidentemente legata ad una tematica di governo delle voci di costo. Anche perché, se non conosci da dove si generano i costi in azienda, puoi fare solo due cose: o spegni l'azienda o tagli le teste delle persone per ridurre i costi. Siccome nessuna delle due, a mio avviso, poi, alla lunga, sono quelle che portano a soluzioni davvero efficienti ed efficaci, bisognava capire cosa avviene all'interno del processo. Lì è lo stabilimento dove consumiamo l'80% dell'energia elettrica, perché l'impianto di galvanica sta acceso 365 giorni all'anno, h 24, anche quando non produce. Quindi consuma anche quando non produce, perché è un processo chimico elettrolitico che deve sempre avere una certa temperatura, quindi le vasche vanno mantenute sempre ad una certa temperatura, quindi, di fatto, impiega sempre energia. Evidentemente, poi, quando io metto all'interno delle vasche pezzi grandi o pezzi piccoli, per poterli sollevare, per fare che ci sia questo trattamento che si appiccica sui pezzi e che poi rimane l'argentatura, ci vuole ulteriore energia. Quindi c'era bisogno di comprendere anche in questo senso. Quindi software dedicato, tutta questa strumentazione ad alta efficienza energetica… ovviamente poi c'è stato l'intervento di un perito perché l'investimento era significativo, il quale ha asseverato le caratteristiche di quest'attività qui e mi ha dato una prima parte di informazioni importanti. L'altra parte, invece, è nel reparto di stampaggio, dove anche lì ci sono le presse che, invece, funzionano ovviamente condizionate dal momento produttivo, però, anche lì, a seconda della dimensione dei pezzi o della complessità proprio delle matematiche del pezzo, impiego più o meno energia e ho bisogno comunque di restituzione di informazioni. Perché nel momento in cui io vado a preventivare quanto mi costa un pezzo, a quanto posso vendere il pezzo…Allora io ho un disegno in 3D del pezzo, questo mi permette di dire "bene, questo pezzo ha una superficie di…, un'inclinazione di…, et cetera, et cetera". Quindi, è una prima stima che mi consente di determinare, ad esempio, in termini di peso, quanto materiale ci serve per produrre quel pezzo lì. E questa è la prima. La seconda è invece la produzione delle

attrezzature per realizzare quel pezzo lì, quindi, ad esempio, lo stampo. I pezzi sono sempre più complessi quindi anche lo stampo ha bisogno di un certo tipo di ingegneria di approccio per poter funzionare n anni, per produrre n migliaia di pezzi. Quindi già lì ho un'altra serie di informazioni. Perché poi lo stampo mi deve dire quante battute ha fatto al secondo, minuto, ora, quanti pezzi buoni sono usciti quindi poi stimare lo scarto. Allora anche lì l'introduzione 4.0. Perché lo scarto, in realtà, non è altro che produzione che io non vendo. Può valere tanto o può valere poco, anche a seconda del materiale utilizzato. Già l'ABS costa un'eresia… in ogni caso lo scarto è produzione non venduta.

Martina Bonollo: E riuscite a riciclare questo scarto?

Raffaella Culpo: Allora, noi facciamo un'attività di riciclo però il materiale riciclato non lo possiamo usare nell'automotive perché noi facciamo pezzi estetici. Ad esempio, nel paraurti vi è una percentuale di materiale riciclato ammesso. In questo momento tutto quello che io riciclo diventa le scocche delle macchine del caffè. Io faccio comunque un'attività di riciclo che ho già iniziato a fare da quasi due anni perché ritengo che il rifiuto possa quasi sempre avere una seconda vita. Sono pochi i rifiuti che non possono avere una seconda vita. Ma anche dai fanghi che fuoriescono poi dalla concentrazione delle acque del processo galvanico si possono estrarre parte dei materiali preziosi che si depositano e quindi in realtà non è più un rifiuto ma una risorsa. In realtà questa cosa è avvenuta. Poi, dicevo, nella costificazione del pezzo e quindi nel capire quando sono in break-even o meno, se sto vendendo bene, se ci sto guadagnando o non ci sto guadagnando. Data la quantità di materiale che mi serve, lo spazio che occupa e quindi lo studio delle attrezzature, quanti secondi ci vorranno per produrlo, quindi quanta energia uso, manodopera. Poi, quanto tempo ci vuole a selezionarlo. Poi, quanto tempo ci vuole per il trattamento galvanico, quanti passaggi di galvanica et cetera. Poi, di selezione e poi tutto lo studio dell'imballaggio. Quindi, in realtà, è una cosa molta approfondita la determinazione del prezzo. Io non produco pane: farina, acqua, sale e ok. Un kilo di pane costa questo. Io produco pezzi che sono fatti di più componenti e, soprattutto, di più passaggi di mano, di più trattamenti et cetera. Quindi ciò è stato necessario anche per essere più competitivi. Non tanto veloci, perché non sempre velocità corrisponde a qualità. Però sicuramente di fare efficienze, quindi anche di definire con il cliente quelle che sono difettosità dovute magari a debolezze di progettazione, ancora a monte, che sono ineliminabili. Quindi l'accettazione da parte del cliente, oppure difettosità che avvengono ad un certo punto legate a un inizio di usura della tecnologia, dei macchinari utilizzati che possono, però, creare quei pezzi per l'aftermarket dove gli standard qualitativi sono leggermente più bassi rispetto alla prima linea. In questo senso è stato indispensabile. Il cliente cosa ci chiede? Il cliente dell'industria 4.0, la nostra tipologia di cliente almeno (che, al 92% del nostro fatturato), è all'estero, è sicuramente più strutturato rispetto all'azienda italiana… ma per quale tipo di motivazione? Perché la dimensione fuori è più grande della dimensione media di un'azienda italiana. Anche qui ci sono le grandi imprese, ci mancherebbe altro, però ci sono anche delle eccellenze piccole/piccolissime dove forse il modello 4.0 ha come necessità prima di tutto quello di mettere anche gli operatori in condizioni di poter utilizzare la tecnologia. Qui vicino c'è un'azienda molto interessante che mi hanno detto che anche loro hanno fatto grandi attività sul 4.0., però hanno una difficoltà oggettiva che non è banale. Il 50% dei loro uomini ha più di 45 anni e ha una scolarità molto bassa. Oggi tutti hanno uno smartphone, lo sanno usare? No. Perché la maggior parte delle

persone usa Whatsapp e telefona, punto. Che non è l'uso dello smartphone, è tutta un'altra cosa. Quindi, portare strumentazioni 4.0 o, comunque, tecnologie in reparto, a volte, può essere più un danno che un vantaggio. Io in questo senso, invece, mi ritengo fortunata perché l'età media da me è meno di 40 anni, ciò significa che ho una popolazione molto giovane e, negli ultimi 4-5 anni, ho, in qualche modo, investito nella scolarità. Ho stimolato chi ha abbandonato scuola, al primo, secondo o terzo anno, a riprendere la scuola serale piuttosto che a prendersi un anno o due anni per completare il percorso di studi. Anche perché, molto banale, ma nelle declaratorie del contratto, in alcuni ruoli, in difetto di diploma di scuole superiori, non possono essere ricoperti. Anche un banale capoturno. Non posso chiedere ad una persona, che non ha alcune competenze o conoscenze, di adottare certe procedure se non è stata messa in condizione di poterlo fare. I nuovi assunti hanno tutti, anche in reparto produttivo, almeno il diploma. Negli uffici invece hanno o laurea breve o laurea magistrale, per cui sono pochi quelli che non hanno fatto questo tipo di percorso. Questo, secondo me, è l'ago della bilancia fondamentale di quando si parla di 4.0 perché per l'azienda non è un investimento a sé stante e punto. "Sono diventato l'azienda modello del 2025". Devo mettermi anche in condizioni di pensare che gli operatori siano in grado di …. Adesso in questo percorso, l'ultimo colpo di reni lo darò nel magazzino parlante. Appunto perché ho un magazzino qui e 12 in giro, è un magazzino… Parlo al singolare perché, per me, sono un tutt'uno. E' un grande magazzino, con delle derivazioni, ma è pur sempre un grande magazzino che vale svariati milioni di euro, che deve evidentemente essere controllato in ogni momento. Primo, per comprendere se ho sempre le scorte di sicurezza e, quindi, se posso permettermi il lusso di dire faccio fare ai miei operatori il ponte del primo novembre piuttosto che a Natale farli stare a casa 3 giorni in più perché ho scorte di sicurezza a sufficienza per coprire richieste diverse dei clienti o magari scioperi di autostrade, camion, benzinai et cetera. Piuttosto che comprendere anche quello che è il turnover su certi articoli piuttosto che su certi altri. Anche perché, fondamentalmente, io produco in funzione della domanda del cliente perché il contratto siglato non è scritto sulla pietra. Quindi non è che se mi dice "produrrai 5mila pezzi all'anno per 5 anni", davvero produrrò sempre 5mila pezzi. Perché poi c'è un delta più o meno del 20% e non è poco. Il che significa che io posso aver prodotto un po' di più lavorando sulle scorte di sicurezza, ma poi me ne chiede sempre 4mila e quindi ne ho prodotti in eccesso o me ne chiede un po' di più e quindi lavoro sempre in affanno perché non riesco mai a starci dietro. In questo senso il magazzino parlante…

Martina Bonollo: Che è già in essere?

Raffaella Culpo: Dal punto di vista tecnologico, abbiamo fatto tutto. Qualsiasi luogo dei magazzini è stato dotato di tecnologia e dispositivi. Siamo partiti a settembre con la formazione 4.0 per tutti gli operatori di magazzino.

Martina Bonollo: E' stata fatta internamente la formazione?

Raffaella Culpo: Sì, internamente, dal mio IT manager. Abbiamo siglato l'accordo con le rappresentanze sindacali e abbiamo scritto questo piano formativo, che si concluderà entro Natale. Saranno tutti dotati di dispositivi che sembrano un po' le pistole, i lettori di barcode che in realtà sono proprio dei terminali pc perché sono un po' più grandi di quella che è una pistola, sono anche una pistola, però mi permettono di produrre tutta una serie di documentazione che mi sposta il pezzo, che lo carica su, che mi controlla esattamente il

posizionamento (magazzino x, scaffale n, piano n). Questo è il… vorrei dire il completamento, in realtà poi "l'appetito vien mangiando". In realtà si generano continuamente delle esigenze nuove. In termini di 4.0, ad oggi, non posso dire di aver visto un impatto positivo sul fatturato perché sono nella fase in cui ho speso molto, soprattutto nell'ultimo anno e mezzo, quindi non è così semplice tradurre la spesa in vantaggio. Sicuramente per la clientela abbiamo avuto un feedback molto positivo invece, perché ragionando tutti con l'EDI, ad esempio (che è il classico strumento con cui ti comunicano su piattaforme dedicate "consegnami n pezzi, il giorno x all'ora y"), sicuramente aver reso tutta questa serie di informazioni all'interno del processo ti permette di aver recuperato in termini di efficienza e quindi i famosi semafori verdi.

Martina Bonollo: E in termini di innovazione di prodotto?

Raffaella Culpo: Il 4.0 nasce anche, per la parte che riguarda l'impianto, anche per innovazione di processo, più che di prodotto. Perché, per quanto riguarda il prodotto, in realtà mi sento come nel mondo della moda: dove lo stilista ha disegnato gli abiti, io devo creare gli abiti, vivo costantemente nell'ansia delle sfilate, della collezione da presentare; presentata la collezione, ovvero, nel mio caso, presentata l'auto sul mercato, mi rilasso. Nel senso che il progetto entra in produzione, quindi vuol dire che ha superato tutto quello che doveva superare. Teniamo conto di una cosa: fatti i primi pezzi, quelli che esteticamente possono sembrare belli, poi bisogna vedere se superano i test di laboratorio. Alcuni test impiegano 8,10 o 12 settimane. Noi abbiamo un laboratorio interno accreditato dove facciamo l'80% dei test. Altri test, però, le specifiche richiedono che siano fatti da laboratori esterni perché devono essere dimostrati da enti indipendenti. Quindi, in questo senso innovazione di processo perché in qualche modo il trattamento estetico che io faccio sui pezzi (che è questa parte decorativa che è la medesima che poi viene fatta nel sanitario.. mi viene in mente la classica doccia di casa), in realtà vi è un'evoluzione normativa in corso dove, appunto, dovrebbe essere settembre 2023 il "sunset date", non si potrà più utilizzare il cromo esavalente all'interno del processo, quindi bisogna cambiare. Noi in un qualche modo abbiamo cercato di anticipare in parte del processo questo cambiamento, perché, appunto, ripeto, che i test sono molto lunghi, perché poi si tratta di un processo chimico e, quindi, ci vogliono più e più mesi affinchè sia stabile, affinchè la qualità del risultato sia quella che si aspetta. Poi, non banale, ma un autoveicolo sul mercato russo dove usano il sale da neve che ti toglie anche le scarpe… i test sono molto diversi da quelli ad esempio per la California, dove lì il problema è il sole. Quindi durabilità, resistenza, peeling et cetera sono diversi e, all'interno dei processi, impattano in modo completamente diverso e a volte anche in modo discontinuo.

Martina Bonollo: Avete avuto cambiamenti organizzativi?

Raffaella Culpo: Sicuramente sì, perché, in qualche modo, poter mappare esattamente tempi e metodologie mi ha permesso di fare delle efficienze, quindi di guadagnare un po' di tempo. Soprattutto per ciò che accade durante il tema notturno. Quindi, cercando di anticipare quella che potrebbe essere stata un giorno una richiesta di conciliazione tempi di vita e tempi di lavoro, per cui mi permette di stressare un po' di più la capacità produttiva hardware (e non quella umana) durante il giorno, quindi dalle 6 di mattina a mezzanotte, e di scaricare un po'

la necessità di operatori durante il turno notturno. Perché ho creato efficienze durante l'orario, un po' più semplice da gestire.

Martina Bonollo: E come competenze interne?

Raffaella Culpo: Conoscenze basi informatiche che non sono Windows, Linux o qualcos'altro. Ma proprio comprendere… in un qualche modo abbiamo addestrato tutti gli operatori e, per far sì poi che non si perdano, riducendo al minimo le informazioni di cui hanno bisogno e che devono restituire, per evitare di creare confusione. Poi, a loro volta, nelle varie aree produttive, ci sono delle persone che sono state addestrate per fare da supervisori/assistenti/babysitter in modo che se l'operatore non si ricorda più se quando avviene questa cosa (al di là che poi a bordo macchine abbia tutte le istruzioni cartacee per…), un'ulteriore assistenza, almeno finchè non saremo completamente convinti che questa cosa avvenga. Il processo nella gestione del personale di rendere tutti edotti e uniformati rispetto a quello che è il risultato finale non è così rapido come può sembrare. Non è "passo dal 3G al 4G" e ok, mi funziona meglio. C'è un'attività ben più fina che va fatta all'interno.

Martina Bonollo: Avete assunto nuove figure qualificate sui temi dell'Industria 4.0 o avete utilizzato le risorse che avevate già in possesso?

Raffaella Culpo: Un IT manager interno, specializzato anche in industria 4.0. Poi abbiamo avuto formalizzato da parte di una società esterna che si occupa anche del tema della cybersecurity, perché siamo certificati informatici per poter condividere i dati, soprattutto i CAD, direttamente dagli OEM. Non possiamo permetterci di avere l'intrusione di un attacco, di un virus o qualsiasi altro. Abbiamo questa forma di assistenza che abbiamo portato anche all'interno del processo, quindi anche tutti i macchinari che non erano parlanti li abbiamo dotati di software e che vengono monitorati anche da remoto. Un'altra cosa importante: l'industria 4.0 ha scatenato la necessità di cambiare il partner informatico. Noi avevamo un sacco di customizzazioni, quindi il programma per la parte di progetto X customizzato, dove c'era solo tizio che poteva farti assistenza, il programma Y, il programma Z. Noi ovviamente come gestionale usiamo SAP, come tutte le aziende nel mondo automotive, da lì, per me che non amo le customizzazioni, perché dico che le customizzazioni devono essere proprio limitate a quella percentuale di cui ho bisogno per avere quell'informazione che non posso estrarre da una cosa che trovo già. Perché devo essere sempre messo in condizioni che la macchina possa ripartire; più customizzato sono, più divento vittima e ostaggio del mio fornitore. Quindi abbiamo cambiato partner, non è stato facile. Abbiamo creato il clone di Cromaplast a livello virtuale, un digital twin, di tutto dal punto di vista amministrativo… L'abbiamo fatto funzionare questo clone per 4 mesi per poi fare, appunto, il passaggio con il nuovo partner. Oggi siamo passati a non ricordo più quanti software customizzati avessimo, troppi… In questo momento abbiamo 3 software che girano in azienda: SAP, un gestionale produttivo sviluppato da loro che colloquia con SAP – quindi restituisce tutte le informazioni all'interno di SAP, quindi non è neanche troppo customizzato, è più customizzato legato al ciclo produttivo, perché se un'azienda produce panettoni rispetto che a noi ha necessità diverse- e un software specifico per il mondo della progettazione. Abbiamo eliminato tutto quello che poteva essere diverso. Questa è stata un'esigenza molto forte e anche una spesa significativa perché cambiare partner è tutto fuorchè una passeggiata di salute. Perché ci sono informazioni che devono travasare, ci sono problemi di compatibilità, dati che si potrebbero

perdere, dati che si potrebbero duplicare. In alcuni momenti, all'interno del clone, è avvenuto: informazioni che si duplicavano, soprattutto in processo produttivo, 500 pezzi che diventavano 2500. Quindi è stato veramente un grandissimo lavoro e l'IT manager è stato molto bravo a condurre le fila tra i due partner, tra l'ex e il nuovo, perché c'erano sicuramente molte fasi delicate.

Martina Bonollo: Come vivete l'innovazione all'interno della vostra azienda?

Raffaella Culpo: Noi innoviamo continuamente, quindi io ai miei dico: "vi ricordate questa cosa che facevamo? È passato remoto.". Perché anche il nostro prodotto è innovato, perché noi, tanto per riassumere in pochi secondi cosa facevamo, noi facevamo oblò per le lavatrici, adesso facciamo musi per auto da 500'000 euro estremamente complessi, quindi già lì abbiamo cambiato, voglio dire, ok? Dieci anni fa facevamo prevalentemente maniglie, cornici e fanali. Quindi sicuramente anche per l'operatore è cambiato il pezzo che vede in mano. Quindi molto complessi, complicati, belli bellissimi, sfidanti. Quindi come sarà l'auto del futuro? Non lo so. Ma so che sarà piena di sensori, quindi i miei pezzi cambieranno ancora perché dovranno ospitare sensori all'interno, quindi anche noi in questo senso ci siamo evoluti. Per cui scansori ottici, 3D, possibilità… proprio perché la geometria è cambiata, da poter determinare, appunto, in tutta questa superficie del pezzo, dove posso io proporre al cliente "installa il sensore che ti da questo tipo di informazione piuttosto che quest'altra, in questo punto anziché in questo" e quindi studiare le tecnologie che gli permettano di realizzare il pezzo così. Abbiamo creato all'interno dell'azienda sia un'unità academy, dove appunto delle persone senior (che non necessariamente sono senior di età ma hanno una seniority lavorativa all'interno di questa azienda qui) possono trasferire a degli junior delle competenze, proprio per poter avere sempre la continuità, ma anche un'unità di ricerca e sviluppo dove, appunto, testiamo anche con materiali completamente diversi, proviamo dei pezzi per fare dei test per vedere se, appunto, nell'innovazione di processo, materiali diversi e processi diversi possono dare dei risultati diversi per poi andarne a parlare con gli OEM. Quindi, in innovazione, se vogliamo chiamarla così in generale, senza andarla poi a renderla sottile, investiamo parecchie centinaia di migliaia di euro tutti gli anni e continuamente, perché evidentemente non bisogna mai, anche in questa fase in cui il mercato è strano, interlocutorio, in cui c'è flessione, in cui si fa davvero meno 20 come c'è scritto sul Sole 24 ore. In cui già noi, in modo non ottimistico, avevamo scritto il budget che stiamo rispettando, però, evidentemente, la tensione e la confusione (perché soprattutto c'è confusione in questo momento)… Diesel si, Diesel no, auto elettrica, 2030, 2040, 2025… Sì, ma se non so dove andare a ricaricarla, è inutile che mi compri l'auto elettrica. Se ogni tanto qualche auto elettrica scoppia (e non lo dicono mai, però avviene), forse di comprarmela oggi non sono così sereno. Quindi anche lì ,non riguarda me, ma evidentemente, potrebbe essere chiesto cosa? Di fare dei pezzi più leggeri, perché l'auto elettrica sappiamo che pesa di più e quindi, per poter garantire prestazioni, dovrò essere in grado di rispondere a sfide, in termini estetici, sicuramente più grandi di quelle a cui sto rispondendo oggi. Quindi innoviamo continuamente.

Martina Bonollo: Quali sono i vostri partner principali per l'innovazione?

Raffaella Culpo: Non possiamo dire che vi sia un partner più importante o meno importante, o che ce ne sia uno che risponda a questo tipo di esigenza più di altri, perché evidentemente…

Il partner informatico è quello che, ovviamente, è sempre più allineato di tutti, che in questo momento è la società X che è arrivata un paio di anni fa e che ci viene dietro, però magari fra 5 anni può essere un'altra, quindi non vorrei battezzarla. Sicuramente sono più partner, perché sono una platea diversa di attori che sono coinvolti. Collaboro anche con Versalis ad esempio perché ci siamo offerti come alfa site per provare a testare materiali diversi che loro stanno producendo in laboratorio in questo momento per poi introdurli al mondo automotive. Con il partner di chimica, ad esempio, diventeremo beta site per loro per una novità legata all'interno del processo per un trattamento estetico interamente green. Quindi sono veramente tanti partner coinvolti.

Martina Bonollo: Collaborate anche con le Università?

Raffaella Culpo: Con le Università di Padova e di Firenze nello specifico, abbiamo scritto un progetto per quanto riguarda il tema dell'economia circolare. Nel 2021 io vorrei scrivere il bilancio sostenibile e alle molte delle attività virtuose che io faccio vorrei darne un valore. Io le faccio perché Raffaella Culpo ritiene che siano importanti farle però in un qualche modo vanno valorizzate. Dal 1° luglio tantissimi produttori di auto hanno sottoposto un questionario a tutta la filiera sulla Common Social Responsibility, su tutte le attività che vengono condotte, che si pensa di condurre o che dovranno essere implementate entro la data X per ridurre le emissioni di CO2, piuttosto che il controllo del rifiuto, il consumo di acqua, il consumo di energia et cetera, et cetera. Mi facevano anche sorridere alcune cose che vedevo perché dicevo: "guarda, noi già le facciamo". Ad esempio, il riciclo di quello che per me oggi è uno scarto, lo faccio con un mio amico di studi che (lui fece Ingegneria Chimica a Padova e che è sempre rimasto molto legato all'Università come responsabile del Dipartimento di Ingegneria) ha messo su un'attività dove prende lo scarto e lo fa ridiventare granulo, che ripeto sono le scocche delle macchinette del caffè, piuttosto che altre attività e le faccio con lui. Sulla parte chimica ad esempio collaboriamo con l'Università di Berlino, perché il mondo dell'auto in Europa è molto forte in Germania. La stessa Francia non è così forte dal punto di vista di centro studi perché, in qualche modo, sta lì, aspetta di vedere cosa fanno gli altri e poi si adegua. Quindi non abbiamo trovato un partner così forte in Francia come invece abbiamo trovato l'Università di Berlino. Poi facciamo anche delle attività specifiche legate a questo mondo con l'Inghilterra perché gli Inglesi poi in realtà sono molto avanti in alcuni contesti. Come con la finanza, lo sono stati anche in questo campo qui e quindi alcune attività le facciamo specificatamente con loro, però sono dedicate al mondo UK o nei paesi in cui loro sono presenti. Sicuramente sono attività che hanno un'importante feedback all'interno della nostra catena di attività, anche perché noi non siamo più sub-fornitori, siamo tier-1 o tier-2 e quindi la catena è molto corta. Veniamo spesso invitati a tavoli tecnici dove proviamo a pensare a delle soluzioni diverse insieme. I partner per le innovazioni a volte li conosciamo proprio lì e cominciamo qualche attività insieme in quel senso lì.

Martina Bonollo: In che modo gli investimenti pregressi in ICT (Software gestionale, sito web, social media, e-commerce, Infrastrutturazione digitale dell'azienda, ecc.) si sono rivelati importanti per sfruttare il potenziale delle tecnologie Industria 4.0?

Raffaella Culpo: Per quanto riguarda gli investimenti in infrastrutture all'interno dell'azienda dobbiamo dire che già qui da noi il Direttore Generale, grande patito dell'informatica, in qualche modo aveva già fatto sì che l'azienda fosse molto avanti da questo punto di vista.

Abbiamo un po' aumentato questo essere avanti, quindi dalla connessione Wi-Fi dappertutto piuttosto che tablet e pc a bordo macchine ovunque e dovunque. Strumentazioni sicuramente tecnologiche in ogni dove della nostra azienda; del gestionale ne abbiamo già parlato in precedenza; il sito web ce l'abbiamo, che però vale più che altro… Siccome noi non ci rivolgiamo ad un mondo Retail, quindi non abbiamo il tema dell'e-commerce, delle fiere… Sarebbero solo denari buttati, come pure per quanto riguarda la parte più legata ai social media. In realtà è più locale, davvero locale, possiamo dire ridotta all'Italia/Veneto per le attività che faccio sulle persone. Uso la parte sociale per quel tipo di attività, per le risorse umane. Tutto quello che faccio di welfare sulle risorse umane ne parlo sui social media. Perché, in un'azienda dove vi è anche presenza sindacale, dove per definizione si pensa in modo diverso, dove io penso che ai miei dipendenti (che hanno più o meno 40 anni) e che possono avere 3 casi: o non hanno figli, o hanno figli o hanno genitori anziani. Sono 3 le esigenze a cui vanno incontro quindi: pensare all'anziano, alla gestione dell'anziano; pensare ai bambini, quindi, quando arriva il bambino, quanto mi costa et cetera, oppure, se sono da solo, potrei voler viaggiare, andare in palestra… Secondo me sono queste le esigenze da ricoprire, che spesso sono lontane da quello che pensano ma fa parte dei ruoli anche questo tipo di rappresentanze. Sicuramente, invece, il sito serve più che altro ai nostri clienti per quello che è la parte legata strettamente al codice etico, ad un primo brainstorming prima che vengano a visitarmi, vedono come sei, chi sei, quanto grande sei. Soprattutto il cliente estero ha in mente che l'azienda italiana sia piccola e a conduzione familiare, con pochi dipendenti e nel garage di casa.

Martina Bonollo: Gli investimenti in tecnologie Industria 4.0 hanno modificato il vostro modello di business?

Raffaella Culpo: Si è sicuramente modificato, questo mi ha permesso di un po' schiacciare la piramide, cosa di cui io sono assolutamente convinta; la gerarchia rende tutto più complicato e deresponsabilizza, ciò non va mai bene. Mi ha permesso di attribuire ai vari manager delle responsabilità e delle competenze che probabilmente già avevano, ma che, in un qualche modo, non erano identificate. Quindi loro, a loro volta, hanno riorganizzato le loro squadre anche valutando quelle che sono le caratteristiche specifiche dei loro operatori. E' stato davvero scoperto che in un reparto avevamo una ragazza molto sveglia e molto brava che oggi è all'interno dell'ufficio acquisti, era sprecata in reparto. Questo è emerso durante questo tipo di attività qui. Un altro ragazzo, molto propositivo, lo abbiamo messo all'interno di quelle squadre che fanno da supervisori e continua a tampinare l'IT manager, quindi estraiamo una serie di informazioni dal SAP per, ad esempio, monitorare se lo scarto durante un certo tipo di attività si impenna in questo punto qui piuttosto che in quest'altro e anche di creare delle efficienze. Poi ha reso la parte manageriale più consapevole di come è fatto il processo, di quali sono le attività e le criticità e, per quelli che sono i centri di costo, renderli consapevoli tutti. Non sono segreti dell'azienda. I segreti quali sono? Il problema mio è di come faccio a trovare la finanza per fare queste attività qui… ma questo non va condiviso con nessuno, è un problema mio. Questa parte strettamente legata, soprattutto per i responsabili di produzione che devono riorganizzare i turni, che devono fare efficienze su un prodotto piuttosto che su un altro, deve cercare di far sì che vi siano minori modi per perdere tempo. Sono state tutte informazioni cruciali e fondamentali che hanno tutti molto, molto ben gradito. Non ho trovato in loro nessun tipo di ostacolo, anzi. Chi non si è sentito in grado di prendersi la sfida, si è

fatto da parte, se ne è andato o ha scelto di retrocedere, di avere ruoli minoritari. Non tutti sono disposti a giocare per fare goal. Non puoi sempre chiedere a tutti che performino nello stesso modo se anche dal punto di vista dell'attitudine non sono in grado di gestire lo stress, non tutti potrebbero stare nella stessa posizione.

Martina Bonollo: L'azienda ha usufruito (o perlomeno fatto richiesta) degli incentivi governativi e/o di altri regionali, o intende richiederli?

Raffaella Culpo: Quelli governativi, quindi il tema dell'industria 4.0, sì… con tutti i crismi del caso. Sperando che nessuno ci venga mai a dire che mancava il documento A, piuttosto che il documento B. Anche perché c'è tantissima burocrazia, questo secondo me è un disincentivo per l'azienda, devo dire la verità. Ad esempio la perizia è costata 25 mila euro, è il costo di un operatore basico. Avrei potuto dare da mangiare ad una persona, anche fosse per 12 mesi, però avrei potuto dare da mangiare ad una persona. La società che stende il rapporto sulla ricerca e sviluppo ti chiede una fee su quello che è il credito di imposta che tu vai a recuperare, e sono decine di migliaia di euro anche lì. In realtà se non sei un'azienda strutturata è quasi meglio non chiedere incentivi. Ho partecipato a dei tavoli dove mi sono vergognata di esserci, in cui c'era il tuttologo della situazione che vendeva la ricetta del "compra tutti i telefoni nuovi, che tanto hai gli incentivi" e qualcuno era davvero entusiasta, in realtà è molto meno banale di come viene proposto. Oppure dire che il modello 4.0 vada bene per tutti… non è applicabile a tutti. O quantomeno non è applicabile a tutti in modo così agevole. Portando nuovamente l'esempio dell'auto: non possiamo prenderci tutti l'auto elettrica se non sappiamo dove andarla a ricaricare. Vale lo stesso per il modello 4.0, perché in realtà c'è tantissimo investimento tecnologico prima, c'è tantissima formazione (prima, durante e dopo) e c'è poi manutenzione, in realtà è una piantina che va annaffiata continuamente. Non è che mi compro la macchina 4.0 per avere l'incentivo e poi non la faccio funzionare, altrimenti ho buttato via dei denari che avrei potuto concentrare in altre parti del business.

Martina Bonollo: Scendendo più nel dettaglio, come gestite i dati?

Raffaella Culpo: Noi abbiamo due server, back-up ogni 15 minuti, due volte all'anno facciamo la simulazione del cyber attack da parte di enti esterni. Ci sono tutta una serie di attività collaterali che sono tutto fuorchè banali; se tu non avessi un IT manager all'interno dell'azienda che programma e che fa parte di queste attività qui, ma dovessi ricorrere sempre ad enti esterni, diventerebbe ulteriormente un aggravio di costi per l'azienda. Sicuramente oggi viviamo in un mondo tecnologico dove l'informazione è denaro ed è tempo ed è sempre più indispensabile. Io ho clienti in tutte le parti del mondo dove l'unico mio problema è fare una telefonata ad un orario A piuttosto che B perché magari non sia notte là o non sia notte qui. Questo è il mio unico problema, ma, anche attraverso i portali che ci misurano quotidianamente, io ho dovuto, ad esempio, prendere un ingegnere che sta tutto il santo giorno, 5 giorni alla settimana, sui portali perché entro 24 ore bisogna rispondere a ciò che ti viene chiesto, o far diventare semaforo rosso in verde, piuttosto che completare l'informazione. Perché poi, spesso, su questi portali vi sono anche delle cose che non sono dovute a te direttamente ma che condizionano la qualità del risultato finale. Se al Monte Bianco è nevicato e la consegna è arrivata in ritardo, il cliente attribuisce a me il ritardo, bisogna dimostrare tutta una serie di attività e avere feedback continuo. Per me, per

Cromaplast, è stato il punto di partenza verso una serie di altre attività perché, come dicevo prima, l'appetito vien mangiando. Sicuramente è stata una prima rivoluzione che come tutte, ad esempio… c'è stato chi è rimasto molto spaventato, perché vedersi arrivare il tablet invece del bloc-notes e sentirsi magari giudicati o valutati. Noi abbiamo spiegato (perché, nel nostro caso, fa parte delle contrattazioni di secondo livello) che lo strumento con cui io in assoluto misuro se faccio bene o faccio male la mia attività è, alla fine se il cliente mi fa o non mi fa il claim. Se io consegno un bel prodotto nei tempi giusti e nel modo giusto. Se nella scatola - mi viene in mente il tema magazzino - dovevano esserci 10 pezzi destri e ce ne sono 9 sinistri, evidentemente qualcosa ho sbagliato ed è un claim. Se ho spedito la scatola in Argentina, al di là del fatto che ci è voluto un mese perché si viaggia via mare e ciò comporta una serie di costi, a far tornare indietro la scatola sbagliata e rispedire quella giusta, ne passa un altro mese. Quindi ho creato un altro problema, quindi va spiegato. Ecco perché anche le persone vanno continuamente aggiornate, non è che dai ad una persona uno strumento e basta. Di tanto in tanto bisogna verificare se le persone hanno lo strumento giusto o se va aggiornato.

Martina Bonollo: Quindi fate corsi di aggiornamento? Se sì, sono programmati?

Raffaella Culpo: Sì ne abbiamo. In parte sono programmati, ci diamo le due grandi scadenze, a primavera e autunno, in cui facciamo un brainstorming et cetera. Però se ti accorgi che sul durante c'è bisogno di intervenire, magari con un gruppetto piuttosto che un altro, perché per alcune innovazioni magari parti da un gruppetto piccolino di quelli che ritieni siano un po' più ricettivi. Parti con un gruppetto di prova, per andare poi a misurare dove ci sono le inefficienze, e, poi, è lo stesso gruppetto sul quale andrai a fare un altro lavoro nel capire se puoi andare ad aggiungere una richiesta o a chiedere una competenza in più o diversa. Con frequenza bimestrale ci sono più o meno due o tre per reparto, piuttosto che uno o due per turno (perché i turni non sono così rigidi e le persone si spostano poi anche all'interno) con cui mi incontro, mi confronto e facciamo una specie di bilancio su cosa è andato bene, su cosa possiamo migliorare, su cosa manca. Lo stesso lo faccio, post industria 4.0, anche legato a tutta quella che è la parte finance dell'azienda: quelli che erano i miei obiettivi, dove siamo arrivati, dove possiamo arrivare o dove non riusciremo ad arrivare. Perché l'amministratore mi chiede un'informazione così dettagliata che non riesco a tirarla fuori da nessuna parte, però naturalmente devo dargli il tempo per poter arrivare anche lì. Ecco perché dico che è sempre un'attività on-going.

Martina Bonollo: E' a conoscenza dell'esistenza del Competence Center formato dalle università del nord-est con obiettivo di diffondere l'industria 4.0 nelle piccole-medie imprese attraverso attività formative e di laboratori di interazione imprese/università? Cosa si aspetta da tale Competence Center?

Raffaella Culpo: Ne avevo letto a marzo/aprile, è assolutamente interessante l'obiettivo. E' un'attività di cui ne avevo già sentito parlare dal Politecnico di Milano perché, poi, con il Professor Taisch, che è un grande sponsor dell'industria 4.0 nel mondo, ne abbiamo parlato più volte. Io sto facendo un percorso in Italia all'interno delle grandi aziende, il tema 4.0 è uno di quelli in assoluto più affrontati, dove evidentemente… Poi, ripeto, va calata nelle singole attività, perché, mi viene in mente, ad esempio, quando sono andata in IMA, dove fanno la cosa per impacchettare le medicine, a parte la velocità pazzesca, lì l'industria 4.0 è anche 6.0 perché hanno una tale quantità di informazioni in pochi secondi. Sicuramente, o

all'interno delle aziende, o magari più aziende piccole insieme, dovrebbero anche avere la volontà – perché a volte bisogna anche superare quel fatto di dire "ma poi mi copiano", tutti copiano tutti e nessuno copia nessuno, perché ogni azienda è a se stessa – però, magari, anche creare dei laboratori di competenze, perché non tutti hanno la possibilità di avere le persone già in grado di rispondere. Io molte figure in grado di… le ho prese da fuori, quindi ho fatto campagne di scouting a non finire per, ad esempio, la figura dell'IT manager. Ce l'avevamo già l'IT manager, ma poteva essere, per carattere, per attitudine o per formazione, il classico assistente delle stampanti. Rispetto a quello attuale che, ad esempio, mi sta creando la rete intranet, che è l'altra esigenza che io sento perché ci sono alcune informazioni 4.0 che devono essere visibili in tutti i reparti e in tutti i momenti. Se la scatola X di pezzi Y che doveva arrivare in reparto alle 9 non è arrivata, non è arrivata perché? Perché nel tragitto l'autista del furgone si è addormentato o perché non è uscita dalla produzione? O perché la stanno ri-selezionando perché c'è un certo tipo di difettosità? O perché la pressa si è fermata o…? Ci sono N informazioni che possono dare. Oppure arrivano i pezzi dove già c'è scritto "sappi che c'è una criticità al millimetro 5/6 della versione della testa del pezzo". Attività formative sicuramente, le competenze vanno cresciute, come le dicevo, nell'esempio di un'azienda qui vicina, dove il titolare mi dice "sai, ho fatto un grande investimento in 4.0 ma mi sono reso conto che ho comprato la macchina prima di preoccuparmi degli utilizzatori". E lui mi ha detto proprio "io ho un grandissimo problema e non lo coprirò con un corso, due corsi o tre corsi. La metà dei miei operatori ha un'età tale che non sarà in grado di poter arrivare, di poter apprendere, di poter utilizzare la macchina. Ma sarà più nel momento in cui, per non saper né leggere né scrivere, blocca tutto e chiama qualcun altro". Quello è un rischio intrinseco di questo tipo di attività. Con le università secondo me è fondamentale la collaborazione. Devo dire che, un po' per le attività che faccio appunto con Padova, con il politecnico di Milano e di Torino. Perché poi nell'auto Milano e Torino sono i due fulcri (soprattutto Torino) da cui vengono fuori delle idee o alcune competenze che hanno loro, magari ridotte a piccole dimensioni da Università, che però possono essere, per me, un primo pezzo per poter provare a fare delle cose. Il problema è riuscire a trovare il tempo per riuscire a fare tutte queste cose, l'importante è organizzarsi. L'industria 4.0 ti permette anche di organizzarti meglio se sei convinto che quando lo fai ti aiuterà. Un imprenditore non deve mai pensare che l'unico stimolo sia l'incentivo governativo per fare le attività. Deve essere lo stimolo per dire, come noi quest'anno, con un mercato che fa meno 20, buttiamo veramente il cuore oltre l'ostacolo e facciamo, proviamo, a mettere giù il processo interamente ecologico. Per andare dai grandi nomi e dire "guarda, sono in grado di darti il pezzo con la finitura interamente ecologica. Non potrai metterlo su una macchina a Mosca, però, per un tot di paesi, potrai metterglielo". Anche in questo senso bisogna essere golosi di fare, imparare, di creare qualcosa di nuovo. A sua volta il Competence Center, secondo me, per poter davvero avere una funzione utile, deve lavorare molto con l'impresa. Deve essere davvero un'attività a quattro mani. Da soli, in entrambi i casi, si rischia di fare inefficienza perché (adesso un po' l'Università è cambiata) in generale le università sono un po' lontane dalla realtà dell'attività dell'impresa. A volte rischi di fare la presentazione teorica bellissima, ma poi in impresa bisogna tradurla in sostanza, bisogna renderla fattibile. Secondo me, più si fanno le attività insieme e più è un win-win per entrambe. Questo lo dico anche per il mio percorso che sto facendo, perché io sono il cambio epocale di quest'azienda qui, un'azienda che era familiare, che poi non lo è più. Io arrivo all'esterno della famiglia, riorganizzo l'impresa e non c'è più una moltitudine di soci familiari

ma c'è un socio solo. Arrivo come elemento di cambio di governance, il famoso passaggio generazionale di cui (perché io mi sono sempre occupata di finanza in impres) dal punto di vista teorico ce n'è enciclopedie. Ma ogni azienda vive il suo ed è comunque sempre un passaggio difficile. Sia per le persone che sono intorno al tavolo della dirigenza, che evidentemente se sono arrivati lì è A) per un fattore anagrafico (ma non sempre) B) perché non tutti sono in grado di mandare avanti l'azienda e quindi devono trovare un accordo che non faccia troppo male alla parte che sta sotto, che è l'azienda. Il secondo, che a volte è più difficile del primo, è far percepire a tutti gli operatori che non sta succedendo niente di drammatico per loro. Ma anzi, che questa cosa avviene affinchè l'azienda possa andare avanti. Perché l'imprenditore 70-75-80-enne (con tutto il rispetto, perché, se è arrivato fino a lì, è perché ha avuto il coraggio in tanti momenti della vita) si trova davanti tre bottoni: il suo riconoscimento personale (a cui non è disposto a rinunciare), il riconoscimento sociale (a cui fa fatica a rinunciare), e la famiglia. Quando la famiglia poi è in azienda, ha paura di scegliere quale dei tre bottoni schiacciare, quale far prevalere, perché dice: "se scelgo la famiglia poi fuori non sono più l'imprenditore", piuttosto che "non sono più benestante perché non godo più di alcune cose". Quindi pensa "metto la famiglia in tutti i ruoli? Ma hanno tutti le capacità? Sono stati abituati a vivere come figli di un imprenditore e ad essere abituati bene, e poi, in azienda, cosa potrebbero fare?". Ma l'azienda a sua volta è fatta di persone che hanno le loro connessioni, che hanno i loro progetti di vita legati al fatto che quell'azienda lì vada avanti o meno. In un territorio come questo, ad esempio, dove c'era la Marzotto che faceva 3500 dipendenti e oggi ne fa 1200, dove c'è un flusso migratorio, mattina e sera, che fa paura, esserci o non esserci, dove l'80 % dei miei dipendenti io li chiamo "a km 0", evidentemente cambia esserci o non esserci. Far percepire a loro che tutte le attività che fai, anche in tema di 4.0, portano al miglioramento del loro lavoro e non è invece un modo per dire "tu sei bravo, tu sei cattivo". Ritengo che forse la spinta politichese, più che politica, di mettere lo slogan, è stata ad un certo punto molto forte. Io ho ricevuto decine di telefonate di consulenti più o meno improvvisati che venivano a venderti la fabbrica 4.0 o il modo per fare credito d'imposta. Però ci vogliono competenze anche perché ci sono sempre in gioco dei denari e spenderli sbagliati possono essere linfa vitale per delle attività piuttosto che per altre. Ritengo che il Competence Center è bellissimo che sia nato, però deve calarsi nella realtà, come pure l'azienda ha bisogno di sapere che può trovare o chiedere delle informazioni. Non tutti quelli che sono al timone dell'azienda hanno lo stesso tipo di apertura mentale che possono averne altri, per non essere spaventati di fronte al cambiamento, perché l'umano tende sempre a non lasciare il certo per l'incerto e spesso questo diventa un limite, una fase killer. Io, con i miei operatori, anche se giovani, a volte ho dovuto forzarli nel convincerli che avrebbero migliorato. Oggi sono contenti però, nel breve, non è sempre stato così semplice. Io sono una fautrice della tecnologia se migliora, ma non va esasperata, come nel dire "la tecnologia mi sostituisce l'uomo". Poi l'uomo cosa lo mettiamo a fare? Mica tutti possono essere gli IT manager o i cyber-man della situazione, non tutti hanno questo tipo di propensione. Ci sarà sempre chi avrà più capacità manuali. In quel senso, se la tecnologia uccide il lavoro dell'uomo completamente, allora non è a servizio dell'uomo, è a distruzione dell'uomo. Almeno per quanto riguarda la mia generazione, nel futuro non so cosa avverrà.

Martina Bonollo: I vostri fornitori li scegliete anche in base alla loro propensione verso il 4.0 o non è rilevante nella vostra scelta?

Raffaella Culpo: No, diciamo che i miei fornitori subiscono prima di diventare fornitori un'assessment, nel senso se hanno le competenze digitali in generale per poter rispondere in tempo rapido a quelle che sono le richieste. Subiscono un assessment dal punto di vista etico e per quello che riguarda la capacità poi di essere organizzati. Anche perché io ho fornitori che sono estremamente piccoli ma molto 4.0, ho fornitori un po' più grandi che sono un po' meno 4.0. Non deve diventare un limite in questo senso, assolutamente. Nel mio mondo, è più indispensabile avere certe certificazioni, e quindi voler dire essersi dotati di un modello organizzativo che vada in una certa ottica, piuttosto che essere troppo evoluti tecnologicamente ma non essere in grado di rispondere su un portale.

Martina Bonollo: Per la gestione dei dati, viene fatta direttamente dal vostro partner informatico?

Raffaella Culpo: Noi abbiamo un'area dove il dato viene salvato all'interno dell'azienda. Noi abbiamo due server (il server e il contro-server, per ogni evenienza), dove facciamo backup dei dati ogni 15 minuti e due volte all'anno facciamo la simulazione del cyber attack da parte di un ente esterno certificato, proprio per verificare che tutto sia a posto, che tutto sia a regime. Il partner informatico più che altro è quello che ci dà la dotazione informatica per la gestione del dato. Ma il dato è nostro. L'unico dato che io non tratto all'interno è il dato sensibile (del GDPR per intenderci) perché l'elaborazione delle paghe non la faccio all'interno per scelta ma lo faccio fare da uno studio esterno. Quindi quel tipo di dato lì… io non ho l'ODV interno perché non ne ho avuto bisogno non avendo il trattamento di quel tipo di dato. Per i suoi limiti, l'applicazione su cui i dipendenti, da pc o da tablet o da smartphone, possono scaricarsi il cedolino, il CUD et cetera, vi posso accedere solo io e la mia assistente del mondo HR, con una password che ci scade tutti i mesi. Anche lì in un qualche modo vi è una protezione del dato. Il dato è comunque dell'azienda e, quindi, i sistemi di cloud, di salvataggi, del controllo da remoto che avviene continuamente. Per quanto riguarda la sicurezza, per gli accessi, piuttosto che l'accensione perenne dei macchinari, lì abbiamo un ponte radio con una società che ci allerta se è avvenuto qualcosa e vediamo se possiamo intervenire da remoto o se dobbiamo andare in azienda.

Martina Bonollo: State pensando di implementare l'intelligenza artificiale in futuro?

Raffaella Culpo: Sì, la implementeremo. Arriverà, però, a tempo debito. Evidentemente abbiamo fatto una grandissima attività sulla gestione della manutenzione predittiva, quindi ho addestrato 3 persone sul tema della manutenzione. Ho preso un altro informatico che gestisce tutti i tipi di macchinari che ci sono all'interno dell'azienda. Ovviamente lui non la fa in prima persona la manutenzione, ovviamente, però organizza ed è responsabile di tutte queste attività. Quando io subisco un audit, ad esempio, anche una banalissima bilancia che ho in laboratorio… vanno a vedere quando ho fatto la manutenzione. Magari la bilancia funziona, ma se mi sono dimenticato di fare la manutenzione ad aprile e sono venuti a giugno, è una non conformità. Anche su tutta quell'attività lì, da cui si traggono un sacco di informazioni. Ci sono però anche i vari fornitori delle manutenzioni, ma è stata tutta un'attività che è stata informatizzata e che viene gestita anche questa in forma di intelligence per poter estrarre delle informazioni.

Intervista realizzata da Martina Bonollo.

Appendix C: Interview with IMAL (English Version)

Firm: IMAL S.R.L.
Contact person: Ing. Lauro Zoffoli
Website: http://www.imalpal.com
Business: machines for the manufacturing of woodfibre manufactures
Location: Modena
4.0 technologies adopted Big Data and IoT

Martina Bonollo: Please describe briefly the activity of the company, the products and the market of reference

Lauro Zoffoli: We produce plants and machines for the production of wood panels, we work on vegetable fibers mainly wood. Let's just say it's a plant engineering and mechanical company. We are divided into areas of competence: we have a technical, plant engineering and mechanical office, a technical, electronic, electrical and software office that operates with about 120 people. The whole IMAL has 230, so half of them are electronics and specialists. We have about 60 graduates and the management is very limited, we are about 20 people.

Martina Bonollo: What are the 4.0 industry technologies that have been adopted by your company?

Lauro Zoffoli: We don't use 4.0 industry technologies very much, they are only used on some testing and control machines because the production is done externally. Machines that make the final phase of testing or control and pass all the data to the ERP.

Martina Bonollo: Why did you invest in the 4.0 industry?

Lauro Zoffoli: Because generally with the 4.0 industry we have a set of data that allows us to control more the quality of the process and then we can, of course, with all the data, control the performance of the machines used by the customer. We have an electronic department that exists within a service department composed of about ten people who intervene when a customer stops or when a plant stops working, working 24 hours a day, 330 days a year. It was our choice to invest in the 4.0 industry and it was not pushed by customers.

Martina Bonollo: What are the results you have obtained from using industry 4.0 technologies?

Lauro Zoffoli: The project is still in progress. We've introduced cloud technologies this year. We are still processing the data coming from the project, because we put industry 4.0 in some of the machines, but only few of them. Only 4 process machines.
We will have more control over the results with the introduction of the new ERP, which should lead to a shift to a new fully digital process management.

Martina Bonollo: Has the introduction of industry 4.0 technologies led to internal organizational changes?

Lauro Zoffoli: We only had training problems when we introduced some machines, optical readers, advanced readers to be able to capture more moving materials. As concerns the

machines, having all the engineers who use the machines, the level of training had very little impact, almost zero. Those who have installed the machines have held some courses.

Martina Bonollo: Do you have a department entirely dedicated to innovation inside your company?

Lauro Zoffoli: There are many people involved in innovation. There are two departments that innovate, then there's me looking for sources of innovation to see. We have 3/4 innovation centers. We use all possible sources of innovation: universities, science parks and consultants, suppliers also and therefore all customers. Not only in the area (Modena), because we export at 99 percent but we have more relations with Italian universities.

Martina Bonollo: Are your suppliers keen on the 4.0 industry?

Lauro Zoffoli: Some of them, few suppliers. They're already struggling to manage orders via cloud so... We don't want to change suppliers, we try to make the current suppliers grow, to get them used to it. Our suppliers are generally located in Europe, Italy and Europe. As a percentage, 75% of them are in Italy and 25% are in Europe.

Martina Bonollo: Have your past investments in ICT been crucial in exploiting the potential of 4.0 technologies?

Lauro Zoffoli: We will see. Up to date we are still at the beginning, we started the project in January 2019. The project has been running for 8 months, we have had problems and we still have problems. But let's just say that we're slowly beginning to see the light. However, our IT skills and ICT are essential for exploiting these new technologies. Which we can't find.

Martina Bonollo: Has the 4.0 industry changed your business model?

Lauro Zoffoli: Let's just say it gives us a chance to sell more. We are in the midst of a servitization process that has been greatly facilitated by the introduction of these new technologies.

Martina Bonollo: Have you applied for governmental or regional incentives for the 4.0 industry?

Lauro Zoffoli: No, we took advantage of the hyper-amortization project on the machines we bought.

Martina Bonollo: How is data generated by IoT technologies managed (internally or externally)? How is it used?

Lauro Zoffoli: The data generated by IoT is managed according to the customer. Some customers make us access, some customers don't make us access to their system. Clearly, I already have to understand in advance who makes us enter the system because you have to understand how the machine works, what problems there are, how to improve the processes before the machine has damage. The data is mainly used for preventive maintenance.

Martina Bonollo: Do you know what the Competence Center of northeastern universities is?

Lauro Zoffoli: No, we mainly collaborate with the Universities of Bologna.
Interview made by Martina Bonollo.
Department of Economics and Business Sciences "Marco Fanno" - University of Padua.

Appendix C: Interview with IMAL (Italian Version)

Azienda: IMAL S.R.L.
Referente: Ing. Lauro Zoffoli
Sito: www.cromaplast.com
Business: macchine per la produzione di manufatti in fibra di legno
Luogo: Modena
Tecnologie 4.0 adottate: Big Data e IoT

Martina Bonollo: Mi descriva brevemente l'attività dell'impresa, i prodotti e il mercato di riferimento

Lauro Zoffoli: Noi produciamo impianti e macchine per la produzione di pannelli di legno, lavoriamo sulle fibre vegetali soprattutto legno. Diciamo che è una società di impiantistica e meccanica. Siamo suddivisi in aree di competenza: abbiamo un ufficio tecnico, impiantistico e meccanico, un ufficio tecnico, elettronico, elettrico e software che opera con circa 120 persone. Tutta l'IMAL conta 230, quindi per metà sono tutti elettronici e specialisti. Abbiamo circa 60 persone laureate e la direzione è molto limitata, siamo circa 20 persone.

Martina Bonollo: Mi può indicare le tecnologie dell'industria 4.0 che sono state adottate dalla sua azienda?

Lauro Zoffoli: L'industria 4.0 da noi è utilizzata molto poco, è utilizzata solamente su alcune macchine di collaudo e di controllo in quanto la produzione è fatta esternamente. Macchine che fanno la fase finale o di collaudo o di controllo e passano tutti i dati all'ERP.

Martina Bonollo: Come mai avete investito nell'industria 4.0?

Lauro Zoffoli: Perché generalmente con l'Industria 4.0 riusciamo ad avere un insieme di dati che ci permettono di controllare maggiormente la qualità del processo e riusciamo poi ovviamente con tutti i dati a controllare l'andamento delle macchine utilizzate dal cliente. Abbiamo un dipartimento elettronico all'interno di un service composto da una decina di persone che intervengono quando un cliente si ferma, quando un impianto smette di funzionare, lavorano per 24 ore al giorno per 330 giorni all'anno. E' stata una scelta nostra quella di investire nell'industria 4.0 e non dai clienti.

Martina Bonollo: Quali sono i risultati che avete ottenuto dall'utilizzo delle tecnologie dell'industria 4.0?

Lauro Zoffoli: Il progetto è ancora in essere. Abbiamo introdotto quest'anno tecnologie cloud. Stiamo ancora elaborando i dati del processo, perché abbiamo messo dentro ad alcune macchine l'industria 4.0 ma poche. Solo 4 macchine di processo. Un maggior controllo sui risultati l'avremo con l'introduzione dell' ERP nuovo, che dovrebbe portare a un passaggio ad una nuova gestione del processo totalmente digitale.

Martina Bonollo: L'introduzione delle tecnologie dell'industria 4.0 ha portato a cambiamenti organizzativi interni?

Lauro Zoffoli: Abbiamo avuto solo problemi relativi alla formazione quando abbiamo introdotto alcune macchine, lettori ottici, lettori avanzati per riuscire a catturare maggiormente i materiali in movimento. Come macchine, avendo tutti quanti ingegneri che usano le macchine, a livello di formazione è stato molto poco l'impatto, quasi nullo. Ci sono stati dei corsi sull'utilizzo da parte di quelli che ci hanno installato le macchine.

Martina Bonollo: Avete un reparto interamente dedicato all'innovazione all'interno della vostra impresa?

Lauro Zoffoli: Ci sono tante persone che sono coinvolte nell'innovazione. Ci sono due reparti che innovano, poi ci sono io che ricerco fonti di innovazione da vedere. Abbiamo 3/4 centri di innovazione. Sfruttiamo tutte le possibili fonti di innovazione: università, parchi scientifici e consulenti, fornitori anche e quindi tutti i clienti. Non solo della zona (Modena), con i clienti no perché esportiamo al 99 per cento ma abbiamo più rapporti con le università italiane.

Martina Bonollo: I vostri fornitori sono improntati sull'industria 4.0?

Lauro Zoffoli: Alcuni, pochi fornitori. Fanno già fatica a gestire gli ordini via cloud quindi si immagini. Non cerchiamo di cambiare i nostri fornitori ma tentiamo di farli crescere, di abituarli. I nostri fornitori sono situati generalmente in Europa, in Italia ed Europa. Facendo la percentuale diciamo per il 75% sono Italia e per il 25% sono in Europa.

Martina Bonollo: Investimenti pregressi in ICT si sono rivelati importanti per sfruttare il potenziale tecnologie 4.0?

Lauro Zoffoli: Questo lo saprò dire più avanti. Per ora siamo ancora all'inizio, siamo partiti a Gennaio 2019. Il progetto è in essere da 8 mesi, abbiamo avuto dei problemi e abbiamo tuttora dei problemi. Però diciamo che pian piano stiamo cominciando a vedere la luce. Le nostre competenze informatiche e l'ICT sono comunque fondamentali per sfruttare queste nuove tecnologie. Che non troviamo.

Martina Bonollo: L'industria 4.0 ha modificato il vostro modello di business?

Lauro Zoffoli: Diciamo che ci dà la possibilità di vendere di più. Siamo in mezzo ad un processo di servitizzazione che è stata facilitata molto dall'introduzione di queste nuove tecnologie.

Martina Bonollo: Ha fatto richiesta di incentivi governativi o regionali per l'industria 4.0?

Lauro Zoffoli: No, abbiamo sfruttato il progetto di iper-ammortamento sulle macchine che abbiamo comprato.

Martina Bonollo: I dati generati dalle tecnologie IoT come vengono gestiti (internamente o esternamente)? Come vengono utilizzati?
Lauro Zoffoli: I dati generati da IoT vengono gestiti a seconda del cliente. Alcuni clienti ci fanno entrare, altri clienti non ci fanno entrare nel loro sistema. Chiaramente devo già

preventivamente capire chi fa entrare perché bisogna capire come funziona la macchina, che problemi ci sono, come migliorare i processi prima che la macchina abbia dei danni. I dati vengono utilizzati principalmente per manutenzione preventiva.

Martina Bonollo: Sa cos'è il Competence Center delle università del nord-est?

Lauro Zoffoli: No, noi collaboriamo principalmente con le università di Bologna.

Intervista realizzata da Martina Bonollo.
Dipartimento di Scienze Economiche ed Aziendali "Marco Fanno" - Università di Padova.

Appendix D: Interview with TECNAU (English Version)

Firm: TECNAU S.R.L.
Contact person: Salvatore Caronia, Maurizio Gianetto, Giada Grimaldi
Website: https://www.tecnau.com/
Business: Metalworker (industrial machinery for finishing digital printing)
Location: Ivrea (TO)
4.0 technologies adopted Big Data, Cloud and IoT

Martina Bonollo: Can you briefly describe the activity of the company, the products and the targeted market?

Maurizio Gianetto: Okay, I'll answer this question. Tecnau is a multinational company with several locations around the world and a network of distributors (we have about 50 distributors). Tecnau engineers, manufactures and sells machines and solutions for digital printing finishing. For clarity... So, industrial printing, large industrial machinery, printers of famous brands such as Canon, HP, Screen, Ricoh, Xerox et cetera, et cetera, et cetera. Our machines are the ones that are placed before and after the large printers with the aim of managing the paper. So they are the so-called unwinding machines or all those machines that are used to cut, accumulate paper and make finished or semi-finished products of the cycle, in fact, of paper production, which are, for example, brochures, booklets with the staple rather than books bound with glue, with soft covers, preparation of books and book blocks and checkbooks, medical prescription books... In short, everything that is part of the paper-based applications that are then usually sold by the print shops that use our machines and printers. So we don't print, we don't sell printers but we produce finishing machines.

Martina Bonollo: Could you please tell me about the technologies of Industry 4.0 that have been adopted by your company?

Salvatore Caronia: As I said, one of the most important projects that we have adopted in the last couple of years is that of collecting data of our machines and, in parallel with this, a preventive maintenance project that will then, we hope, lead to predictive maintenance. I'll give you a brief summary and the difference between these two, maybe you already know this. With preventive maintenance, we, let’s say, as a company, with our technicians, our knowledge and experience, give a useful life to the pieces that make up our machine and advise the customer to change a certain piece every certain time. The customer then, with the software that we have implemented in our most important machines, once he goes to replace the piece, to view it, et cetera, he can save the action, which will end up in a database and we (we or the customer, et cetera, et cetera) can see the action that has been carried out over time, see when the piece has been replaced, why it has been replaced. So to expand our experience and, in future machines, then, in fact, to be able to give increasingly targeted and more appropriate advice. Predictive maintenance, which is a much bigger project that we are carrying out, is, instead, something different, that is, it is the machine itself that, through the control of parameters (which can be frequency, temperature, sound, et cetera, et cetera), indicates itself, through the use of, clearly, the software and the programs, the problem that it is facing. So, it's as if the machine was aware, it knew what it is drifting, giving us, let’s say,

an indication to go in search of a solution to the problem. But this is still under development, we are still expanding. On the other hand, as I told you, instead, the whole part of production data collection. So, as my colleague said, our machines are in the finishing field of the paper and digital printing industry. So, as main data, for example, I'll just give you a very simple example to understand, we could collect the number of books produced by a company or the number of feet of paper, meters produced and, based on this, be able to understand if the company, if the machine, if our machine is working well or if there is something wrong. And once again give better customer service. To put it in a nutshell.

Martina Bonollo: Do you have other 4.0 industry technologies? Other than IoT, as far as I understood… Do you have any other technology?

Salvatore Caronia: Essentially the fields of application with which we use them are these three.

Maurizio Gianetto: Here, just a premise regarding what that my colleague has just said. One of the reasons why we are trying to focus a lot on the development of these technologies, these implementations that, mainly... This is a premise that we must tell you in a proper way. The company has taken a path, as we had already told you this in the e-mails, we have not already reached a goal. So it is something that is evolving and we, for our part, have made a lot of progress, but we are still at an early stage, let's say. One of the issues that push us to move in this direction is a matter related to the type of products that we offer on the market. Because the world of paper, the world of digital printing or offset printing (which we touch only closely but not directly), is a world that, in theory, usually, is decreasing. That is, fewer and fewer quantities are being produced, fewer and fewer batches. On the other hand, the market for variable-format printing, i.e. variability, is a very growing sector. So it is important to analyze the data when you have highly variable productions, because, I make an example of a line, of one of our top lines, which is called "Libra 800", which is the one that produces books in variable format. Since books can be variable one from the other and therefore they have different measures (length, width, thickness et cetera), if I can understand the production times, the speeds of the paper, the speeds in which the machine has stops, pauses, slowdowns et cetera, what can I do? I can optimize those processes that then allow me to maintain a higher performance, because, for example, I can organize the printing of the roll that then has to be processed, so that this same roll has already pre-optimized books to meet the needs of our machine but, above all, that our machine can perform best with this, in fact, this product. So it's very important: the more data we can collect and, above all, organize, the more, especially in the variability of the product, we remain competitive in the market. This is basically an idea that we're focusing on a lot.

Martina Bonollo: Was it also a request from your customers or more of a desire to be more competitive?

Maurizio Gianetto: Both, I think. Our customers rely heavily on what is a variable type of productivity because this is what the market imposes today. There are no more productions, I make the same example, just to stay on the same topic, of books, there are no more large productions of one million copies, 500 thousand copies, usually, at this time. The requests are requests from small publishers, small publishing houses, emerging publishers. That, therefore,

perhaps, initially ask for 100 copies/200 copies. What's going on? The printer, i.e. the person who owns both the printers and our machines, must produce the finished books that can then be given to those who request them. What does he have to do? He must be able to collect several small orders together in order to be able to keep a line, an activity, active, with production cycles that are usually 24/7, so they are continuous. The idea is: the orders are collected altogether, productivity remains the same as when producing large batches. The advantage is that they serve smaller end customers.

Martina Bonollo: What have you achieved, in terms of results, with the use of industry 4.0 technologies? (turnover, customers, production)

Salvatore Caronia: So, in terms of turnover, I can't answer that. But, certainly, we have achieved a high level in terms of customer satisfaction, since from our project on the first line on which we installed the data collection project, precisely for the reasons that my colleague said before. For example, we could see that, with some formats, the line performed better, and with a suitable printing sequence you could obtain, you can obtain, a higher speed of the overall line. In addition to this, by collecting, for example, errors (because we also collect errors from the machine), the analysis of these errors by our technicians, we can give the customer timely feedback. This means that the customer knows almost immediately, I do not say immediately because we have international customers, clearly, the data is in real time, but, let's say, there is still a human factor that interposes itself to the immediacy, let's say so. So the customer, through our feedback, can go directly to the source of the problem and this, in a world that works 24 hours a day, is a key thing for a customer who, therefore, stops as little time as possible.

Maurizio Gianetto: Look, I'm just giving you a very vague indication, because then, of course, there are some specific data on what the turnover is, et cetera, that can not be disclosed, of course. But let's consider this, in a market like ours which is in decline, which has reached peaks of up to 20% over time from one year to the next, our company grows at a rate of about 10-12% per year, broadly speaking. In recent times it seems that we have reached a plateau, in the sense that we have more or less stopped on the size of large companies. This is more or less a vague idea about the type of company we are.

Martina Bonollo: Have you had any internal organizational changes since the introduction of 4.0 industry technologies? (Reorganization of production processes, marketing processes, personnel management)

Maurizio Gianetto: So, let's say that the company, let's consider it in a temporal excursus that starts from its birth, the company is now 30 years old. To make you more or less understand what the process was... In 1998 there were 18, 16/18 people working in the company, and the company was a local company, so obviously limited only to the Italian territory, although perhaps the productivity was already ideally directed abroad, but still, the compages were purely Italian. In 2013 we reached, with a constant increase in the number of people, in 2013 we became a multinational with 3 centers, one in America and one in Sweden, and it was the Italian company that obviously bought the foreign companies. We are currently (therefore in 2019, almost 2020) to be in the order of around 300 employees. So I'd say the increase was substantial. The processes have, of necessity, been optimized. But also, I'm just

saying, very clearly, the... The production was divided by line, by type of market and, in addition to this, of course, all sectors were involved. Because, as well as the administration sector, the administrative department, for example, has grown, so has the mechanical and assembly department, the engineering department. Engineering, among other things, has recently introduced internships, apprenticeships with schools, we have just begun to use what are projects “alternanza scuola lavoro” to also have, let’s say, young minds to train and to have as, in short, as a generational change. Because time passes and people, some people leave the company, and it is right that young minds, let’s say, enter. It's our wish. So, let's say that the company is always in a process of becoming and I think that it's the only way, at the moment, to be able to keep a company in absolutely positive because, otherwise, it would not make any sense, in fact, to expand like this.

Martina Bonollo: How important do you think internal skills are for the adoption of 4.0 technologies? Are these competencies specific or general?

Salvatore Caronia: They are certainly very important. In my opinion, skills are 100% important in every field. It is also true that the 4.0 industry, and all that that it is related to the 4.0 industry, is a new, fertile ground, in which one can, in my opinion, experiment. I don't know if our main... wants to add something, our software person who takes care firsthand of this. But, certainly, precisely, such an important project was given to people who have the capabilities needed to deal with it, for sure. Informatic skills, but not only informatic skills from the point of view of the construction of all the software infrastructures but, behind this, there is also a very big job made by a very diverse team (and that is made by our technicians, by our designers) up to, let's say, the design and construction of the software of industry 4.0 and IoT. But then there's a whole different department, and I'm also in charge of this, that interfaces between the customer and the company. Then feedbacks, service, continuous reports, exchanged between us and the customer, to deepen the after-sales of the line with the 4.0 industry program installed. Giada, do you want to add something else?

Giada Grimaldi: When you talk about Industry 4.0, you should actually broaden the scope, the vision, a little bit, because this includes many sectors. That is, yes, we are talking about a lot of information technology, a lot of software because it takes a whole infrastructure below the company level to support you. Then, you also need the knowledge of the people who transmit feedback directly from the field, of the customer, and of all the data collected by the customer and also by the technicians who go there to do, in fact, the service. And not only that but also that of, for example, the mechanics' department because, without their information, which is the basis of everything, we don't know... For example, I give examples, of wear, we don't know how long a component could last or not. So, in reality, Industry 4.0 should be seen not only as a tool, as a software infrastructure, which, however, unfortunately, it has to be said, is a bit at the base of everything. But in reality the user base it gathers is the whole company.

Martina Bonollo: How is innovation managed within your company? Is there an internal department dedicated or is it left to the creativity of individuals? How much do you annually invest in innovation in terms of the percentage of turnover?

Maurizio Gianetto: So, let's say this. We are a company that has grown very quickly and that has reached the connotation of multinational, in fact, having to face what are the difficulties of the market, that is, to be competitive and to continue to engineer new solutions. So, the idea is that we could not devote a department to what is the study of innovation itself. However, the idea is, for example, that the company invests more than 23% of its turnover in research and development in order to innovate. So, in my opinion, this is already quite characteristic, for a very simple matter, in the sense ... The solutions, as well as in any market, must evolve because the customers' demands simply change. And this is a bit like the example I made before, from mass production we have shifted to parcelled production. This is constantly happening, so, research and development are also this: finding solutions that, competitively speaking, can give an advantage to the customer and, above all, perhaps anticipate the times. That is finding what are needs that may emerge, is not just about innovation for its own sake. It is the same principle that can be applied to many things: to innovation linked with information technology, to the development of computers, but also to what can be the evolution of communication from the point of view of the image in social networks. Once upon a time, there was the "communication manager", now there is the "growth hacker" et cetera, et cetera, et cetera. It's just a way of seeing things that changes and it's a way of relating to things. So I try not only to affect the customer, for example, with proposals, but I try, above all, to accommodate him. I do this both from the point of view of marketing and communication, but I also do it with the actual production. I provide objects, called like this (engineers are not very pleased), ie solutions, systems that are used to simplify the life of the end customer, which are used to accommodate him and, especially, to reduce costs because this is another major problem. Lowering costs means, for the customer who has to resell a product, it means, basically, gaining the upper hand, in the sense of being able to propose much more interesting things.

Martina Bonollo: Which are your main partners for innovation? (University, other companies)

Maurizio Gianetto: Let's say so, as a first impact, then maybe my colleagues can explain to you better. Let's say that our type of innovation is very simple in the first place. Usually, we work with our own customers, who are usually large industrial realities, so also very famous names, which, usually, what do they do? They ask for certain technologies to be perfected. So the research and study are done according to a fairly well-focused question. And this has already happened in the past with historical customers, who were initially provided with solutions and then, with these same customers, these solutions were reworked, reworked to meet the demands and have given birth to completely new product lines that, in fact, were interesting for the market and could be applied not only to this customer but to a much wider range of, in short, firms, companies, and customers.

Salvatore Caronia: I would just like to add that, as far as the new field, as I said before, of the predictive maintenance is concerned, we also contacted the University, some researchers who may have already experimented with predictive maintenance, even if in other fields, and who could guide us, especially at the beginning, in this initial phase.

Martina Bonollo: Has the introduction of 4.0 industry technologies led to changes in the management of relationships with your suppliers and with the supply chain in general?

Maurizio Gianetto: To answer this question, in reality, I do not know if we are the right people to address, because you should talk with the purchasing department when talking about suppliers. It must be said, for what I know about this subject, that there has been an automation of these processes. That is, also in the request for spare parts, parts, orders et cetera, et cetera, et cetera, because with the increased productivity we could not otherwise keep up with the request for parts for the construction of the machines. There's no... Let's not say, though, that "it's all automated and human work doesn't exist". No, it does exist. Because in our field, the premise that must always be done is that the machines are very customized, so you have to work often closely with suppliers to ask them certain parts that are built, if not individually, but in very small quantities. So often, what I usually call the world of digital printing, but especially our compages, is an atypical multinational. Why atypical? We have very high levels of turnover, we produce very high-level machines but we don't have mass production, in the sense that our machines are actually made ad hoc. This would also be difficult to do with a fully automated warehouse and a series of fully automated implementations to handle suppliers and things like that. It would not be possible, because often you need human contact and engineer certain specific parts.

Martina Bonollo: So you do not choose your suppliers based on their predisposition to the industry 4.0 but on other factors

Maurizio Gianetto: No, I would say, in this case, absolutely not. Also because, for a matter of cost reduction, but, above all, for a matter of, let's say, the need to have materials of a certain type and quality, we have always remained very attached to the supply chain that we have created over time. Why is that? Because our suppliers, first and foremost, they are, very often, local, they are suppliers who know us and, above all, who can also provide for the emergencies that we may have, within a limited time. In this case, it's like working with an extended family, with an extended company. Why is that? Because it helps everyone a little. We are able to produce better and we can still guarantee the quality of components, people, our suppliers provide us with components that are qualitatively superior because they know our market and our needs.

Martina Bonollo: Has your business model changed as a result of investments in 4.0 technologies? (For example the transition from selling products to selling services)

Salvatore Caronia: Let's say that, as far as service is concerned, the way of doing service has changed. I'll tell you what I mean. Our company also offers... Our American company, the American part of our company is basically a service company, in the sense that it does not sell machines (the machines are made either in Italy or Sweden) and the American branch, let's say, deals mainly with service. So when the customer signs a contract with us, he also gets a service package, let's say. So the after-sales service. What has changed is the way we do this assistance to the machines that have equipped our software, let's say, of industry 4.0 and IoT. In the sense that, as I said before, there is daily contact between us and the customer. That is, the customer sends us the data every day, we analyze it and, day by day, we give him direct feedback. So, while before you could not, this could not be done and, hence, the customer called the service agency and so our, for example, our colleagues had to go there when a break of some importance occurred and the machine stopped for a few hours. Now we are informed, practically, in real-time. We can give feedback in real-time and, sometimes, there is

no need to go to the field because the problem is, let's say, fixed before the break, the stop, becomes catastrophic. So there has surely been a change in the way of doing service and when this thing will be extended to more machines and it will be more and more refined et cetera, et cetera, it will surely change completely the way of doing service in general, not only for the most important lines as it is right now.

Martina Bonollo: Has the company used or applied for government or regional incentives or does it intend to apply for them?

Salvatore Caronia: The answer is yes, Tecnau has requested incentives from the Piemonte Region through the IR2 call (https://bandi.regione.piemonte.it/contributi-finanziamenti/bando-ir2-industrializzazione-dei-risultati-ricerca) to "Support for the economic enhancement of innovation through the experimentation and adoption of innovative solutions in processes, products and organizational formulas, as well as through the financing of the industrialization of research results". The results of the call have not yet been published. I add something about the question you asked earlier. Just a small specification, we are a company that, basically, is focused on the sale of products and not services. Services are an added value that we have implemented over time (remote assistance et cetera, et cetera, et cetera) but the core business is the sale of systems for production. Everything else is linked to the fact that the machines have a normal wear process and, therefore, need constant assistance. Fortunately it does not often happen with our machines, but the fundamental idea is this: all the accessory services that have been created and implemented, even with the help of those that are the prospects of IoT, Industria 4.0, machine learning et cetera, et cetera, et cetera, are aimed at developing anyway the sale of a product, not the sale of an accessory service. Although this may be useful, it can be developed over time with analysis and control systems but the tip, but what these systems aim to is to develop and optimize the machines that are, which are produced and sold by us. That's the whole idea.

Martina Bonollo: How have past investments in ICT (management software, website, social media) proved to be important in order to exploit the potential of Industry 4.0 technologies?

Maurizio Gianetto: For what concerns website, social media, et cetera, I have to say that, for now, there has been a change, but the impact of technology has been marginal for us, absolutely. It’s different for what can be the internal management software of the company and so on. On the communication side, there have been developments, we have tried to make an analysis of what are the data obtained from social services, which can be Linkedin, Twitter, the site, et cetera, Google and all other related services and connected. But these things are... I call them "soft analysis," why? Because let’s say, the market in which we operate is, again, a very particular market, it is a niche market, so the normal policies of marketing communication can be adapted but up to a certain extent. On the one hand, it's a big advantage, on the other hand, it's a big disadvantage. Why is it a big advantage? Because we are in such a niche sector that there is no great difficulty in finding us. In fact, there are few companies operating in our sector, which mainly produce machines like ours, and this is why we have to be very careful. The disadvantage is that, in such a market, the number of users is very low and the demand is very high. Therefore, it is often difficult to meet or approach the end customer. Often, I give you an example, the company manager, who is the person who basically decides whether or not to buy and implement a new line, perhaps, said

in simple terms, is so busy that he doesn't even look at social media. Maybe the marketing department of the company looks at them, but they are two completely different entities and two completely different realities. So the idea, for example, of working with social networks, developing systems and automation, et cetera for the release of articles, rather than comments, posts, events et cetera, is aimed to increase brand awareness. But often nothing of the things that are published, that is ... We are not, we can not and we can never function as an e-commerce site that advertises because it can sell a product directly. Our lines are lines that are difficult to sell and they must be sold wisely, usually after that engineers from both sides have met and discussed the needs. So social media and all these are always and only an idea of branding positioning as a company and, secondly, as a product positioning. So new technologies help, but they're a small part, let's say.

Martina Bonollo: How do you manage the data generated by the IoT? In the company or in the cloud? Autonomously or through external companies? How are they used? How are they changing the company's business model?

Giada Grimaldi: From the point of view of the IT infrastructure, we have an external company that gives us support regarding the infrastructure, the systems, from the point of view of the systems. While software development is all done by us. We do not rely on, so far, on the cloud by choice of the management board, but we do not exclude that in the future we will use it. So, for the moment, the data stored is saved on a physical PC here... Actually, it's virtual, but it's still the physical machine here. We develop all the software that is produced. Because it's really customized.

Martina Bonollo: How many servers do you have?

Maurizio Gianetto: So, basically the company... But I'm only talking about the Italian side because it's a different matter. Let's just say so, let's try to simplify it. The company has 3 main servers, one in Italy, one in Sweden and one in America. The servers are connected to each other via VPN connections. By server, I mean the body of computer structures within every company, every location. Then, obviously, each site has, for each service, an X number of virtual machines that act as real servers, which I establish in an order of magnitude of 15/20 per site. So that's about 45 in total.

Giada Grimaldi: Let's say that most of the main servers are still in Italy. Because the whole IoT part is made here.

Maurizio Gianetto: For what concerns IoT. But for all the rest also the other...

Martina Bonollo: In the email, you said that you have not Big Data but relational data, right?

Salvatore Caronia: Yes.

Martina Bonollo: This production of great data, even though they are not Big Data, is pushing you towards the adoption of Artificial Intelligence?

Maurizio Gianetto: It's too early, in my opinion. What do you mean by Artificial Intelligence? Perhaps we need to make a distinction here, a little more specifically.

Martina Bonollo: If you want to describe a little bit what you mean by Artificial Intelligence so as not to create confusion.

Maurizio Gianetto: By Artificial Intelligence I mean systems able to process data and create autonomous actions, just to simplify, because it would be a bit more complex. So far, I wouldn't label it as artificial intelligence. It's still in its infancy. You can talk about it because you can link it to the Industry 4.0 of the sensor that receives an input, then provides it to the computer of the machine and the computer of the machine processes a response and, above all, gives a response that can be an adjustment, et cetera. But here we start to talk about something more advanced and about this predictive maintenance et cetera, et cetera, et cetera, that is still in an initial phase.

Salvatore Caronia: Exactly. ..

Maurizio Gianetto: I wouldn't say that Tecnau already makes artificial intelligence systems because it would be a big leap of faith.

Martina Bonollo: Do you know the Competence Center of the North-East Universities? It is a group of Universities and small/medium enterprises that try to spread Industry 4.0 through training activities, interaction laboratories, etc.

Maurizio Gianetto: No, not me personally.

Salvatore Caronia: Not personally, but it's interesting. We'll inform about it.

Interview made by Martina Bonollo.
Department of Economics and Business Sciences "Marco Fanno" - University of Padua.

Appendix D: Interview with TECNAU (Italian Version)

Azienda: Tecnau SRL
Referenti: Salvatore Caronia, Maurizio Gianetto, Giada Grimaldi
Sito: https://www.tecnau.com/
Business: Metalmeccanico (macchinari industriali per la finitura della stampa digitale)
Luogo: Ivrea (TO)
Tecnologie 4.0 adottate: Big Data, Cloud, IoT

Martina Bonollo: Mi potete descrivere brevemente l'attività dell'impresa, i prodotti e il mercato di riferimento?

Maurizio Gianetto: Ok, a questa domanda rispondo io. Tecnau è una multinazionale con diverse sedi all'interno del mondo e una rete di distributori (sono circa 50 i distributori che abbiamo). Tecnau ingegnerizza, produce e vende macchine e soluzioni per il finishing della stampa digitale. Per semplificare un po' la spiegazione... Quindi, stampa industriale, grossi macchinari industriali, stampanti di marchi e brand famosi come Canon, HP, Screen, Ricoh, Xerox et cetera, et cetera, et cetera. Le nostre macchine sono quelle macchine che sono disposte prima e dopo alle grosse stampanti per, appunto, gestire la carta. Quindi si tratta di sbobinatori (svolgitori vengono anche chiamati) oppure tutte quelle macchine che servono per tagliare, accumulare la carta e realizzare quelli che sono dei prodotti finiti o semifiniti del ciclo, appunto, produttivo della carta, che sono, per esempio, brochure, libretti con il punto

metallico piuttosto che libri brossurati a colla, con copertina morbida, preparazione di libri e blocchi di libri e blocchetti di assegni, ricettari medici… Insomma, tutto quello che fa parte delle applicazioni di tipo cartaceo che poi vengono vendute dai print shop, solitamente, che utilizzano le nostre macchine e le stampanti. Quindi noi non stampiamo, non vendiamo stampanti ma produciamo le macchine di finishing.

Martina Bonollo: Potreste cortesemente indicarmi le tecnologie dell'Industria 4.0 che sono state adottate dalla vostra azienda?

Salvatore Caronia: Come le dicevo, uno dei progetti più importanti che abbiamo adottato da un paio d'anni a questa parte, è quello di raccolta dati all'interno delle nostre macchine e, parallelamente a questo, un progetto di manutenzione preventiva che poi, speriamo, porterà alla manutenzione predittiva. Le faccio un breve riassunto e differenza tra queste due, magari già lo sa. La manutenzione preventiva, siamo noi che, diciamo, come azienda, con i nostri tecnici, le nostre conoscenze ed esperienze, diamo una vita utile ai pezzi che compongono la nostra macchina e consigliamo al cliente di cambiare un determinato pezzo ogni tot tempo. Il cliente poi, con il software che abbiamo implementato nelle nostre macchine più importanti, una volta che andrà a cambiare il pezzo, a visionarlo, et cetera, potrà salvare l'azione, che andrà a finire in un database e noi (ma noi o il cliente, et cetera, et cetera) possiamo andare a vedere l'azione che è stata effettuata nel tempo, andare a vedere quando il pezzo è stato cambiato, perché è stato cambiato. Così da ampliare la nostra esperienza e, nelle future macchine, poi, appunto, poter dare dei consigli sempre più mirati e più adeguati. La manutenzione predittiva, che è un progetto molto più grande che stiamo portando avanti, è, invece, qualcosa di diverso, cioè, è la macchina stessa che, tramite il controllo di parametri (che possono essere di frequenza, temperatura, suono, et cetera, et cetera) va ad indicare lei stessa, tramite, chiaramente, il software e i programmi, il problema che sta avendo. Quindi è come se la macchina sapesse, conoscesse cos'è che sta andando alla deriva, dandoci, diciamo, un'indicazione per andare miratamente ad ovviare al problema. E questo però è ancora sotto sviluppo, insomma, stiamo ancora ampliando. Dall'altro lato, come le dicevo, invece, tutta la parte di raccolta dati di produzione. Quindi, come ha detto il mio collega, le nostre macchine sono nel campo del finishing dell'industria della carta e della stampa digitale. Noi, quindi, come dati principali, per esempio, le faccio soltanto un esempio molto semplice per capirci, potremmo andare a raccogliere i libri prodotti da un'azienda o il numero di piedi di carta, di metri prodotti e, in base a questo, poter capire se l'azienda, se la macchina, se la nostra macchina sta funzionando bene o se c'è qualcosa che non va. E ancora una volta dare un servizio migliore di service al cliente. In poche parole.

Martina Bonollo: Avete altre tecnologie dell'industria 4.0? Quindi IoT, da quanto ho capito… Ne avete anche altre tecnologie?

Salvatore Caronia: Essenzialmente i campi di applicazione con cui li usiamo sono questi tre.

Maurizio Gianetto: Ecco, solo una premessa riguardo al discorso che ha appena fatto il mio collega. Una delle motivazioni per le quali noi stiamo cercando di puntare molto sullo sviluppo di queste tecnologie, di queste implementazioni che, per la maggior parte… Questa è una premessa che dobbiamo fare in modo doveroso con lei. L'azienda ha intrapreso un percorso, le avevamo già anche detto all'interno delle e-mail, non abbiamo già raggiunto un

traguardo. Quindi, è qualcosa che si sta evolvendo e siamo, dal canto nostro, abbiamo fatto numerosi progressi, ma siamo ancora in una fase iniziale, diciamo. Una delle questioni che ci spinge a muoverci su questa direttiva è una questione legata alla tipologia di prodotti che noi offriamo sul mercato. Perché il mondo della carta, il mondo della stampa digitale o della stampa offset (che noi tocchiamo solo da vicino ma non direttamente), è un mondo che, in linea teorica, solitamente, è in diminuzione. Cioè, vengono prodotte sempre meno quantità, meno lotti. Dal canto stesso, però, invece, il mercato della stampa a formato variabile, cioè della variabilità, è un settore molto in crescita. Quindi è importante l'analisi dei dati nel momento in cui si hanno delle produzioni altamente variabili, perché, io faccio un esempio di una linea, di una delle nostre linee di punta, che si chiama "Libra 800", che è quella per produrre libri a formato variabile. Visto che i libri possono essere variabili uno dall'altro e quindi avere misure differenti (lunghezza, larghezza, spessore et cetera), se io capisco le tempistiche di produzione, le velocità della carta, le velocità in cui la macchina ha dei fermi, delle pause, dei rallentamenti et cetera, posso andare a fare che cosa? Ad ottimizzare quei processi che poi mi permettono di mantenere un rendimento più elevato, perché, per esempio, posso andare ad organizzare la stampa della bobina che poi dovrà andare ad essere processata, in modo tale che questa stessa bobina abbia i libri già pre-ottimizzati perché vengano in contro alle esigenze della nostra macchina ma, soprattutto, che la nostra macchina possa rendere al meglio con questa, appunto, questo prodotto. Quindi è molto importante: più dati riusciamo a raccogliere e, soprattutto, ad organizzare, più, soprattutto nella variabilità del prodotto, rimaniamo competitivi sul mercato. Questa fondamentalmente è un'idea su cui noi stiamo puntando molto.

Martina Bonollo: E' stata anche una richiesta da parte dei vostri clienti o più una vostra volontà di essere più competitivi?

Maurizio Gianetto: Entrambe, credo. I nostri clienti puntano molto su quella che è una produttività di tipo variabile perché questo è quello che impone oggigiorno il mercato. Non ci sono più produzioni, faccio sempre l'esempio, tanto per rimanere nello stesso ambito, di libri, non vi sono più le grosse produzioni di un milione di copie, 500 mila copie, solitamente, in questo momento. Le richieste sono richieste di piccoli editori, piccole case editrici, editori emergenti. Che, quindi, magari, inizialmente chiedono 100 copie/200 copie. Che cosa succede? Lo stampatore, cioè la persona che detiene sia le stampanti che le nostre macchine, deve produrre i libri finiti da poter poi dare a colui che ne faccia richiesta. Che cosa deve fare? Deve riuscire a collezionare insieme più ordini di piccole dimensioni per poter comunque tener attiva una linea, un'attività, con dei cicli produttivi che solitamente sono 24/7, quindi sono continuativi. L'idea è: vengono raccolti gli ordini tutti insieme, la produttività rimane invariata come quando si producevano lotti di grandi tirature. Il vantaggio è: si servono però clienti finali più piccoli.

Martina Bonollo: In termini di risultati, cosa avete ottenuto dall'utilizzo delle tecnologie dell'industria 4.0? (fatturato, clientela, produzione)

Salvatore Caronia: Allora in termini di fatturato, questo non saprei risponderti. Ma, sicuramente, in termini di soddisfazione del cliente, questo sì, già dal nostro progetto sulla prima linea su cui abbiamo installato il progetto di raccolta dei dati, proprio per i motivi che diceva il mio collega. Per esempio, abbiamo potuto vedere che, con alcuni formati, la linea

performava di più, e con un'adeguata sequenza di stampa si riusciva ad ottenere, si riesce ad ottenere, una velocità della linea complessiva maggiore. Oltre a questo, tramite la raccolta, per esempio, degli errori (perché noi raccogliamo anche gli errori di una macchina), l'analisi di questi errori da parte dei nostri tecnici, possiamo dare al cliente un tempestivo feedback. Questo significa che il cliente sa quasi immediatamente, non dico immediatamente perché ci sono clienti internazionali, chiaramente il dato è sì in tempo reale però, diciamo, c'è ancora un fattore umano che si interpone all'immediatezza, diciamo così. Quindi il cliente, tramite il nostro feedback, può andare direttamente andare alla fonte del problema e, in un mondo che lavora 24 ore su 24, è una cosa fondamentale per un cliente che quindi rimane fermo il minor tempo possibile.

Maurizio Gianetto: Guardi, le do solo un'indicazione molto vaga, perché poi, ovviamente, ci sono dei dati specifici su quelli che sono il fatturato, et cetera, che non possono essere ovviamente divulgati. Però consideriamo questo, in un mercato in flessione come il nostro che ha raggiunto nel tempo punte anche del 20% da un anno all'altro, la nostra azienda cresce ad un ritmo di circa 10-12% annuo, a grandi linee. Negli ultimi sembra che abbiamo raggiunto un plateau, nel senso che ci siamo più o meno fermati sulle dimensioni di grandi aziende. Più o meno questa è un'idea vaga sulla tipologia di azienda che siamo.

Martina Bonollo: Avete avuto cambiamenti organizzativi interni in seguito all'introduzione delle tecnologie dell'industria 4.0? (Riorganizzazione dei processi produttivi, dei processi di marketing, nella gestione del personale)

Maurizio Gianetto: Allora, diciamo che l'azienda, consideriamolo in un excursus temporale che parte dalla sua nascita, l'azienda ha adesso 30 anni. Per farle più o meno capire qual è stato il processo… Nel '98 le persone attive all'interno dell'azienda erano 18, 16/18, e l'azienda aveva un carattere di impresa locale, quindi limitata, ovviamente, solo al territorio italiano, per quanto magari la produttività fosse già anche idealmente rivolta all'estero, ma, comunque, la compagine era prettamente italiana. Nel 2013 siamo passati, con un aumento costante delle persone, nel 2013 siamo diventati una multinazionale con 3 centri, quindi uno anche in America e uno in Svezia, ed è stata la compagine italiana ad aver acquistato ovviamente le aziende estere. Ci troviamo attualmente (quindi nel 2019, quasi 2020) ad essere nell'ordine dell'intorno dei 300 dipendenti. Quindi direi che l'aumento è stato notevole. I processi, per forza di cose, sono stati ottimizzati. Ma anche proprio, dico solo, molto chiaramente, si sono divise le… La produzione si è divisa per linee, per tipologie di mercato e, oltre a questo, ovviamente, tutti i settori ne sono stati coinvolti. Perché, così come il settore dell'amministrazione, del dipartimento amministrativo, per esempio, è cresciuto, così è cresciuto il reparto officina e montaggio, il reparto di engineering. Engineering, tra l'altro, ultimamente, con degli stage, degli apprendistati con le scuole, abbiamo appunto cominciato ad utilizzare quelli che sono dei progetti alternanza scuola/lavoro per avere anche, insomma, menti fresche da poter formare in anticipo e per poi averle anche come, insomma, come ricambio generazionale. Perché il tempo passa e le persone, alcune escono dall'azienda, ed è giusto che menti fresche, insomma, entrino. E' un po' il nostro desiderio. Quindi, diciamo che l'azienda è in un processo sempre di divenire e penso che sia l'unico modo, attualmente, per poter mantenere un'azienda assolutamente in positivo perché, sennò, non avrebbe senso, appunto, un'espansione di questo genere.

Martina Bonollo: Quanto sono importanti, secondo voi, le competenze interne per l'adozione delle tecnologie 4.0? Queste competenze sono specifiche o generali?

Salvatore Caronia: Sono sicuramente molto importanti. Le competenze, in ogni campo, secondo me, hanno il 100% dell'importanza. E' anche vero che l'industria 4.0, e tutto ciò che è relativo all'industria 4.0, è un terreno nuovo, fertile, nel quale si può, secondo me, sperimentare. Poi non so se vuole aggiungere qualcosa la principale, la nostra softwerista che si occupa in prima persona di questo. Ma, sicuramente, appunto, un progetto così importante è stato dato a chi ha le capacità sicuramente di poter affrontarlo, ecco. Informatiche ma, non soltanto informatiche dal punto di vista proprio della costruzione di tutta l'impalcatura di questi software, ma dietro ci sta un lavoro anche molto grande di un team molto vario (e sono i nostri tecnici, sono i nostri progettisti) fino a, diciamo così, al progetto e alla costruzione del software di industria 4.0 e IoT. Ma successivamente c'è tutto un altro reparto, e io mi occupo anche di questo, di interfaccia tra cliente e azienda. Quindi di feedback, di service, di report continui, mandati tra noi e il cliente, di approfondimento post-vendita della linea con il programma di industria 4.0 installato. Giada, vuoi aggiungere altro?

Giada Grimaldi: Quando lei parla di Industria 4.0, in realtà dovrebbe ampliare un po' il bacino, il raggio di visione, perché questo comprende un po' tanti settori. Ovvero, è vero, sì, si parla di tanta informatica, di tanto software, perché ci vuole tutta un'infrastruttura sotto a livello aziendale che ti supporti. Poi ci vogliono anche le conoscenze delle persone che trasmettono un feedback dal campo, del cliente, quindi tutta la raccolta dati dal cliente e anche dai tecnici che vanno lì a fare, appunto, il service. E poi non solo, anche del, ad esempio, del reparto dei meccanici perché, senza le loro informazioni che sono poi alla base di tutto, non sappiamo… Ad esempio, faccio degli esempi, dell'usura, non sappiamo quanto un componente potrebbe durare oppure no. Quindi, in realtà, Industria 4.0 dovrebbe essere vista non solo come tool, come infrastruttura software, che, comunque, quella, purtroppo, bisogna dirlo, è un po' alla base. Però in realtà il parco utenti che raccoglie è tutta l'azienda.

Martina Bonollo: Come viene gestita l'innovazione all'interno della vostra azienda? C'è un reparto interno dedicato o è lasciata alla creatività dei singoli? Quanto investite annualmente in innovazione in termini di percentuale sul fatturato?

Maurizio Gianetto: Allora, diciamo questo. Siamo un'azienda che è cresciuta molto in fretta e che ha raggiunto la connotazione di multinazionale, appunto, dovendo fronteggiare quelle che sono le difficoltà del mercato, cioè quello di essere competitivi e di continuare a ingegnerizzare quelle che sono delle soluzioni nuove. Quindi, l'idea è che non si è potuto dedicare un dipartimento a quello che è lo studio dell'innovazione in sé. Però, l'idea è, per esempio, che in ricerca e sviluppo l'azienda investe più del 23% del suo fatturato per poter innovare. Quindi, questo, secondo me, è un dato già abbastanza caratteristico, per una questione molto semplice, nel senso… Le soluzioni, un po' come in qualsiasi mercato, si devono evolvere perché semplicemente cambiano quelle che sono le richieste dei clienti. Ed è un po' l'esempio che facevo prima, da una produzione massificata si è passati ad una produzione parcellizzata. Questa cosa la si ha in continuazione, quindi ricerca e sviluppo è anche questo: trovare le soluzioni che, competitivamente parlando, possono dare un vantaggio al cliente e, soprattutto, precorrere magari i tempi. Cioè trovare quelli che sono dei bisogni che possono ancora arrivare, non si tratta solamente di innovazione fine a se stessa. E' lo

stesso principio che si può applicare a tantissime cose: all'innovazione legata all'informatica, allo sviluppo dei computer, ma anche a tutta quella che può essere l'evoluzione della comunicazione sotto il punto di vista dell'immagine nei social. Si nasceva una volta e c'era il "communication manager", adesso c'è il "growth hacker" et cetera, et cetera, et cetera. E' proprio un modo di vedere le cose che cambia ed è un modo di rapportarsi con le cose. Quindi io cerco di, non solo più colpire il cliente, per esempio, con quelle che sono delle proposte ma cerco soprattutto di venirgli incontro. Questo lo faccio sia sotto il punto di vista del marketing e della comunicazione, ma lo faccio anche con la produzione vera e propria. Io fornisco quelli che sono degli oggetti, chiamati così (agli ingegneri non fa molto piacere), cioè delle soluzioni, dei sistemi che servono per semplificare la vita del cliente finale, che servono per venirgli incontro, e soprattutto per abbattere i costi, perché questo è un altro problema grosso. Abbattere i costi vuol dire, per il cliente che deve rivendere un prodotto, vuol dire, fondamentalmente, avere il coltello dalla parte del manico, nel senso di poter proporre delle cose molto più interessanti.

Martina Bonollo: Quali sono i vostri partner principali per l'innovazione? (Università, altre aziende)

Maurizio Gianetto: Diciamo così, come primo impatto, poi magari i miei colleghi le spiegano in modo un po' più dettagliato. Diciamo che la nostra tipologia di innovazione è molto semplice in prima battuta. Solitamente noi collaboriamo con gli stessi nostri clienti, che sono solitamente delle grosse realtà industriali, quindi nomi anche molto famosi, che, solitamente, che cosa fanno? Chiedono di perfezionare determinate tecnologie. Quindi la ricerca e lo studio viene fatto secondo una domanda abbastanza ben focalizzata. E questa cosa qui è già successa anche in passato con clienti storici, a cui inizialmente erano state fornite delle soluzioni e poi, con questi stessi clienti, queste soluzioni sono state rielaborate, rielaborate per, appunto, sopperire a delle richieste e hanno dato vita a delle linee di prodotto completamente nuove che, appunto, erano interessanti per il mercato e si potevano non solo più applicare a questo cliente ma ad un ventaglio di, insomma, aziende, società e clienti, molto più ampio.

Salvatore Caronia: Aggiungo soltanto che, per quanto riguarda invece il nuovo campo, come le dicevo prima, della manutenzione predittiva, lì abbiamo contattato anche l'Università, alcuni ricercatori che magari hanno già sperimentato la manutenzione predittiva, anche se in altri campi, e che ci potessero guidare, soprattutto all'inizio, in questa fase iniziale.

Martina Bonollo: L'introduzione delle tecnologie dell'industria 4.0 ha comportato cambiamenti nella gestione delle relazioni con i vostri fornitori e con la filiera in generale?

Maurizio Gianetto: Per rispondere a questa domanda, in realtà, non so se siamo le persone direttamente più in linea, perché bisognerebbe parlare con l'ufficio acquisti quando si parla di fornitori. Bisogna dire che, almeno, per la mia conoscenza in merito, c'è stata una automazione di questi processi. Nel senso, anche nella richiesta di parti di ricambio, pezzi, ordini et cetera, et cetera, et cetera, perché con la produttività aumentata, se no non si poteva stare dietro, appunto, alla richiesta di parti per la costruzione delle macchine. Non c'è… Non pensiamola, però, neanche troppo dalla parte di dire "è tutto automatizzato e il lavoro uomo non esiste". No, esiste eccome. Perché nel nostro ambito, la premessa che bisogna sempre fare

è, le macchine sono macchine molto custom, quindi spesso bisogna collaborare a stretto contatto con i fornitori per chiedergli determinate parti che vengono costruite che, se non singolarmente, però in piccolissime quantità. Quindi spesso, io quello che definisco solitamente il mondo del digital printing, ma soprattutto la nostra compagine, è una multinazionale atipica. Atipica per quale motivo? Abbiamo dei livelli di fatturato molto alti, produciamo macchine di altissimo livello ma spesso conduciamo una produzione di tipo centellinato, nel senso che le nostre macchine effettivamente vengono fatte ad hoc. E quindi questo sarebbe anche difficile da fare con un magazzino completamente automatico e una serie di appunto implementazioni completamente automatiche per gestire fornitori e cose di questo genere. Non sarebbe fondamentalmente possibile, perché spesso serve il contatto umano e discutere ingegnerizzando delle determinate parti specifiche.

Martina Bonollo: Quindi non scegliete i vostri fornitori in base alla loro predisposizione verso l'industria 4.0 ma per altri fattori

Maurizio Gianetto: No, io direi, in questo caso, assolutamente no. Anche perché, per una questione di abbattimento costi, ma, soprattutto, per una questione di, come dire, bisogno di avere materiali di un determinato tipo e di una determinata qualità, siamo sempre rimasti molto legati alla filiera che abbiamo creato nel tempo. Perché? Perché i nostri fornitori, in primis sono fornitori di zona molto spesso, sono fornitori che ci conoscono e soprattutto che possono sopperire anche alle emergenze che possiamo avere, in tempi limitati. In questo caso è come lavorare con una famiglia allargata, con una compagnia allargata. Perché? Perché la cosa aiuta un po' tutti. Noi riusciamo a produrre meglio e possiamo garantire comunque la qualità dei componenti, le persone, i nostri fornitori ci forniscono dei componenti che sono qualitativamente superiori perché conoscono il nostro mercato e i nostri bisogni.

Martina Bonollo: Il vostro modello di business è cambiato in seguito agli investimenti nelle tecnologie 4.0? (Ad esempio il passaggio da vendere prodotti a vendere servizi)

Salvatore Caronia: Diciamo che, per quanto riguarda il service, è cambiato il modo di fare service. Ora le spiego un po' quello che intendo. La nostra azienda offre anche… La nostra azienda Americana, la parte americana della nostra azienda è un'azienda fondamentalmente di service, nel senso che non vende macchine (le macchine vengono fatte o in Italia o in Svezia) e la sede americana, diciamo, si occupa principalmente del service. Quindi, quando il cliente fa un contratto con noi, viene anche venduto all'interno un pacchetto service, possiamo dire. Quindi un'assistenza post-vendita. Quello che è cambiato piuttosto è il modo di fare questa assistenza nelle macchine che hanno equipaggiato il nostro software, diciamo, di industria 4.0 e IoT. Nel senso che, come dicevo prima, c'è un contatto giornaliero tra noi e il cliente. Cioè il cliente ci manda i dati giornalmente, noi li analizziamo e, giorno per giorno, gli diamo un feedback diretto. Quindi mentre prima non si poteva, questa cosa non poteva essere fatta e quindi il cliente chiamava l'agenzia di service e quindi i nostri, per esempio, i nostri colleghi dovevano partire quando accadeva una rottura di una certa importanza, quindi la macchina era ferma per un tot di ore. Adesso noi siamo informati, praticamente, in tempo reale. Possiamo dare dei feedback in tempo reale e certe volte non c'è neanche la necessità di andare sul campo perché il problema viene, diciamo così, sistemato prima che la rottura, la fermata diventi catastrofica. Quindi sicuramente è avvenuto un cambiamento nel modo di fare service e quando questa cosa sarà ampliata a più macchine e sarà sempre più affinata et cetera, et

cetera, sicuramente cambierà totalmente il modo di fare service in generale, non soltanto per le linee più importanti come per adesso avviene.

Martina Bonollo: L'azienda ha usufruito o ha fatto richiesta degli incentivi governativi o regionali o intende richiederli?

Salvatore Caronia: La risposta è affermativa, Tecnau ha fatto richiesta di incentivi da parte della Regione Piemonte attraverso il bando IR2 (https://bandi.regione.piemonte.it/contributi-finanziamenti/bando-ir2-industrializzazione-dei-risultati-ricerca) a "sostegno alla valorizzazione economica dell'innovazione attraverso la sperimentazione e l'adozione di soluzioni innovative nei processi, nei prodotti e delle formule organizzative, nonché attraverso il finanziamento dell'industrializzazione dei risultati della ricerca". Gli esiti del bando non sono ancora stati pubblicati. Una cosa in merito alla domanda che ha fatto prima. Solo una piccola specificazione, siamo un'azienda che, fondamentalmente, è focalizzata sulla vendita di prodotti e non di servizi. I servizi sono un valore aggiunto che abbiamo implementato nel tempo (assistenza remota et cetera, et cetera, et cetera) ma il core business è la vendita di sistemi per la produzione. Tutto quello che è un'intorno è dato dal fatto che le macchine hanno un normale processo di usura e quindi hanno bisogno che ci sia un'assistenza costante. Fortunatamente non succede spesso per le nostre macchine, però l'idea fondamentale è questa: tutti i servizi accessori che sono stati creati e implementati, anche con l'aiuto di quelle che sono le prospettive di IoT, Industria 4.0, machine learning et cetera, et cetera, et cetera, sono volte a sviluppare comunque la vendita di un prodotto, non la vendita di un servizio accessorio. Anche se poi questo può essere utile, si potrà sviluppare nel tempo con sistemi di analisi e di controllo ma la punta, ma ciò a cui puntano questi sistemi è sviluppare e ottimizzare le macchine che vengono, che da noi vengono prodotte e vendute. Questa è l'idea.

Martina Bonollo: In che modo gli investimenti pregressi in ICT (software gestionale, sito web, social media) si sono rivelati importanti per sfruttare il potenziale delle tecnologie dell'Industria 4.0?

Maurizio Gianetto: Sotto il punto di vista sito web, social media, et cetera, devo dire che, per adesso, il cambio c'è stato, ma l'impatto della tecnologia per noi è stato marginale, assolutamente. Discorso diverso per quello che può essere il software gestionale interno dell'azienda e quant'altro. Dalla parte appunto di comunicazione, per carità, ci sono stati sviluppi, si è cercato di fare un'analisi di quelli che sono i dati ricavati appunto dai servizi social, che possono essere Linkedin, Twitter, il sito, et cetera, Google e tutti gli altri servizi annessi e connessi. Ma queste cose sono delle… Io le definisco "analisi soft", perché? Perché, diciamo, il mercato in cui operiamo è un mercato, di nuovo, molto particolare, è un mercato di nicchia, quindi le politiche normali della comunicazione del marketing si possono adattare ma fino ad un certo punto. Da un lato è un grosso vantaggio, da un lato è un grosso svantaggio. Un grosso vantaggio perché? Perché siamo un settore così di nicchia che per farci trovare non c'è una grandissima difficolta. Effettivamente le aziende che operano nel nostro ambito, che soprattutto producono macchine come le nostre, sono poche. Lo svantaggio è che, in un mercato di questo genere, l'utenza è molto bassa ed è una utenza con delle richieste molto elevate. Quindi, spesso, è difficile poter incontrare il cliente finale o ad avvicinarsi ad esso. Spesso, le faccio l'esempio, il manager aziendale che poi è la persona che decide fondamentalmente l'acquisto o no e l'implementazione di una nuova linea, magari, detto

proprio in parole povero, è così tanto impegnato che i social non li vede assolutamente. Magari li guarda lo stesso reparto marketing dell'azienda ma sono due entità e due realtà completamente differenti. Quindi l'idea, per esempio, di lavorare all'interno dei social, sviluppando dei sistemi e automazioni, et cetera per il release di articoli piuttosto che commenti, post, eventi et cetera, è fatta nell'ottica di aumentare la consapevolezza del brand . Ma spesso nulla delle cose che vengono pubblicate, cioè… Non siamo, non possiamo e non potremo mai funzionare come un sito di e-commerce che si fa pubblicità perché può vendere direttamente un prodotto. Le nostre linee sono delle linee che sono difficili da vendere e devono essere venduta con una grande cognizione di causa, solitamente dopo che ingegneri da entrambe le parti si sono incontrati e hanno discusso le necessità. Quindi i social e tutto questo sono sempre e solo un'idea di posizionamento di branding come compagnia, secondariamente come prodotto. Quindi le nuove tecnologie aiutano ma sono una parte minima, diciamo.

Martina Bonollo: Come gestite i dati generati dall'IoT? In azienda o nel cloud? Autonomamente o tramite aziende esterne? Come vengono utilizzati? Come stanno modificando il business model dell'azienda?

Giada Grimaldi: Dal punto di vista dell'infrastruttura informatica, abbiamo un'azienda esterna che ci dà un supporto per quanto riguarda appunto l'infrastruttura, la sistemistica, dal punto di vista sistemistico. Mentre lo sviluppo del software è tutto fatto da noi. Non ci appoggiamo, per ora, sul cloud per scelta del direttivo, però non escludiamo che in futuro ci si possa tranquillamente andare. Quindi, per il momento i dati immagazzinati vengono salvati su un PC fisico presso da noi… Anzi, in realtà è virtuale, ma è comunque da noi la macchina fisica. Tutto il software che viene prodotto, appunto, lo sviluppiamo noi. Perché è proprio customizzato.

Martina Bonollo: Quanti server avete, circa?

Maurizio Gianetto: Allora, fondamentalmente l'azienda… Io parlo però solo della parte italiana perché poi è un discorso a sé stante. Diciamo così, cerchiamo di semplificare. L'azienda dispone di 3 main servers, uno è in Italia, uno in Svezia e uno in America. I server sono collegati tra loro tramite collegamenti VPN. Io per server intendo il corpus di strutture informatiche all'interno di ogni azienda, di ogni sede. Dopodichè ovviamente ogni sede ha, per ogni servizio, un X numero di macchine virtuali che fungono da server veri e propri, che stabilisco in un ordine di grandezza delle 15/20 per sito. Quindi sono circa 45 in totale.

Giada Grimaldi: Diciamo che il grosso dei main server sono comunque in Italia. Perché tutta la parte IoT è da noi.

Maurizio Gianetto: La parte relativa solo all'IoT, sì. Però per tutto il resto anche le altre…

Martina Bonollo: Nella mail avete detto che avete non Big Data ma dati relazionali, se non sbaglio.

Salvatore Caronia: Sì.

Martina Bonollo: Questa produzione di grandi dati, anche se non sono Big Data, vi stanno spingendo verso l'adozione di Intelligenza Artificiale?

Maurizio Gianetto: E' troppo presto secondo me. Cosa intende per Intelligenza Artificiale? Bisogna forse fare in distinguo qua, un po' più nello specifico.

Martina Bonollo: Se volete voi descrivere un po' voi cosa intendete con Intelligenza Artificiale in modo da non creare confusione.

Maurizio Gianetto: Ok. Io per Intelligenza Artificiale intendo sistemi in grado di elaborare dei dati e creare in autonomia delle azioni, tanto per semplificare, perché il discorso sarebbe ancora un po' più complesso. In questo momento, non mi sento di parlare di intelligenza artificiale nei nostri ambiti. Mi sembra un discorso ancora inziale. Si potrà parlare perché si può legare il tutto a quello che può essere l'Industria 4.0 del sensore che riceve un input, quindi lo fornisce al computer della macchina e il computer della macchina elabora una risposta e, soprattutto, dà una risposta che può essere un aggiustamento, et cetera. Ma qua iniziamo a parlare di qualcosa di più avanzato e di questa manutenzione predittiva et cetera, et cetera, et cetera che però è in una fase iniziale.

Salvatore Caronia: Esatto. .

Maurizio Gianetto: Non mi sentirei di dire che Tecnau fa già sistemi di intelligenza artificiale perché sarebbe un grosso salto nel vuoto.

Martina Bonollo: Conoscete il Competence Center delle Università del Nord-Est? E' un insieme di Università e piccole/medie imprese che cercano di diffondere l'Industria 4.0 tramite attività formative, di laboratori di interazione, et cetera.

Maurizio Gianetto: No, io personalmente no.

Salvatore Caronia: Personalmente no, però è interessante. Ci informeremo adesso.