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"How will industrial jobs evolve?" The new particular relationship between Man and Machine in the Industry 4.0.

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ACADEMIC YEAR 2017-2018

-"How will industrial jobs evolve?"-

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Chapter 4: Empirical Findings

Chapter 5: Data Analysis

Introduction

You can imagine, create and build the most wonderful place on earth but people will always need to make the dream come true ".[1]

Inspired by this famous quote of the greatest animator in the world, Walt Disney, this piece intends to analyze human capital and its value as a decisive and central factor both in the strategies and in the objectives of an organization.

Let's imagine the company organization without the presence of human capital: who or what would be able to keep the company up and running?

If in the last century this concept could be the theme of a science fiction movie or the sequel of "Back to the future", today is no longer the same situation.

Reality is changing, and we are in the new industrial age 4.0.

The standard concept of an organizational model tends to fade and to be replaced by innovative forms based on technological development and on the application of state-of-the-art systems and software which are able to create a new reality amplified by efficiency and speed of production.

What is this concept about?

In order to achieve the objective of the current research, it is necessary to consider the Industry 4.0 as a whole applicable not only to industrial production activities but also to the entire sphere, characterized by this revolution able to increase the communication and exchange network, manage the protection through cyber security and increase the reality compared to what has been thought and implemented.

And at this point another question arises: if all the above is possible, will Italy be able to face and exploit this opportunity?

The aim of my work is to analyze the radical change that is taking place with the advent of the 4th industrial revolution, underlining, with respect to the three industrial revolutions that preceded it, the speed of technology development, the digitalization of production processes and the fast interconnection. The first exploratory part of the work aims at framing the concept of Industry 4.0 to the "state of the art", thus starting from the

[1]Walt Disney, https://www.thewaltdisneycompany.com/

Italian situation included in the European scenario, with a particular attention to Germany and France that represent the opposite situations for the applicability of the Industry 4.0 principles.

Then I will illustrate the new technologies that are the protagonists of the phenomenon, that new companies cannot disregard if they want to fully exploit the benefits they can bring.
A disruptive evolution means that it is not only possible to improve the production by using new technologies such as digitalization but to reinvent the organization of the company, and guarantee the new tools and skills toward workers to be able to implement the principles of the 4.0 Industry and gain value. It is then useful to do well on how to reach the platform model and how the impact of the application of new technologies and platform models lead to create a transversal and innovative system, by eliminating the patterns of the old business organizations and providing a future for new professionals. The concept of Open Innovation and its expression trough different types of Platforms will be considered as innovative results of Industry 4.0, where the advention of new technologies give the possibility the make share of information and cooperation between companies abandon the traditional business organization (vertical organization) and make more attention to the horizontal one.[2]

Stating this, we propose, firstly, to raise the question; how is it possible to create new place of work, even more, create new works of the future? How can these principles to be implemented considering a new organizational scheme of the company based on Industry 4.0?

The centrality of the human factor is confirmed by the World Economic Forum[3], which emphasizes that, by 2020, one third of the skills required by the employees will include skills that are not considered crucial for the role played today.

[2] Markus Nordlin, CIO Zurich Insurance, *Accelating Digital Transformation*, Capgemini/Counsulting Analysis,2013

[3] The World Economic Forum is the International Organization for Public-Private Cooperation.The Forum engages the foremost political, business and other leaders of society to shape global, regional and industry agendas. It was established in 1971 as a not-for-profit foundation and is headquartered in Geneva, Switzerland.

Therefore, loss of jobs or new opportunities and training of new professionals for tomorrow?

New skills will serve the world of work concerning the human factor, so that it will be possible to reach those working prototypes that today are only imaginary.

The research question, to which we want to give an answer, it is considered the starting point for providing a general overview of the phenomenon that allows us to understand how a company can increase its success and performance by adapting to new needs. A further question to which we are going to provide an answer is: "are new technologies a threat or not? Is there an actual risk of man-machine substitution? "

This work will be able to positioning the possible results based on a survey conducted on some companies through which will be possible to have the different interpretation and implication of the application, of that points that we will analyzed in detail later.

To start

First of all, we should start saying that Italy is not - often many people forget it - the bottom of Europe. The Italian industry can boast the second position (2.3% share), as far as reference to the manufacturing sector at European level is concerned, nonetheless, to keep this rank, it has to invest culturally and strategically on its modernization.

The concept of "speed" takes a central role in the choices that individual companies implement.

To understand which opportunities the Fourth Industrial Revolution offers, it is sufficient to start observing the strategic pillars of the actions of the National Industry 4.0 Plan. This piano is known as Piano Calenda and will be considered the representative starting point of the revolution.

The "key" goals are[4]:

- supporting innovative investments by increasing spending on Research & Development;
- supporting technological investments so that the Company becomes increasingly digitalized.

– increasing the know-how of human capital by developing the necessary skills required by the new markets.

[4] MEF, *Piano Nazionale Industria 4.0,* 2017-2020, *Investimenti, Produttività, Innovazione,* 22 Maggio 2017

These targets are meant to ensure a suitable context for the development of the digital transformation; for examples the adaptation of the network infrastructure or the guarantee on private investments.

Among micro and macro aspects, it is essential to highlight innovation as one of the basic aspects in order to implement the revolutionary aspects that characterize industry 4.0. However, we can analyze the concept of innovation in a strict sense in this context where "to innovate" does not mean to automate the "factory" *tout court*[5]. The new vision wants to describe an intelligent factory, in which people and tools are integrated. In fact, without people it would not be possible to realize efficiently any kind of innovation. The center of the study, returning to the words expressed by Walt Disney, is to study how human capital can be "reused" in order to enhance the new technological levers rather than disappearing from the industrial scenario.
Companies use machines, the new Cloud, platforms and innovation systems in order to create a perfect system, which is able to achieve the targets. Thinking about a company without human capital would be like thinking of a body without a soul, where the vital impulses necessary for coordination are missing.
Based on that, it is difficult to define in one way the Industry 4.0.[6]
The interaction of different types of technologies allows the companies which are able to take advantage of this convergence to achieve levels of synergy between high internal structures.

However, there is still no definition of Industry 4.0 because within the same phenomenon various enabling technologies are involved. Industry 4.0 remains the theorization of a new production paradigm based on the interaction of computers and physical systems?
They are both present in the same production process.
Talking about Industry 4.0 in paper corresponds to focusing purely on the aspect of human resources. Human resources from the revolution can reap benefits and advantages but at the same time they have the awareness and the fear of not being necessary for their companions. The main fear for employees is as obvious to lose their own job.

[5] *Industria 4.0 Uomini e macchine nella fabbrica digitale*, Annalisa Magone e Tatiana Mazali, march 2016
[6] KPMG, *The Factory of the Future- The challenges for Tomorrow*, part 1, 2017

In this view, with the concept of Industry 4.0 where robotics, software and innovations of integrated technology are at the top of the debate, the paper does not want to give up the human aspect. The worker 4.0 collides with the difficulties and obstacles that this revolution places in front of him.
In history the revolutionary waves have always dealt with the adaptation of the society to the "new" principles that these have brought.

The world changes, goes on, transforms their aspects, so without the man as a worker, family, society that assimilates these changes and makes them daily activities, no results will ever find a positive response ...
Therefore at the end of the study the paper turns to the analysis of the above described phenomena in a context of human re-classification within the new industrial era 4.0, and how the creation of new platform models will be the new starting point for the industry organization and therefore, at the same time, the capability of the industry world to be able to accept and introduce the future of the jobs.
The document also provides surveys data and detailed information to support this thesis as well as a general overview of what is has already happened.

Chapter 1: The Industry 4.0 phenomenon

Industry 4.0 is a word that is popular in the economic and media world, it is a buzz that passes from social media to literature, from academics to scientists, who analyze the concept in a deep-way in order to provide a broad and detailed definition of it. We are talking about Industry 4.0 phenomenon not only in Europe but also globally.[7]

Since the German Federal Government, which was a pioneer of the revolutionary wave with Industry 4.0- having announced in 2011 the intention to put the innovative aspects generated by the revolution 4.0 as one of the fundamental points of the technological development strategies in the mechanical, economic and industrial field - there were many academic publications that through reports, essays, books and conferences focused on the topic starting to define the boundaries of its application.[8]

The literature, following the revolution, start to focus on events with the characteristics: "new", "different", "updated", and also analyze how these aspects are applied by companies to meet the growing demands of the market in terms of efficient application methodologies that generate positive effects.

It becomes necessary, as for every revolutionary wave, to come to the definition of the pillars on which the Industry 4.0 must base its roots.

"In this hyper-technological scenario, man remains the task essential to bring creativity, to govern technologies, to design systems, control and improve production processes and consequently also the products and services"[9]

It is difficult to establish a starting date for the revolution 4.0; the beginning is now, it is still ongoing .... only afterwards will it be possible to indicate the founding act.

It is possible to start from the assertion that in history there have been several revolutions, leading the world to be as it is at present and simplifying the life of society. The first, the

[7] A.Dujin, C.Geissler, "*Think Act,The Industrie 4.0 transition quantified*", Roland Berger, April 2016

[8] A.Dujin, C.Geissler, "*Think Act,The Industrie 4.0 transition quantified*", Roland Berger, April 2016

[9] cit; Satoshi Kuroiwa-Toyota

second and the third industrial revolution are the starting point that allows us to reach the last revolutionary wave in analysis.[10]

Starting from the origins and stating how each revolution has a specific connotation based on population, geographic area and timing of implementation, the three industrial revolutions that have followed in the Western world differ in the progress they have caused to society radically changing aspects related to the economic world. However, if the association with past innovations has implemented within the economic-industrial system, the effects of 4.0 are still in the experimental phase of implementation and evaluation.

The first industrial revolution is considered a process of economic / industrial evolution that, from a farming-commercial-artisanal system, created a modern industrial system characterized by the use of machines. Based on the above, we have witnessed the first technological and economic progress; the steam engine was introduced in 1784, and consequently the use of water as motor power also used in its steam form, to mechanize production.

In this way the whole textile and metallurgical sector is mainly affected, but it involves all sectors from agriculture to population, transport, trade and industry. The "machine" that replaces and speeds up the activities carried out by man becomes the protagonist of the described event. The machines, with ever simpler technology, do not require special training of workers who thus found more and more jobs.

Technological progress led to population growth and a growth in demand for goods and services. The increasing production, the opening of the markets, thanks to the development of the railway system, were certainly among the bases that led to the birth of the second industrial revolution, which began between 1856 and ended in 1878.

Its main features are: the superiority obtained in the scientific field and the substantial flowering in the technological field, strengthened by the discovery of new energy sources, the use of oil and electricity in the daily life of the company both in the economic– and industrial field, as well as in the everyday life of society. At the same time, the use of new communication and transport systems starts in this period.

The innovations that characterize the 2/4 of the revolutions that we will analyze are the combustion engine and the electric one, the new sources of chemical and hydroelectric

[10] E. De Simone, *Storia economica: dalla rivoluzione industriale alla rivoluzione informatica*, Franco Angeli, 2014

energy, the use of new materials such as aluminum and iron. The progress achieved by the invention of new machines for the industries that allow the increase in production is of remarkable importance.

Industrialized Countries begin to invest in education and scientific research; the craftsman begins to replace the factory, the organization of work and specialization are aimed at obtaining maximum results and maximum profitability.

Instead, electronic interventions and the development of telecommunications (mothers of new social platforms and information interconnection) mark the birth of the third industrial revolution around the end of the 20th century.

The three industrial revolutions indiscriminately lead to an economic revolution and the invention of new engines and energy sources each characterizing its era of belonging. They shift attention to the human and social aspect. The three revolutions have led to other social revolutions highlighting the first inequality of income between the social classes especially by the peasants, in the second instead improve the conditions of the workers reducing the disparity, same reaction is generated by the third revolutionary wave where, however, increased the difference in salary among the workers.

Finally, a third connection between these is the will of the three revolutions to improve the everyday life of the city man, allowing him a profitable job in the shortest time possible with the aim of increasing production and reducing time.

However, despite the succession of three revolutionary waves, it is the third, which accompanies until the contemporary era, known as the digital or computer revolution, which has developed the inclusion of radical technologies, high-level processing devices ("mainframe computers ", the 60s), personal computers (the '70s and' 80s) and the spread of the Internet (the Nineties), bringing down those belonging to the electrical and analog sectors.[11]

Digital technologies, therefore, are not new to the 4th industrial revolution, but unlike the previous one, in this they are distinguished by a higher level of integration and sophistication that leads to the transformation of global societies and economies.

IT systems able to interact with the physical systems in which they operate and which are equipped with computational capacity, communication and control; technologies that, if exploited to their full potential, lead to the increase of the competitiveness among the

[11] E. De Simone, *Storia economica: dalla rivoluzione industriale alla rivoluzione informatica*, Franco Angeli, 2014

industries increasing the single levels of value compared to the competitors and through the growing integration of the "cyber-physical systems"[12] (CPS) of the industrial production.

The new company needs to be lean, fast and quick in execution; the consumer determines the demand in a very variable way. The company must respond to the continuous fluctuations of the market in a very flexible manner.

It should be noted, however, that the 4th industrial revolution does not exclusively concern the possibility of having always connected digital tools, its field of application is much wider; we witness the simultaneous development of different innovations from the scientific field (DNA sequencing), nanotechnologies, renewable energy, quantum computing.

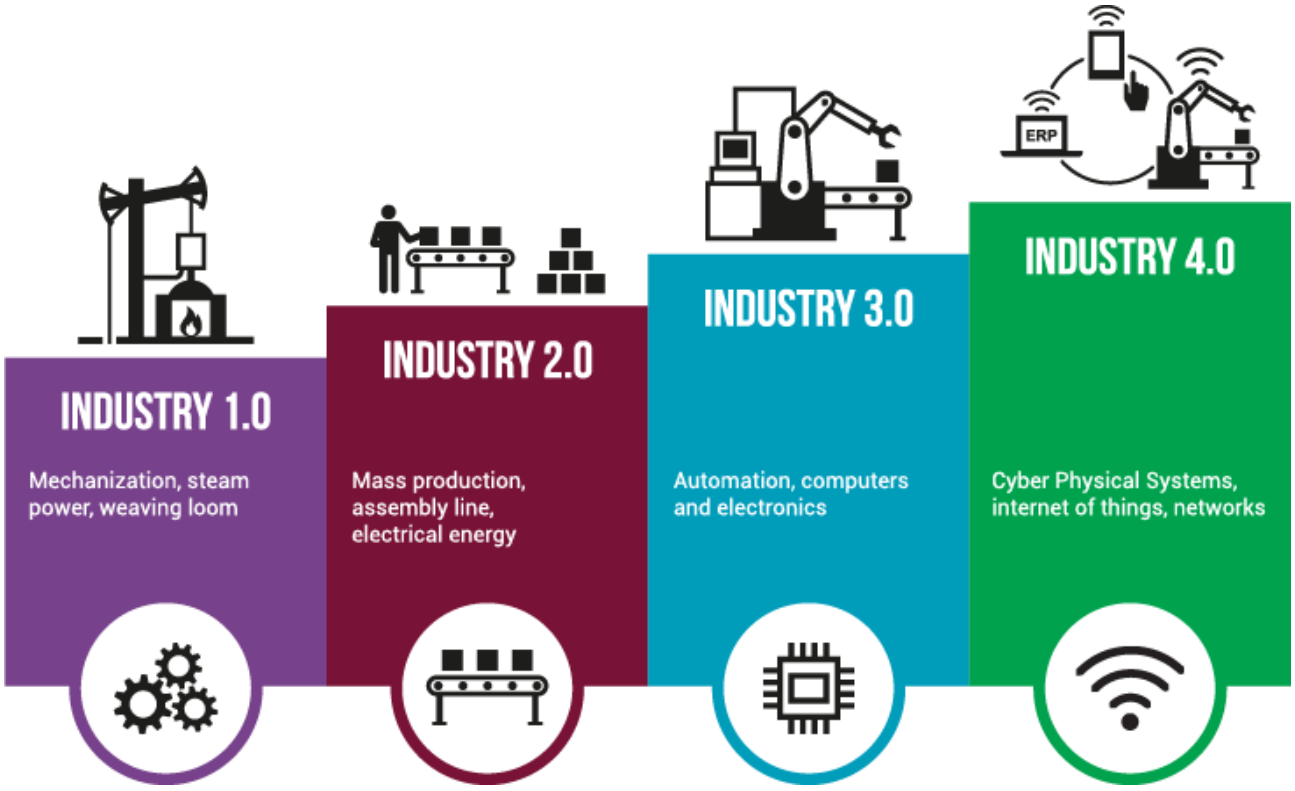

Figure1: Industrial Revolution; transforming industries and innovation (Source: http://spacenews.com/sponsored/industrial-revolution/) IFF Research 2018

[12]PWC "*Cogliere l'opportunità del rinascimento digitale* ", 2015

We find ourselves, it is true, in the wake of the 3 previous revolutions, in an almost natural evolution of 3, but this 4th revolution stands out from the others for these 3 points, supported by Klaus Schwab, founder of the World Economic Forum:

-*Speed*: each change is occurring at an exponential speed differently from the linear velocity that characterized the previous revolutions; fast interconnection leads to the creation of ever-new and increasingly performing technologies;

- *Scope and Intensity*: the transformation underway combines various digital technologies, with a profound heterogeneity of its effects from an economic, corporate and social point of view

- *Impact on systems*: the nature of this revolution indiscriminately affects countries, sectors, and individuals, hence society in general. Technology is not an exogenous force, but must be woven into the social fabric and not suffered. It must become an instrument to improve society and not a force on which the individual cannot exercise any control.[13]

Technology and digitization will be completely revolutionary for our times. Innovation, understood both as development and diffusion, travels at an "unprecedented speed" to use a “Schwab term”.
Examples are companies like AIRBNB[14], or UBER[15], whose development was lightning fast in no time; or even the Apple[16] case, with I-phone (just to use one of the most popular products, for example), launched on the market in 2007 and today the best-selling smartphone with about 2 billion pieces (Apple data, 2015).

Another characteristic is harmonization, understood as the integration of different technologies and innovations. Neri Omar, designer and architect give us concrete examples of what has just been described, combining aspects of different disciplines, computational design, additive manufacturing and materials engineering, to create

[13] K. Schwab, *The Fourth Industrial Revolution*, Franco Angeli, 2016
14 (**AIR B & B**) A lodging reservation website from Airbnb, Inc., San Francisco, CA (www.airbnb.com) that lets property owners list their spare room, apartment or home in thousands of cities worldwide. Founded in 2008, as of 2016, Airbnb had more than two million listings worldwide.
15 Uber is a technology platform. Our smartphone apps connect driver-partners and riders.
16 Apple is a prominent hardware and software company.

systems that favor the interaction between microorganisms, such as our body, what we consume and the houses in which we live.
It is the information revolution, because the possibility of interconnection between the various parts of the world has developed the phenomenon of globalization.

Digital is the transition to the use of PC and advanced systems and software able to store data and documents. The innovation is therefore linked to the birth of computers, robots, the first spacecraft, space and satellites.
In this way it is the expression with which the transformation of the productive structure is portrayed and therefore, more generally, of the entire socio-economic factory that involves an advancement of the whole society.
For the first time, we can say that an industrial revolution has been announced "*a priori"*, and not in line with what happened in history, only looking at the consequences generated. For the first time, companies have the opportunity to budget and define objectives in a concrete way. The new tools provided by the technology of Industry 4.0 offer the chance to use databases, computer systems software in the manufacturing robots and machinery field which allow maximizing the output of the different activities. In this way, differently from the economic trend of the past, the effects generated by the revolutionary actions have not recorded positive or negative results by attacking the standards registered by the reference market until that date.
In this regard, companies, having the opportunity to concretely predict the results of their management administration have placed at the top of their objectives the ability to achieve a zero percentage of errors deriving from their activities managing to control the possible creation of contingencies.[17]
The above is in contrast with the thesis in the scientific field. The literature on the subject provides more articles in which a thesis is emphasized in opposition to the premeditation of the effects. It is stated that although Industry 4.0 is a top priority for many research centers around the world, most of the articles do not take into account a pre-definition of the cause-effect relationship of new technologies and systems 4.0 but that provides a wider vision

[17] M. Tiraboschi, F. Seghezzi, *Il Piano nazionale Industria 4.0 : una lettura lavoristica*, Labour & Law Issues, Adapt, vol.2, N.2, 2016

This is how, the main promoters are divided into two different groups: those who have limited themselves to describing a general panorama or, on the contrary, those who have focused on a very specific scenario with the possibility of avoiding an overview that is necessary to correctly analyze the phenomenon.

Until 2015, we can state how the concept of Industry 4.0 was a term with an open meaning, which was supported by a series of more or less valid arguments, but without giving an exhaustive definition. In the first place, companies showed some confusion and perplexity in trying-to take the initiative and implementing an idea 4.0, without knowing what it was.

From a quote from "*l'Industrie 4.0*", we can reach an exhaustive conclusion in the first attempt to arrive to a definition of Industry 4.0. This is therefore expressed in this way; "One of the topics most frequently discussed, but nobody was really able to explain to a child what it consisted of".

In this way it is stated that the principles of the industry 4.0 are treated by different agents and in heterogeneous fields, including a general sphere of meaning but without being able to summarize the specific detail of the revolutionary phenomenon.

There is talk of Industry 4.0 but there is no real economic manifesto on the subject. So, returning to the quote it would be complex to respond to the various "why?" of a child curious to know the Industry 4.0 in its detail.

Only in 2015, a research group tried to give an organic definition of the topic summarizing all the literature about the subject. The results of the research, showed a first overview of the key aspects of the phenomenon, showing the benefits, defining the objectives and basic constituent elements that were characterizing it, as well as the methodology chosen to define the application of the principles, in addition to analyze the changes related to the various operators involved.

Furthermore, since the 4.0 industry is supported by technological innovation, the main technologies used and the possible uses are exposed.

What does it mean for industry 4.0?

This new concept describes the integration of all the value-adding business divisions and of the entire value-added chain with the aid of digitalization.

This is only the first of a long series of definitions that we will meet in our path, trying to reach at the end of the paper every significant aspect of this phenomenon.

This revolution 4.0 is the economic and mechanical paradigm to create value; as it is indicated in a simple phrase, Industry 4.0 means "to paradigm shift in companies' manufacturing strategies."

The term became publicly known in 2011, when for the first time in Germany, during the Hanover Fair, the term "*Industrie 4.0*" was publicly pronounced by a group of researchers chaired by Siegfried Dais; the name was chosen to refer to the work they performed. The President, belonging to the engineering and electronics multinational, Robert Bosch GmbH, and another expert in the field, Henning Kagermann of the Acatech (German Academy of Sciences and Engineering) presented to the German Federal Government a series of recommendations for its implementation. Then, in the year 2013, on April 8th, the final report of the working group was published at the annual Hanover Fair.

The fair was made up of a series of representatives of the economic, political and academic fields and promoted the idea of an approach to strengthening the German manufacturing industry. The German government supported the idea by announcing that *Industrie 4.0* would be an integral part of Germany's technology innovation project, with an implementation in 2020, with which the country expected to assume world leadership in technology.

Industry 4.0 was born in the manufacturing sector, but it has been spreading over all the various fields of application of new technologies.

The initiative promoted in Germany is part of the "High-tech Strategy 2020" plan, which was supported by approximately 6000 companies. The target of the plan is to develop a new concept for the future of industry in particular in the manufacturing sector. Obviously similar initiatives were undertaken also in other Countries of the world.

Similar projects for example are: Smart Manufacturing Leadership Coalition (USA) and the US Advanced Manufacturing Initiative in the USA, Cyber-Physical Systems Innovation Hub in India, e-F@ctory in Japan and the Horizon 2020 framework program encompassing the entire European Union.

Therefore the new industrial revolution creates a vision of the future that aims at finding a unique system able to link both the real and virtual world. Business activities will create a network of connected networks that link machinery, production activities and production facilities.

The concept of CPS, previously mentioned in the paper as Cyber-Physical Systems, allows the creation of a productive system capable of exchanging multiple information, implementing decisions and providing-reciprocal controls among the systems.

These innovations allow a significant improvement in terms of production and in the use of raw materials and data, as well as a significant development of the supply chain and the management of the product life as a whole.[18][19]

The benefits of the revolution are widespread but the most significant are: greater flexibility, higher standard of quality, both for products and processes, an increase in the speed of realization and delivery of the product. The entire production system becomes "Smart", creating a network capable of bringing an additional value to the product and following it from its initial phase to delivery (End-to-end relationship).

1.1 European Framework; the Italian National Calenda Plan, Germany and France

The part that we will analyze in this paragraph, following the volunteer to expanding the scope of action by framing the Italian Plan (Calenda) in an International context, taking into consideration the initiatives of other Countries that more or less have implemented programs to support the Industrial Revolution number 4 and therefore the development of the new Industry 4.0.

The world is characterized by Countries and populations, territories and urban areas, traditions and different cultures that lead to detect modes of dissemination, application and subsequent results in different ways according to the needs and the best way to receive the result.

It is possible to see how some Countries are represented by analogies of approach and others are characterized by their total differentiation both in the way of implementing the principles underlying the 4.0 Industry and in their effective implementation.

On the basis of what it is expressed, the world is subdivided into three approaches at the 4.0 Industry, having indeed a more German approach, an Italian one and finally a French one.

[18] William MacDougall,*Industry 4.0, Smart Manufacturing for the Future*, German Trade & Invest

19 MEF, Piano Nazionale Impresa 4.0, Guida agli Investimenti, 19 Settembre 2017

The three models also involve other Countries and, to make the situation easier to perceive, let's have a look to the list below.

• Research oriented model: Germany, Japan and the United States
• "Enterprise oriented" model: Italy
• Mixed model: France and United Kingdom

If the world can be unpacked in three different models, we have to say that in most cases the model followed is the German one, therefore we will start with our Italian Plan to develop the analysis of the phenomenon and then to subsequently move deep into the analysis of Germany and France.[20][21][22]

The Italian scenario: The Calenda National Plan

"Italy is a great industrial Country. Our manufacturing companies represent the engine that drives the Country's economic growth and development thanks to their ability to produce wealth and employment, make associated industries and services flourish, and contribute to the Country's financial, economic and social stability"[23]
It is therefore in Italy's interest to create an environment that is favorable to business. Industrial policy is back on top of the Government's agenda and the tools that we have introduced are tailored to the trademark entrepreneurial spirit within the Italian economy, and are well suited to the new phase of globalization and major technological change we have already embarked upon.
The "*Impresa 4.0*" National Plan, represents a major opportunity for all companies that are ready to take advantage of the unprecedented incentives offered by the Fourth Industrial Revolution.

20 MEF, *Piano Nazionale Industria 4.0, 2017-2020, Investimenti, Produttività, Innovazione*, 22 Maggio 2017

21 MEF, *Piano Nazionale Impresa 4.0, Guida agli Investimenti*, 19 Settembre 2017

22 Comitato Leonardo, Kpmg, *Industria 4.0 per un'impresa globale: la dimensione del fenomeno, le implicazioni per il paese, le policy*, 13 November, 2017

23 MEF, *Piano Nazionale Industria 4.0, 2017-2020, Investimenti, Produttività, Innovazione*;

The Plan in Italy provides for a wide array of consistent and complementary measures promoting investment in innovation and competitiveness - all measures that have proved their effectiveness in the past have been strengthened under a "4.0" logic, and new measures have been introduced to meet new needs.

The Government and the business community as a whole must make the most of this opportunity.

This is why we have embraced a new paradigm of policymaking: we have planned measures that every company can put in place automatically – thus avoiding any evaluation procedures, any restrictions in terms of its size, sector or location.

As demonstrated by the considerable financial resources that have been committed to the Plan in the coming years, this Government is offering enterprises that want to grow and innovate a new deal.

The "*Impresa 4.0*" National Plan will affect every step of the life cycle of companies that want to improve their competitiveness by supporting investments, the digitalization of industrial processes, improvement in workers' productivity, as well as the development of new skills, new products and new processes.

The success of the "*Impresa 4.0*" National Plan depends on the extent to which entrepreneurs take advantage of the measures that have been put in place."[24]

The National framework defined by Minister Calenda in the aforementioned part, makes it possible to consider the phenomenon of Industry 4.0 as an "Industrial Revolution" which, by striking the global economic and industrial system, modifies relevant aspects of their economies in a radical way and at a speed without precedents. Italy first and foremost as other governments (Germany and France later) is launching incentive measures towards these changes and developing strategies in terms of interactional competition that to date are starting to register potentially positive effects generated by the transformation.

The Government, with the aim of promoting, implementing and disseminating the fourth industrial revolution through the implementation of the National Industry 4.0 Plan, carried out in advance a research concerning the characteristics of the Italian industrial sector, which should have gone to welcome and make it its own new innovative principles adapting them to the sector they belong to in a compliant manner.

[24] cit; Carlo Calenda Italian Minister of Economic Development.

The Plan launched by the Government takes into consideration three guidelines and it is based on four areas of intervention defined in order to achieve the objectives that the Government has imposed.

Guidelines:

- Operate in a logic of technological neutrality
- Intervening with horizontal and not vertical or sectorial actions
- Act on enabling factors

The areas of intervention where the Government intervenes in order to achieve the objectives are:[25]

- Innovative investments
- The skills
- Enabling infrastructures
- Public support tools

The national Industry 4.0 plan emphasizes the question concerning the objectives to be achieved; particularly important is the attention to new Investments will tend to increase into different sectors; private sector, broadband infrastructures, digital sales chains envisaged in the Made in Italy.

Other particular focus is also made on the skills section, where the initiatives promoted by the National 4.0 Industry plan are aimed at promoting training and specialization for 200,000 students and 3,000 managers on issues related to the 4.0 industry.

Based on the above, the skills sector to create a true national network 4.0 on the creation of Digital Business Points. The new network aims to disseminate basic knowledge locally in the field of Industry 4.0, innovative tools are supported by digital resources and technology transfer.[26]

25 Comitato Leonardo, Kpmg, *Industria 4.0 per un'impresa globale: la dimensione del fenomeno, le implicazioni per il paese, le policy*, 13 November, 2017

26 MEF, Piano Nazionale Impresa 4.0, *Guida agli Investimenti*, 19 Settembre 2017

Finally, competence centers are provided, where high-level training and development of industrial research projects and experimental development are supported.
Finally, the Government participates in the incentive of training 4.0, which aims to protect and strengthen employment through the Tax Credit 4.0.
The implementation of the Plan includes a set of support measures planned in order to manage the investments and the framework provides six distinct corrective measures:

1) Super- depreciation/amortization; it serves to support and incentivize companies that invest in new capital goods, intangible assets and materials functional to the technological and digital transformation of production processes.
It is the over-valuation of 130% of investments in new capital goods purchased or leased.

2) Iper – depreciation/amortization; it refers to the same functions of super-amortization with an over-estimate of 250% of investments in new tangible assets, devices and technologies enabling the transformation in key 4.0 purchased or leased.
At the same time, the overvaluation in the case of tangible 4.0 and intangible assets of 140% of the cost of acquisition of intangible assets (software) functional to the technological transformation in key industry 4.0
3) New Sabatini; this measure aims at supporting companies that require bank financing for investments in new capital goods, machinery, plants, factory equipment for productive use and digital technologies (hardware and software).
4) Guarantee Fund for SMEs[27]; its function is to support companies and professionals who have difficulty accessing bank loans because they do not have sufficient guarantees.

5) Tax credit for R&D; its function is to stimulate private spending in Research and Development to innovate processes and products and ensure the future competitiveness of companies.
6) Startup and innovative SMEs; it aims to support companies at all stages of the life cycle. This measure promotes the development of the National ecosystem of innovative entrepreneurship and it spreads a new culture aimed at collaboration, innovation and Internationalization.

[27] Small and Medium-Sized Enterprise - acronyms- thefreedictionary.com

7) Patent Box; its activity is to make the Italian market more attractive for long-term domestic and foreign investments, providing for tax on income deriving from the use of intellectual property.[28] [29]

The German scenario: Pioner of the revolution

If the National Industry 4.0 Plan is for Italy the heart that sets in motion the whole system, concerning the industry 4.0 application and objectives, the model that we will define in this section is the main competitor with which we are going to collide.

Germany, a pioneer country of Revolutionary Advent 4.0, develops in a precise and detailed way, through a Digital Agenda promoted by the Government, a set of rules: rules for living, working and doing business in the new digital age.

The pivot on which this path is leveraged is a new economic and innovation policy designed by the German government to allow the implementation of the principles within an entrepreneurial community, social partners, civil society, the university system and research, overall with the imprint of the German co-management culture.

The Digital Agenda put in place by the Government for the period 2014-2017 develops its policy of application mainly on three main objectives: growth and employment, access and inclusion and trust and security.

The key to understanding this path is a policy linked to the innovative aspects and on this basis , in 2013, the "Platform Industrie" 4.0 was created with the aim of confirming Germany's prominent position, compared to other Countries, in what it deals with the sector of the manufacturing industry, boosting its efficiency at the International level and spurring the acceleration of digital change.

The platform underlying the German model involves 300 stakeholders from around 160 organizations, working together to develop and coordinate information and network services, to increase knowledge on the potential of the industry and develop solutions within the whole production chain.

28 MEF, Piano Nazionale Impresa 4.0 , Risultati 2017-Azioni 2018, 19 Settembre 2017

29 MEF, Piano Nazionale Impresa 4.0 , Guida agli Investimenti, 19 Settembre 2017

The real center of German politics is found on the concept of direct funding for research and development projects, that are assessed and managed by the Ministry of Economic Affairs and Energy and the Ministry of Education and Research.

The technologies developed by the German model and considered the pillars of the revolution, are three and they are connected to the use of the Internet as an instrument.

1) Internet of Thinks which includes research programs such as Trusted Cloud, Smart Data, Smart Services World I and Smart Services World II;

2) Internet of Things which includes the Autonomics for Industry 4.0 and Smart Home programs, PaiCE[30];

3) Internet of Energy including the E-Energy and ICT[31] for Electronic Mobility III programs;

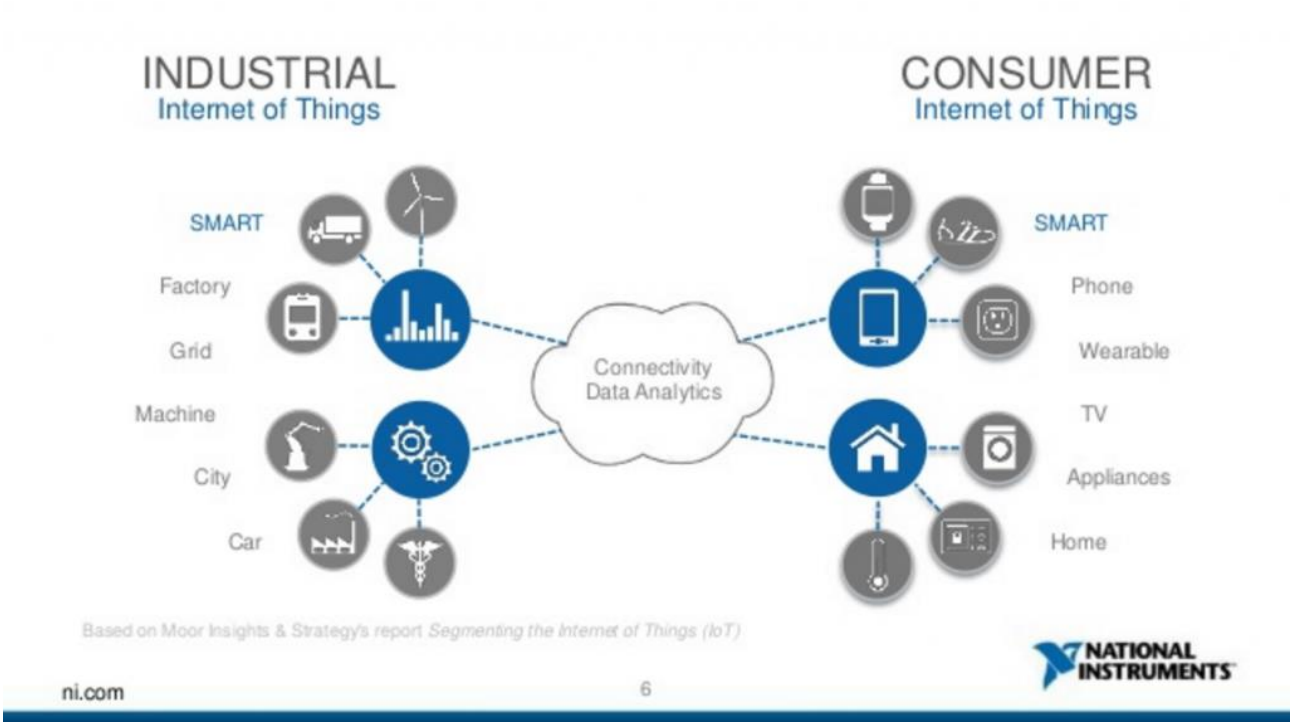

Figure 2: Gearing Up For the Industrial Internet of Things, (Source: Moor insights and Strategy's report Segmenting the Internet of Things(IOT), National Instruments), 2018

[30] The Pacific Area Incentives & Conferences Expo

[31]The collection of technologies that deal specifically with processing, storing, and communicating information, including alltypes of computer and communications systems as well as reprographics methodologies. McGraw-Hill Dictionary of Scientific & Technical Terms, 6E, Copyright © 2003 by The McGraw-Hill Companies, Inc.

The German program benefits from its leading position compared to other Countries, thanks to the successful results registered over the years.
To date 117 programs have been implemented, involving 725 partners for a total of 457 million euro of funding granted by the German Federal Government.[32]

The French scenario: Indutrie du Future

The second country, with which we face the major clash, is France, with the project launched in 2015 and called "*Industrie du Futur*", the main aimed at the modernization of French industry and the transformation towards a world marked by digital. The same project has been publicly funded with 100 million euro, to which 2.2 billion of loans guaranteed by Bpifrance for "Industrie du Futur" have been added.
France subdivides research projects, into 9 different clusters - shown below - with specific areas of intervention, for which there is a need for allocation of 1636 million euro:

1) Data economy
2) Intelligent objects
3) Digital trust
4) Production of intelligent food
5) New resources
6) Sustainable cities
7) Eco-sustainable mode
8) Medicine of the future
9) Transportation of the future

The merit of the implementation of the "*Industrie du Futur*" plan is attributed to the presence of an Association that plays a fundamental role, allowing the effective

32 Comitato Leonardo, Kpmg, *Industria 4.0 per un'impresa globale: la dimensione del fenomeno, le implicazioni per il paese, le policy*, 13 November, 2017

transformation of the new technologies obtained from research into the field and applying them to the real productive factory.
The French national territory is thus divided into areas and it is coordinated by the Association through projects and initiatives aimed at modernizing, innovating and transforming the industry with a digital footprint.
At the end of this overview of application and reception of the principles of the industry 4.0 in the different Countries of the world, it is possible to observe that, although the application methods reveal common aspects, also among the main giants such as Germany and France, there are however some differences.
The main difference is found in the tax relief policies introduced in Germany, similar to those present in the Italian National plan, but not present in the French one.

On the other hand, it is the responsibility of France to introduce 140% of the Super-amortization, Corrective Measure for the purchase of machinery functional to the various companies, and to benefit from a value corresponding to 5 million deriving from direct tax benefits.
Wanting to represent world areas in distinct areas, through operating nucleus and their affinities and discordances, on one side we can position Germany, the United States and Japan with the incentives for Research and Development and in the opposite side there is Italy with the policy of tax reduction for companies.
Only in the middle (mixed model) there are France and the United Kingdom, whose initiatives, although focused on research projects, involve the presence of tax relief. In this regard the Italian National plan differs substantially because it has not foreseen a plan focused on research.

As a conclusion we can see how different policies have been implemented for different production systems, which provide for a good degree of perceived effectiveness already in the early initial stages.
The systems are presents and the focal point of the study remains only in the real and effective implementation capacity of the previsions described above.

The three above mentioned Countries have a description of their projects and the ways in which they are operating for the implementation of the principles of Industry 4.0, considered the main pillars of the revolutionary wave. They have decided to join forces

in June 2017 in Turin going, by signing an agreement to promote and develop the digitalization of the manufacturing sector. The agreement aims to bring together France, Germany and Italy and, on the basis of the experiences of the three different National programs, share together three focal points of Industry 4.0:

1) Preparation of common standards and a reference architecture for the digitalization of manufacturing;

2) Greater accessibility of the digital revolution for SMEs;[33]

3) Sharing of information and experience gained on the various policies adopted in order to identify best practices;

Even with this attempt it is difficult to state that the three great powers of Industry 4.0 have actually granted their programs and went on to outline a single practical model of implementation. The differences remain at the base of each Country, giving the effective impression that an interpretative key that foresees the competitiveness of the Country-systems and a link to globalization at the same time must still be found, or rather, "created" from the origin.[34]

[33] Small and Medium-Sized Enterprise - acronyms- thefreedictionary.com

[34] Comitato Leonardo, Kpmg, *Industria 4.0 per un'impresa globale: la dimensione del fenomeno, le implicazioni per il paese, le policy*, 13 November, 2017

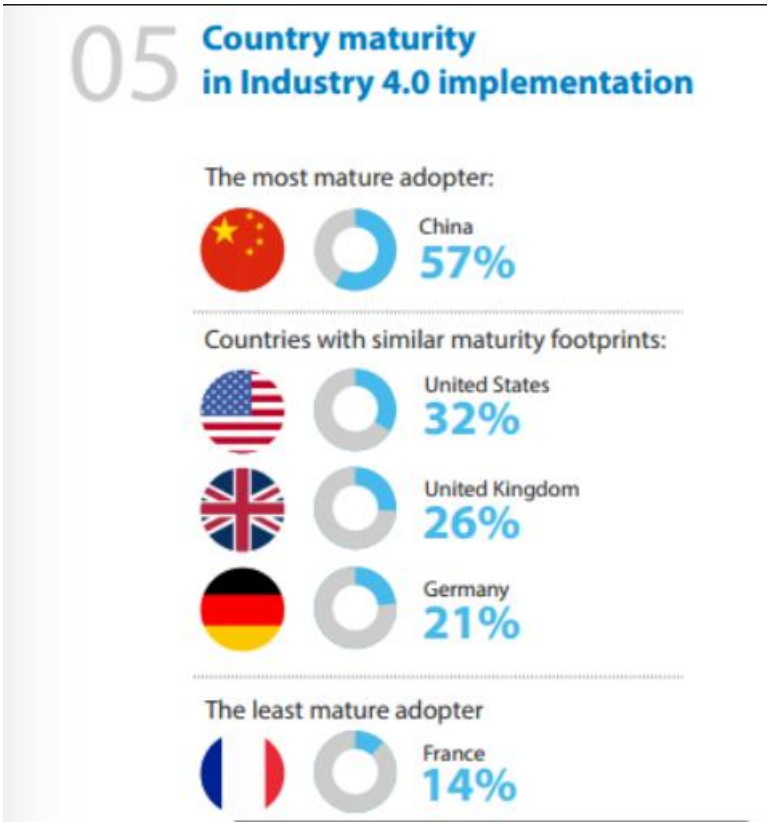

Figure 3: Country Maturity in Industry 4.0 implementation, (Source: Digital Vision 360@IEXPDACH@Industry4.0), 2017

The phenomena of Industry 4.0 is too recent to be able to accurately state the real International comparison of the results obtained by the various initiatives to promote Industry 4.0, both because some Countries that have approached are still experiencing initial experimentation and because the different support policies adopted make the comparison more complex. Through the figure above - *Figure 3: Country Maturity in Industry 4.0 implementation, (Source:* Digital Vision 360@IEXPDACH@Industry4.0), 2017 - it's possible to notice at a glance how the country that adopts the principles with greater rapidity is China. Following US, UK and Germany, France is ultimately able to accommodate the fourth revolution.

Despite the need to wait at least three years before we can provide better balance sheet data and better understand the results, some macroeconomic considerations of how

Countries have developed their models allow us to frame the moment when Industry 4.0 started to move its first steps.

Talking about Industry 4.0 as the fourth industrial revolution, that took place on the planet coincides with the affirmation of a new period of global recovery in world economies.
The recovery of the economic force underway was the springboard for the 4.0 principles that were developed. The situation is positive from 2016 for most of the great world powers, especially for the above-mentioned Countries.
The gross domestic product, the first alarm bell in the family of economic / industrial growth / loss was recorded in continuous growth with the succession of the quarter. The only exception is in France, where instead of recording GDP[35] growth, its value is 0.1%[36] lower than in the previous period, but with a capacity for rapid recovery in the following quarters.
An aspect worthy of note regarding the growth of industrial forces is the value inherent the industrial production, which in Italy specifically shows an increase that is higher than the average of other Countries, even those that are growing.
As a result of an increase in production there is an increase in employment in the sector, where however the differences with the various Countries are more marked. For examples France only registers a strong structural loss for the entire period. Germany on the other side has a constant craze.
Italy, on the other hand, is characterized by a positive result, with an increase in the number of employed workers, up by 0.3%[37] in the second quarter of 2017, compared to all the others, which is in slight decline.
Regarding this, although the analysis is still before a concrete result and in the future it will be possible to evaluate its effects, it is possible to notice how today the three phenomena seem to converge in a positive way and therefore support a promising and positive period for the effects that can be reached.[38]

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[35] GDP (Gross Domestic Product) is the final value of the goods and services produced within the geographic boundaries of a country during a specified period of time, normally a year. GDP growth rate is an important indicator of the economic performance of a country. (The Economic times journal)

[36] European Economic Forecast, Summer 2018(interim), https://ec.europa.eu/info/publications/economic-and-financial-affairs-publications_en.

[37] IMF World Economic Outlook (WEO) Update, July 2017*: A Firming Recovery*

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SURVEY by KPMG

- Dissemination of the Industry 4.0 Plan in the Italian industrial system-

The National Industry Plan 4.0 assigns the knowledge of the effects generated and how they were perceived, through the results obtained from the survey conducted on a sample of 330 Italian companies, located throughout the Country, without distinction of sector, according to the Confindustria Committee.

In this case, the survey structures the contents in three distinct parts:

1) Knowledge of the plan;

2) Use of the instruments of the plan;

3) The impacts expected by Industry 4.0;[39]

The knowledge of the plan registered a value of 78% of the Italian companies that participated in the survey. The data is not homogeneous and it is differentiated by geographical location and company size. The size of companies plays a very important role; indeed 94.5% of the companies that know the plan have more than 250 employees, while the 35.2% is limited to that of the smaller companies that are not aware of the plan. The information was mainly conveyed through the trade associations and also through institutional channels or the simple "word of mouth".[40][41]

39 Comitato Leonardo, Kpmg, Industria 4.0 per un'impresa globale: la dimensione del fenomeno, le implicazioni per il paese, le policy, 13 November, 2017

40 MEF, Piano Nazionale Impresa 4.0, *Guida agli Investimenti*, 19 Settembre 2017E

41 MEF, Piano Nazionale Impresa 4.0, *Risultati 2017-Azioni 2018,* 19 Settembre 2017

The chart below shows the % value of the plan knowledge for companies based on their size.

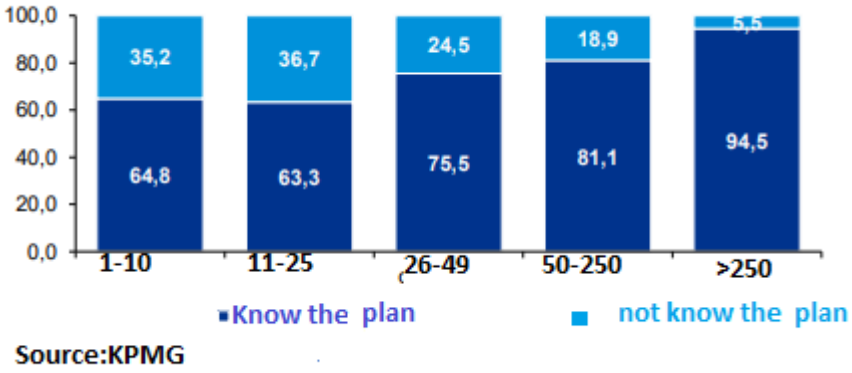

Figure 4: (source: KPMG processing on survey data - original source from "Piano Nazionale Impresa 4.0- Ministero dello Sviluppo Economico", 2017)

The progress of knowledge of the Plan is confirmed by the level of use that is recorded among the companies that have joined the plan. Companies adhering to the Plan using one or more instruments of this, 57.6% of companies use one or more of these that are the basis of the Plan launched by the Government.

Also, in this case the surveys show how the size of the company is a relevant factor in order to obtain the general data concerning the use of one or of more plan instruments.

The companies with the largest shareholdings that reach 250 employees register the use of 67.5%, while that of small businesses is only 41.3%.[42]

The specific data are shown in the chart below.

[42] Comitato Leonardo, Kpmg, *Industria 4.0 per un'impresa globale: la dimensione del fenomeno, le implicazioni per il paese, le policy*, 13 November, 2017

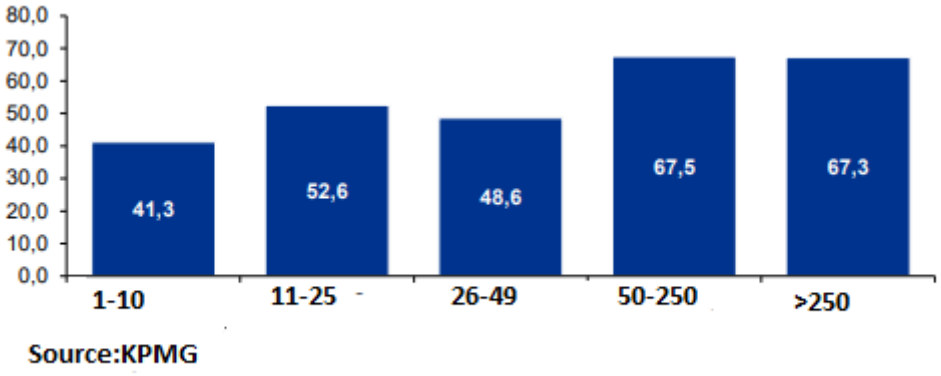

Figure 5: (source: KPMG processing on survey data - original source from"Piano Nazionale Impresa 4.0- Ministero dello Sviluppo Economico", 2017)

Also, the sector plays an important role, the companies in the textile clothing and leather sector adhere to the plan with a participation of 78.9%, those of the agro-food sector of 75%, while the participation of the construction industry sectors is decidedly more limited. They use the tools with a percentage of 16.7%.

In this way, taking a look at the data emerged with the survey carried out and the object of our study and analysis, it is clear how the measures implemented by the Italian government have highlighted the need to increase the offer of products and services 4.0 by becoming suppliers of these solutions of effective transformation agents, that guarantee the recovery and the different readiness to invest.

In fact, in the absence of the instruments of the Plan, investments made by just under one company every two are 47.9% and in smaller quantities than those that would not have made an investment in the absence of the facilities guaranteed by the plan. The remaining part is held by those who made the planned investments and did not undergo any change, with the presence or absence of the Plan.[43]

[43] Comitato Leonardo, Kpmg, *Industria 4.0 per un'impresa globale: la dimensione del fenomeno, le implicazioni per il paese, le policy*, 13 November, 2017

This basis of application of the instruments records how not all those mentioned as corrective measures have been applied homogeneously and with equal intensity, it is possible to record 3 that stand out:

1) hyper amortization; 72.4%;
2) super amortization; 47.6%;
3) R & D tax credit; 45.6%;

The graph below reports again results of the survey analyzed by the company KPMG: the predominance of hyper-depreciation on all other measures is visible to the naked eye.[44]

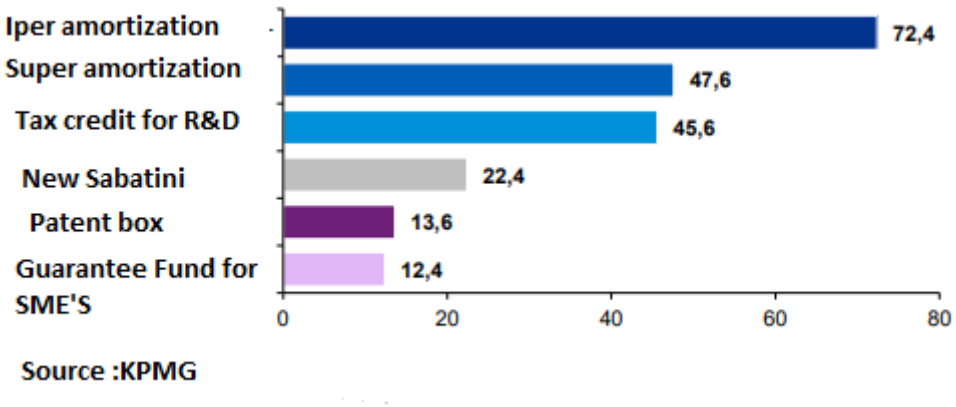

Figure 6: (source: KPMG processing on survey data - original source from "Piano Nazionale Impresa 4.0- Ministero dello Sviluppo Economico",2017)

As for the knowledge of the Plan also in this case the greater the size of the company, the greater the percentage of investments made also by the last sources emerges as a quarter of the companies that made investments with other actors in the supply chain. At this

[44] Comitato Leonardo, Kpmg, *Industria 4.0 per un'impresa globale: la dimensione del fenomeno, le implicazioni per il paese, le policy*, 13 November, 2017

point a network is formed that makes it possible to coordinate the investment programs of different players along the supply chain, generating a new positive and innovative push towards the tradition that characterizes the Italian production chain and the advent of the 4.0 technologies, that aim at interconnection and coordination of the various companies operating.

The last aspect is inherent to the impacts expected by the firms of the Industry 4.0 brought by the Plan, both on the production system and within the organization of the single companies.
Returning to the mentioned basic concept of the difficulty in confirming actual data today and the predictive propensity of the analysis, it is expected that there will be an impact of 73.2%. A medium-high value worthy of consideration.
Also, in this case the impact is different on the basis of the size and the sector of the company considered.
The perceived impact increases with increasing size and it is greater in the wood sector, furniture and paper, while very reduced in the pharmaceutical or in the transport sector.

Companies come to affirm that for them, with the application and use of tools 4.0, there will first be an increase in production efficiency and, secondly, an increase in the added value of the products and services offered. Even if minor, the expected impacts on improving relations with customers and relations with suppliers remain to be considered.
The results are to be attributed differently depending on the sector they belong to.
The productive efficiency is found more in large companies and for companies in the strict sense. While in terms of the products or services offered, the effect is the most significant opposite for companies in the construction sector and services in general.
The graph shows the trend described above.

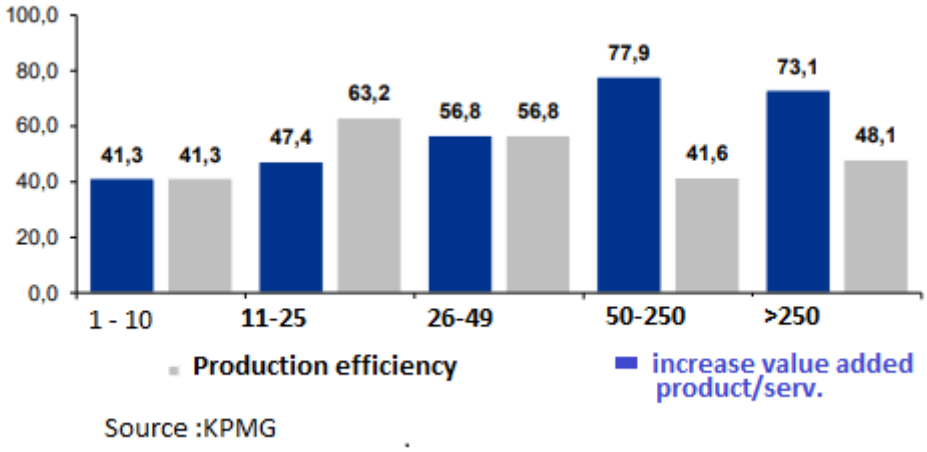

Figure 7: (source: KPMG processing on survey data - original source from "Piano Nazionale Impresa 4.0- Ministero dello Sviluppo Economico", 2017)

The last and most important part of HR is the placement in the framework of public interventions on the training of personnel to be qualified to obtain the right requirements and operate efficiently, within the Smart Factories.

The survey achieves results that allow us to affirm that 68.8% of companies, that have made investments with production effects through the National Plan, will be implemented in the near term of specific professional training activities. More will be those of industries in the strict sense and in particular those of the manufacturing sector, while the initiatives of the others operating in different sectors will be reduced.
Another fact that may be interesting relates to the investment made in the Advance Manufacturing Solution, that in the technological field is the most decisive enabling technology chosen by the companies. The others considered still too immature could find a greater efficiency in the data that will be detected by 2019.

The survey conducted leads us to investigate qualitative aspects regarding the revelations generated by the work, where it is possible to recognize, that the industry paradigm is entering into the heart of the production processes and is introducing itself into the culture of companies of various types.
At this point emerges that concept, found several times, where the only real limit to the possibility of innovating production from a digital point of view is given by the creativity of the entrepreneur, who together with the entire hierarchical structure plays a

fundamental role in the progress of possible results, given the immense potential of the extension of the phenomenon.
With regard to entrepreneurial skills, Italy, through the National Industry 4.0 Plan, organizes the entrepreneurial activity through a "natural" development where the entrepreneur aims at making investments in the perspective of a real business transformation.

However, to provide greater insight into the effects generated by the first applications of the 4.0 principles, we can rely, not only on the survey carried out by KPMG, that allows us to have quantitative statistical values, but at the same time are considered important aspects analyzed and the results collected through focus groups , vertical and horizontal insights or simple on-bench analysis of innovation and transformation experiences, where the dimension and sectoral aspects play an important role. Easily understandable as these data are not of a statistical nature, but they serve to clarify reflection ideas to broaden the analytical framework under consideration.
With this further verification, the results we have found show values that coincide and remain constant with those found in the survey, with the exception of a variable concerning the level of use of the instruments made available to the Plan, which is much lower than the levels found in the survey especially in the "qualified" craft sector.
The business areas that are expected to have a more significant impact are strongly confirmed as follows:
• the efficiency and flexibility of production;
• increasing the added value of the products / services offered;
• the customization of the offer.[45]

The first point is characterized by the centrality of Advanced manufacturing solutions that allow various types of companies to greatly increase production, guaranteeing production flexibility, guaranteeing production to record an increase in efficiency while maintaining compliance with quality standards. If the level of digitization reaches the maximum, the

[45] Comitato Leonardo, Kpmg, *Industria 4.0 per un'impresa globale: la dimensione del fenomeno, le implicazioni per il paese, le policy*, 13 November, 2017

total control of the various production phases is achieved by implementing the concept of "automated" production.

The increase and optimization of productivity is further generated by the horizontal and vertical integration of the production itself.
Integrating means generating an increase in productivity for production plants and a greater speed of reception and adaptation to change in relation to constant changes on the demand side, with consequent increase in planning flexibility and reduction of finished products, maintaining the quality unchanged of the product and services offered, reducing the production and delivery time of the finished product, creating a relative defined "on demand".

Second technology emerging from the principles 4.0, and of particular importance even before the product service is really produced, is the additive manufacturing that has the function of reducing the possible problems in the actual production phase. The technology in question is allowing many companies to reduce the time required for testing, prototyping, thus accelerating the development of the production, almost halving the time for the transition from the concept-idea to the final product-object, going to limit the probable inefficiencies found in the development phase. At this point it is stated that 3D printing techniques and additive manufacturing play a fundamental role in the product development process, while virtual reality and simulation facilitate the introduction of creative innovation in the design phase. The second aspect to be addressed is the increase in the added value of the products and services offered which, for Industry 4.0, lead to a total redefinition of the production cycle and consequently a redefinition of the business model and of the product that begins to take on new characteristics compared to the models of the past. The technology characterizing this aspect is the Internet of things (IoT), a technology that emerges with the complex industrial Internet and allows to definitively innovate the business model now based on the customer, with an efficient interaction between the Internet of things and the services. This concept allows the re-design of the entire business model both for the aspect concerning the production process and in terms of distribution and maintenance, as well as for the commercial aspect. The whole new system based on the efficiency of the internet provides for the possibility of carrying out what in the past was anchored to the fixed production structure through a

mobile device, so as to give the possibility at any time, situation or geographical area to carry out the required activity.

Finally, the analysis of the third point leads us to dwell on the possibility of customizing the client and the offer to a much greater extent than in the past. The three aspects analyzed summarize the geolocation, the Internet of things able to improve and innovate the production, the use of sensors in order to prevent possible failures and human-machine interaction with the use of "wearable technology "; this new trend allow companies to improve and customize production based on the different needs of the customer.

It is also important the expectation of the analysis of Big Data obtained by customers and their ways of behaving, that can allow companies to adapt their proposals according to the different needs of customers.[46]

Industry 4.0: from new technologies to the new company

In a year the launch of the Industry 4.0 Plan, the Minister of Economic Development, Carlo Calenda, has drawn up an initial assessment of the results expected from the plan, summarized as follows:

- increase of the demand on the domestic market for capital goods, with growth rates that reached 11.6% in the first semester;
- the number of companies that will increase R & D spending has increased;
- 3.5 billion public investments have been allocated on the ultra-broadband, thus allocating them both to infrastructures and to the satisfaction of the demand of families and businesses, so as to reach the hedging targets to 2020;[47]
- in the first 8 months of the year the amount guaranteed by the Guarantee Fund increased by 10.7 percent;

[46] Comitato Leonardo, Kpmg, *Industria 4.0 per un'impresa globale: la dimensione del fenomeno, le implicazioni per il paese, le policy*, 13 November, 2017

[47] MEF, Piano Nazionale Impresa 4.0, *Risultati 2017-Azioni 2018*, 19 Settembre 2017

On September 21, 2017 the same Minister Calenda presented the second phase of the National Plan. The program changes its name: not just Industry 4.0, but in Italian "Impresa 4.0", open to all companies that have undertaken or are in the process of embarking on the digital transformation path, providing them with a range of tools to support, not just financial type.

We no longer speak only about super and iper –amortization or about credits for innovation, but in detail about:
tax credits for research and development, agreements for innovation on industrial research projects and experimental development, development contracts on large-scale strategic and innovative investment programs, the establishment of highly specialized competence centers on advanced technologies for companies, and technology transfer centers for training and consultancy activities.

Companies must be able to keep the opportunities that arise, not only from the technologies, but from the possibility of reviewing and rereading their processes and their operating procedures in a logic of integration and collaboration along all their supply chains and within the whole their organization.

In order to fully understand the evolution of the concept from Industry 4.0 to Enterprise 4.0, this work can't ignore the analysis of the technologies that represent the starting point, the fulcrum of the analysis. We have to use the terms used by BCG in the paper "Industry 4.0: "The Future of Productivity and Growth in Manufacturing Industries", the 9 founding pillars of Industry 4.0 on which the concepts expressed up to now are based.

The nine innovative pillars: enabling technologies

"*The fourth industrial revolution is based on new digital industrial technology and on nine fundamental technological advances. In this transformation, sensors, machines, workpieces and IT systems will be connected along the value chain in addition to single company. These connected systems (also known as cyberphysical systems)*

can interact with each other using standard Internet-based protocols, analyze data and predictfailure, so as to be configured to adapt to changes.
Industry 4.0 will make it possible to collect and analyze data between machines, allowing greater speed, flexibility and efficiency.
These are processes to produce goods of superior quality at reduced costs. This in turn will increase producing productivity, moving the economy, encouraging industrial growth and changing the profile of the labor force, ultimately changing the competitiveness of businesses and regions and exploring their potential technical and economic benefits for manufacturers and production
equipment suppliers."[4849]

The technological advances that form the basis of Industry 4.0 are already available for production, but they will have to integrate and interact with each other with the aim of bringing greater production efficiencies to lower costs.
From a study by Boston Consulting it emerges that the 4th industrial revolution focuses on the adoption of some technologies called "enablers", concepts, as already mentioned, already present as theories, because they have never found applicability in production.

"They are defined as "old" knowledge, because they represent concepts already present but that have never broken the wall of division between applied research and production systems; others are considered radical innovations, also called destructive, as they are able to wipe out the old production paradigms"[50]

All this is now possible, as I expressed in the previous paragraph, thanks to the interconnection and the collaboration between systems.
Through enabling technologies, companies have the opportunity to radically innovate their business model.
The term "enabling technology" means: "a technology that" enables "man to do things that he was not able to do before, therefore making him able to create new opportunities".

[48] www.inovasyon.org
[49] BCG, *Industry 4.0: The Future of productivity and Growt in Manufacturing Industries,*2017
[50] BCG, *Industry 4.0: The Future of productivity and Growt in Manufacturing Industries*,2017.

In this analysis, I will take inspiration from the paper of BCG, which identifies nine enabling technologies, defined pillars of Industry 4.0, and on which the concepts expressed here are based:

-Big Data and Analitycs

-Autonomous robot

-Simulation

- Horizontal and Vertical System integration

-The Industrial Internet of things

-Cybersecurity

-The Cloud

- Additive Manufacturing

- Augmented Reality

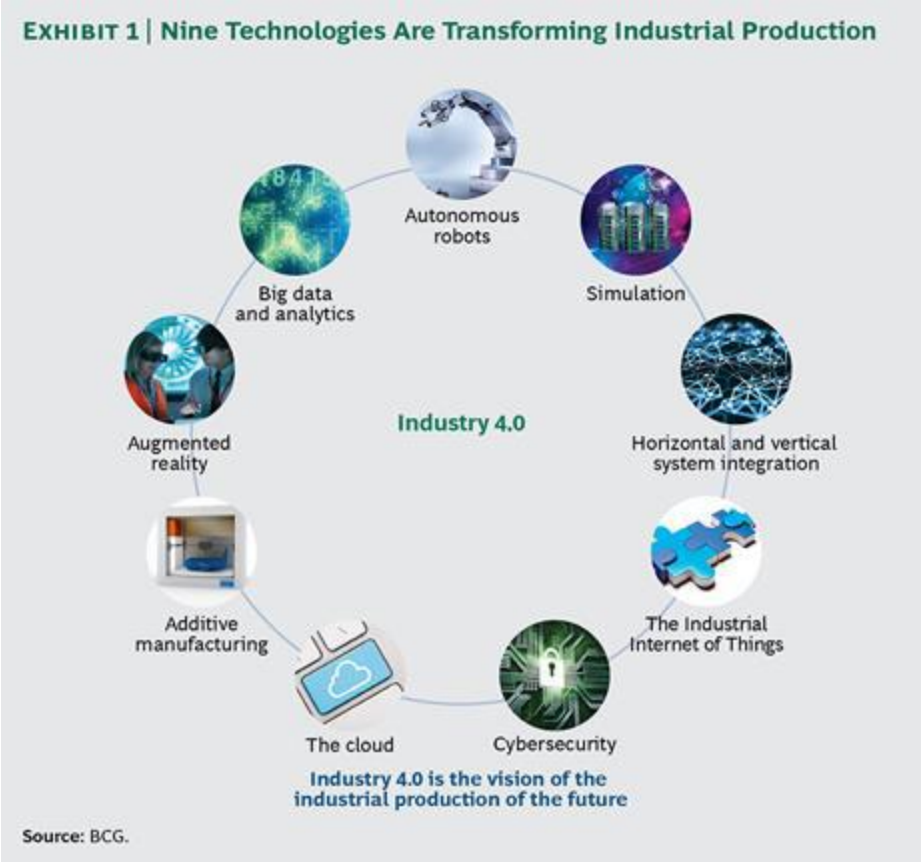

Figure 8: BCG, Industry 4.0: *The Future of productivity and Growt in Manufacturing Industries*

Big Data and Analytics

The term Big data refers to a flow of data so numerous and complex that traditional systems are not able to manage ; the term indicates precisely that set of technologies that allow to collect and process a large amount of information, increasingly growing, that pass through the Internet or other sources: social media, wearable devices, sensors, smart grid, etc. [51]

The information coming from all these cognitive domains poses important problems and processing difficulties, both for the dimensions and for their very different nature, but at the same time it opens new opportunities for companies if we consider the possibility of correlating and [52]interpreting " de-structured "data, using real time and predictive analysis. This allows us to optimize products and production processes, as well as to improve business strategies.

[51] https://linkinnovation.network/big-data-e-big-analytics-industry-4-0/-

[52] https://linkinovation.network/bigdata-big-analitycs, 24 agosto 2017

In global competitive dynamics, decision-making processes are changing substantially. Corporate decisions can no longer be released from the systematic analysis of data that are expected to grow exponentially in the coming years. So, in short, being able to manage increasingly large amounts of data at ever higher speeds. To do this, more complex methodologies and faster and more performing hardware configurations, as well as relative memory and processor space are required. [53]

Particularly useful for the investigation of Big Data are the prescriptive or predictive analysis[54] that, unlike the simple forecast analysis, allows the generation of a comprehensible model of data that can make the future or expected results or even drive and interpret the data towards a possible problem solving. Thus, an indication of the corrective or preventive actions to be taken to achieve the desired results is provided. We identify models that are able to discharge defective chips from the beginning of the process, thus reducing the risk of obtaining, at the end of the production cycle, a defective product (for example, the activity developed by Infineon Technologies, a semiconductor manufacturer of Siemens group) to the detriment of a good quality finished product.
Prescriptive models explain the motivations of a certain event through a set of immediately usable rules, and allow data-driven decisions, based on machine learning algorithms.

Considering that in history there has never been so much availability of data relating to people, as well as digital skills and men capable of managing them, it is assumed that even governments could, in an immediate future, use big data to obtain more and more automated programs that will support the policies of the public administration and provide citizens with increasingly efficient services and reduction of bureaucracy, saving time and maximizing "real-time" efficiency[55].

[53] A. Magone e T. Mazali, *Industria 4.0 Uomini e macchine nella fabbrica digitale,* Guarini e Associati, March 2016

[54] Eidon lab, Ricerca e Sviluppo, lab news ,21settembre 2017 , BIG DATA E BIG ANALYTICS, https://eidonlab.org/news/

[55] World Economic Forum, *Deep shift technology tipping points and Software Impact, Survey Report, Global agenda Councilon the future of software and Society,* November 2015

Greater use of web tools can significantly improve and modernize the functions of public administrations by improving quality, transparency and accountability to the services offered to citizens (e-government).

The digital age is marking an important step for governments, in terms of less protection of public authority and the need to change its "modus operandi" at the level of legislative and executive power. The speed on which the 4.0 industrial revolution is based requires a speed never known before, to examine issues and find solutions, without considering the greater information held by citizens, who increasingly require their involvement and interaction.[56] [57]

Obviously, this generates the need to create a climate of trust in the information and decision-making processes managed by the algorithms; privacy, attribution of responsibility for data management, reliability of data, are legitimate concerns to which it is necessary to find a new approach[58] and new guidelines.

Autonomous robots

Manufacturers in many industries have long used robots to tackle complex tasks, butrobots are evolving for even greater utility. They are becoming more autonomous, flexible and cooperative.
The costs and the increasing ease of use will also extend their use in all sectors.
The robotic activity is precise, fast and it guarantees the achievement of company objectives with greater ease.
Until recently, the use of robots was limited to carrying out tasks related more to the automotive world and in any case always supervised by specialized personnel. Unlike before, robots are now able to interact autonomously through network clouds and connect to each other.

[56] World Economic Forum, *Deep shift technology tipping points and Software Impact, Survey Report, Global agenda Councilon the Future of Software and Society*, Novembre 2015

[57] K. Schwab, *The Fourth Industrial Revolution*, Franco Angeli, 2016

[58] Eidon lab, Ricerca e Sviluppo, lab news ,21settembre 2017 , BIG DATA E BIG ANALYTICS, https://eidonlab.org/news/

For example, Kuka[59], a European manufacturer of robotic equipment, offers autonomous and interconnected [60]robots, so that they can work together and be able to automatically adjust to fit the product online.
For istance the Italian company COMAU,[61] in Turin, produces anthropomorphic and humanoid robots used for about 85% for the automotive sector and the rest for the "general industry". The company doesn't lose to look at the market and its evolution; this means that the product also follows the evolution of the market and changes, improving its performance in terms of speed, competitiveness and low production costs, but also the style in order to become more attractive to customers.

The study of the Italian case represented by Generali Italia, ready to use artificial intelligence to improve the service, is also interesting in the application field.
In the article published on july 2018 on the Digital 4 Executive, the CFO of the insurance company[62], David Cif, explained that for the time being it has already gone beyond the experimentation: 20 robots are used at full capacity in repetitive activities, such as cancellations, which require a very standardized and automated sequence of activities.
The robot (in this case, not physical) is nothing but a software, an algorithm that simulates and repeats standardized operations and processes, acting directly on existing applications and acting as if there was a person dedicated to the activity. It is a program with a level of artificial intelligence, that makes it able to replicate human actions.

The goal is always to improve customer's services and to free resources and skills for additional development
AI (artificial intelligence), with particular reference to the CC (Cognitive computer) platforms, equipped[63] with learning machines, reasoning skills, speech recognition, natural language processing, artificial vision, can therefore perceive the context through sensory extensions similar to those human resources, elaborating them and observing the context, proposing a suggestion aimed at recommending the best action to be implemented.

[59] BCG, *Industry 4.0: The Future of productivity and Growt in Manufacturing Industries*, 2017.

[60] A.Magone,T.Mazali, *Industria 4.0 Uomini e macchine nella fabbrica digitale*; Guarini e Associati,2017
[61] A.Magone,T.Mazali, *Industria 4.0 Uomini e macchine nella fabbrica digitale*; Guarini e Associati,2017
[62] Digital 4 Executive, n.33 maggio 2018
63 https://www.digital4.biz/procurement/strategie/procurement-4-0-la-check-list-lufficio-acquisti-digitale

The AI can draw information necessary to reach concrete solutions, taking inspiration from situations that have already taken place and whose results are elaborated to automate even very complex decision-making processes.[64]

Another practical example, almost fantasy is the case of Deep Knowledges Ventures, a Japanese company specialized in research in the medical-scientific field.
The Deep Knowledges Ventures has appointed this robot, "Vital", as a member of the board of directors. Vital is an algorithm able to evaluate investments in the area of the biotechnologies, that the board decides to carry on and to predict its eventual success / failure.[65]
Process automation saves costs by lowering prices and selling more. Already the economist Keynes with his theories, at the beginning of the 30s, said that the greater profits obtained by a company pushed it to increase wages, so as to push the workers to increase consumption and therefore production; hence the resulting increase in jobs.
On the impacts deriving from the use of new technologies on the world of work, as negative or positive consequences in terms of employment, I will talk later.

Simulation

Numerical simulation is a very powerful analysis tool. It is still used experimentally, in various scientific and technological fields. This technology overcomes some difficulties related to the physical reproductions of systems, studied and analyzed, that can normally be encountered in a real laboratory, allowing to develop simulation models that operate in "near real time" and allow predictive analysis of the behavior of systems, machines and plants.

[64] https://www.digital4.biz/procurement/strategie/procurement-4-0-la-check-list-lufficio-acquisti-digitale/
[65] https://www.huffingtonpost.it/.../deep-knowledge-ventures-algoritmo-nel-cda_n_5321

This technology is, therefore, similar to a sort of virtual laboratory; in the design phases, 3D simulations are used to allow very little time and cost reduction, to obtain useful information to make optimal choices from the design.
Numerical simulation becomes a very useful tool, especially when it can be applied throughout the product development cycle (pervasive simulations).

These simulations use real-time data, they save time and costs necessary to create prototypes or to experiment models, then not applicable.[66]
The simulation can represent the physical world in a virtual model (digital twin), which can include machines, products and people: each physical object has its own virtual copy, physical and virtual reality can be compared in terms of data, identified problems and planned solutions and optimizations, before we move on to production. Therefore, the role of business and technical data analysts is fundamental.[67]
There are various fields of application of the simulations and a short classification of the simulation technologies is proposed below according to their purpose.

"Simulation technologies to support decisions:

♣ *DSS (Decision Support System): the dominant functionality is provided by the use of mathematical and analytical models that allow to simulate the behavior (for example, the temporal dynamics) of a system subject to different management options and to calculate the indicators for the quantitative evaluation of the criteria (multi-criteria analysis).*[68]

***Simulation technologies to support product design and engineering*:**

♣ *MBS Simulation (Multibody or Multibody Simulation Modeling)*
♣ *BEM Simulation (Modeling of the boundary elements)*
♣ *SEA Simulation (Statistical energy analysis)*
♣ *CFD Simulation (Numerical fluid dynamics analysis)*

[66] https://linkinnovation.network/simulazione-macchine-interconnesse-industry-4-0/
[67] https://eidonlab.org/news/

[68] https://nova-fund.com/simulazione-macchine-interconnesse-tecnologia-abilitante-industry-4-0/

♣ *FEM Simulation (Finite Element Method)*

Simulation technologies to support the analysis of manufacturing and process:

♣ *CAM (Computer Aided Manufacturing)*

♣ *CAPP (Computer Aided Process Planning)*

♣ *Virtual Commissioning*

Thanks to the use of this enabling technology it will be possible for companies:
• to reduce time and costs associated with the planning;
• manage company know-how, using simulation to gain experience and manage results so that they become a reusable asset;
• maintain a sustainable competitive advantage over time by constantly innovating and at the same time reducing the risks related to innovation."[69]

Currently, 3D simulations of products, materials and production processes are already being used in the design phases. Future developments envisage a greater extension of operations, exploiting data in real time to create a virtual model that reflects the physical world with the consequence of creating increasingly complex and different materials. For example, Siemens has managed to optimize the machining process of a machine up to 80%, by developing a virtual machine that can simulate machining parts using the physical machine's data.

Horizontal and vertical integration of the system

Most of today's IT systems are not fully integrated. Companies, suppliers and customers are rarely closely linked, as well as individual departments from engineering to service passing through production.
It is necessary to create an intelligent network that automatically controls the process, both in qualitative and quantitative terms.

[69] https://eidonlab.org/simulazione-macchine-interconnesse-industry-4-0/

The application of Industry 4.0 technologies will make it possible for departments, companies and functionalities to become much more cohesive, for example with cross-company networks that guarantee a constantly evolving data integration with a completely automated process.[70]

For istance Dassault Systèmes and BoostAeroSpace have launched a collaboration platform for the European aerospace and defense industry. The platform, called AirDesign, serves as a common workspace for production planning and collaboration and it is available as a service through a private cloud. This platform manages the complex task of exchanging product and production data between multiple partners.[71]

It is a traceable and interoperable collaboration platform open to the Internet, consisting of a neutral workspace for advanced TDP exchange for Aircraft Program design and manufacturing.

The main features of AirDesign are:

- *developing a reliable platform capable of handling the complexities of secure product structure;*
- *integrating the best-in-class software for large file transfer;*

[70] BCG *Industry4.0 the future of productivity and growth*

[71] www.boostaerospace.com

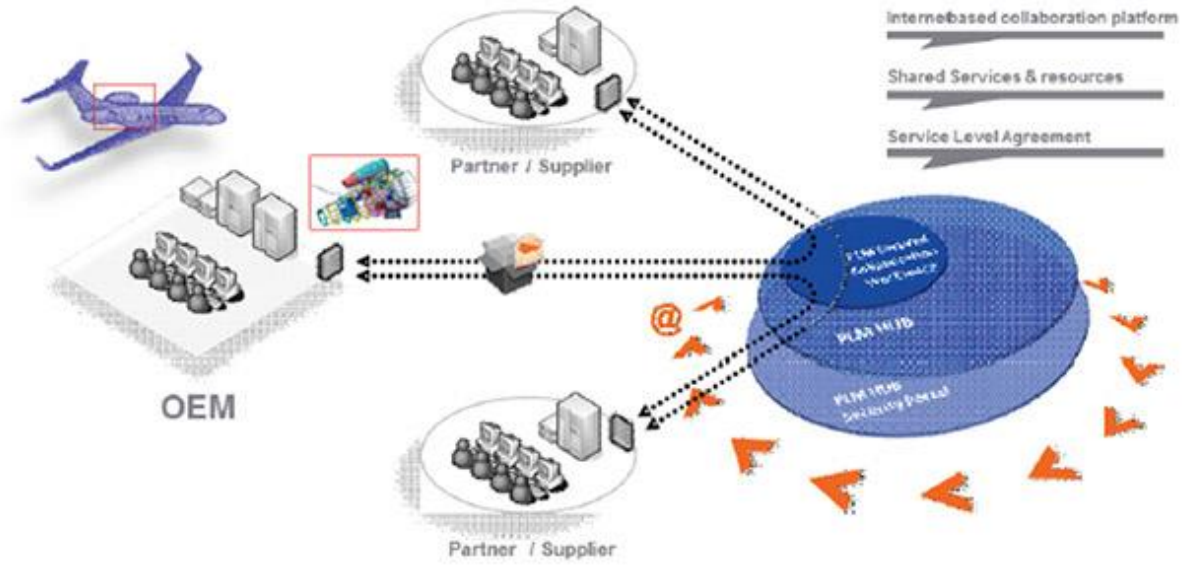

Figure 9: Source: www.boostaerospace.com

- *standard service to exchange TDP with any industrial partner with full segregation is guaranteed;*
- *reduced effort to convince partners to deploy it;*
- *versatile implementation from manual operation (web interface - fast to deploy) to end-to-end integration capabilities;*
- *exchange pattern that is meant to be the context of each program / partner and applied through an automated orchestrator.* [72]

[72] Source: www.boostaerospace.com

Internet of Things

Kevin Ashton, born in 1968, pioneer of technology was born in England, he is the founder of the Auto-ID Center at the Massachusetts Institute of Technology (MIT) and creator of a global standard system for RFID[73] and other sensors, it's said to have been the first to have used the term "Internet of Things" or IOT, in order to describe a system in which the Internet is connected to the physical world through widespread sensors.[74]
In 1999, Ashton was working with colleagues on RFID tags, special electronic labels, now mostly used by logistics companies on parcels or documents to track their "status", which could be applied more or less everywhere. They could be read remotely with special radio devices.[75]
Almost 20 years later, those tags have been transformed into sensors that can read from the environment the most different information, from temperature to movement, from GPS position to weight, from chemical composition to soil moisture, and transmit them anywhere in the world using the protocols and infrastructure of the Internet.
Any object, provided that have to be connected to the Network and have to communicates something to someone, can therefore fall into this definition.

Not only that, IOT will allow field devices to communicate and interact with each other and with multiple centralized controllers, allowing real-time answers, modifying behaviors, memorizing instructions and then "learning" from the interaction.[76]

From Ashton's definition others have been followed, each one definable however to the use that it wants to make and referable to a "*family of technologies*"[77] (currently not particularly innovative), whose purpose is to make any type of object, a device connected to the Internet that can enjoy all the features to have the objects born to use the network.[78]

[73] radio frequency identification) is a form of wireless communication that incorporates the use of electromagnetic or electrostatic coupling in the radio frequency portion of the electromagnetic spectrum to uniquely identify an object, animal or person.(InternetofThingsAgenda)

[74] https://www.aspeninstitute.it/system/files/inline/Internet%20of%20Things.pdf
-The Aspen Institute based in Washington DC today and business centers in Aspen (Colorado) and Wye River (Maryland) was founded in 1950 and since then has been promoting and fostering the development of an enlightened leadership, formed in dialogue and able to face the challenges of global society.-

[75] www.IOTLab.it/le_tecnologie_IOT

[76] Aspen Institute- IOT – *Una tecnologia destinata a rivoluzionare il mondo in cui viviamo e lavoriamo*, settembre 2015

[77] Aspen Institute- IOT – *Una tecnologia destinata a rivoluzionare il mondo in cui viviamo e lavoriamo*, settembre 2015

[78] Aspen Institute- IOT – *Una tecnologia destinata a rivoluzionare il mondo in cui viviamo e lavoriamo*, settembre 2015

The sensors, as well as many other similar devices, that connect physical elements and networks, are developing and proliferating in a speed time. Even tiny sensors invade our world every day, installed in homes, on clothes, in production systems; the effect of their development will have consequences in every sector, from manufacturing to infrastructures, to health and will be associated with all "smart cities" initiatives.

From consumer's point of view, the IOT is somehow the most fascinating technology 4.0 because it allows us to go deeper into the digital world, everything that is part of our daily life and allows us to "talk" and make people talk they, from the appliances to the bank up to the services we use.

Such as, switching to the industrial world, as reported by the BCG[79] study, Bosch Rexroth, a supplier of drive and control systems, has equipped a valve production plant with a semi-automatic and decentralized production process.

The products are identified by the radio, the frequency identification codes and the work stations "know" which production steps must be performed for each product and these are able to adapt to perform the specific operation.

In the insurance field, the company Aetna is developing a sensor that, positioned inside a car mat, can perceive, from the change in gait of a subject, a varied physical state, such as a heart attack.[80]

Furthermore if we don't go too far into the purely engineering field of technology, we would rather focus on the report of the McKinsey Global Institute, *The Internet of Things:"map value beyond the hype"*[81], which seeks to determine exactly how IoT technology can create real economic value .

The ability to make different systems work together, is the basis of the creation of economic value, so the more connected devices will be, the greater the consequent economic impact will be.

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[79] The *Boston Consulting Group* (*BCG*) is a global management consulting firm with over 80 offices around the world.

80 The Internet of things: the opportunities and challenges of inter conectedness, roundtable on digital strategies overview, darthmouth, 2014

81 McKInsey, *The Internet of Things: "map value beyond the hype*", 2015

McKinsey, based on an analysis of over 150 case studies of manufacturers applying technology from the medical field to the safety or monitoring of machinery, estimated that the IOT has a total potential economic impact of $ 3.9 trillion to $ 11.1 trillion a year by 2025, with higher margins in manufacturing and health, safety and logistics industries.

Therefore, unlocking this potential means, however, that companies that use IOT technology will play a fundamental role in the development of processes and adequate systems to maximize value, overcoming all the technical, organizational and regulatory obstacles that we often find in organizing process.
McKinsey has identified 9 sectors, where the IOT could have the greatest economic impacts, from health as already mentioned (Human) to the home (as energy and safety management), from factory to company and mobility.

The results of the research led to define some aspects:
- Interoperability between IOT systems is fundamental for a value between 40% and 60% of the settings; exchange information regardless of the system manufacturer.

- Data from IOT technology must be exploited to forecast and optimize and not just to monitor. The evolution will have to use data to increase, through the use of machines, human capabilities in order to make the machine itself autonomous operationally; to date the data and the ability to produce them, are minimally used and analyzed (about 1%).
- The technology will have to be more applied to business-to-business applications, rather than to applications of "consumer use", of greater common attraction;

- The value generated by IOT applications, could in 2025 be estimated at 90% for the benefit of industries[82] and consumers.
An example, in 2025 remote monitoring could create up to $ 1.1 trillion dollars a year in value by improving the health of patients with chronic diseases through a tv-monitoring of patients that would also ensure a reduction in hospital costs.

Value creation can only be achieved if those who offer these technologies have all the tools to manage them. The specific tools moves from managerial skills to the necessary

[82] https://www.internet4things.it/iot-library/mckinsey-l-internet-of-things-spiegata-ai-top-manager/

laws, especially from an ethical point of view, when data analysis makes the life and preferences of consumers the point of discussing the real economic opportunity.

"The IOT does not oblige us only to simply adapt regulations, lifestyles or re-evaluate styles and opportunities. We need a new social contract. there are moments in history - and this is one of those, in which the acceleration is such that what existed before, no longer works and the instruments are inadequate. "[83]

The digitization of machines, vehicles and other elements of the physical world is a very powerful idea. Capturing the full potential of IoT applications will therefore require innovation in technology and business models, as well as investments in new skills and talents. With policy actions to foster interoperability, ensure security and protect privacy and property rights, the Internet of Things can start to reach its full potential, especially if the leaders really take a decision-based decision-making process.

Cloud

The Cloud represents the connective tissue of Industry 4.0, the one that allows to build an innovative, more effective and efficient production strategy, exploiting sensors, artificial intelligence and robotics.
Companies, in order to study analysis and applications, are already using cloud-based software. However, the concept, already expressed on several occasions, of interoperability and is fundamental again greater sharing of data between sites and business boundaries.

As already seen before, with the use of big data and the big opportunities that these have created in contributing to the development of new decision-making processes, cloud technologies will also allow to obtain more memory and more capacity and speed of calculation.

[83] *Massimo Russo, Italian Journalist, expert of network, technology, innovation*

Clouds are technologies that take advantage of HW and SW available on the network to improve performance reaching reaction times of a few milliseconds. As a result, to make the most of the data and functionality of a machine, more and more cloud services can be used, enabling multiple services.
The Cloud infrastructures are therefore large data centers that allow the user to have the resources he needs (storage, applications, programs, services) with the formula of "payment on consumption".
In this way a new business model is born, that allows to reduce considerably the internal computer power, to be able to acquire it outside according to the needs of the moment. Therefore, on the one hand we will have the provider of hardware services - software usable at any time, from anywhere and through any device; on the other hand, the customer who can access the services remotely, without the need for installation, updating and backup or maintenance of the infrastructure; all "on demand" and with payment for use.
Cloud computing has considerable advantages in terms of cost savings and optimization of the spaces to be used for hardware placement; they guarantee a greater speed in the request of data and a high level of security both physical and "cyber" due to the type of hardware that performs better than the standards of corporate hardware.

A very current example of cloud usage, is electronic invoicing, which is the digital process that allows the generation, transmission, management and storage of invoices in electronic format, definitively abandoning paper support. The advantages of electronic invoicing derive from the standardization and digitalization of all the processes linked to the life cycle of the invoice, with significant efficiency gains and cost reduction.
Moreover, the cloud can be used in the dematerialization of corporate documents, a topic currently very popular among companies that have to deal with difficulties, paper quantities, storage space and management personnel.

Obviously, every company manages the request for services in the cloud, according to the level of security we want to give to the process; often the production processes of a company require the maximum protection in the management of data and information, such as to have to resort to cloud on private platforms. Most companies, in order to protect

their own information, take advantage of services in the cloud through the SAAS[84] model, which makes it possible to make the programs accessible via internet through a third-party company (Hosting provider), by connecting from anywhere and on any device, through a "pay per use" contract.

The IAAS[85] model is still little used, but it is expanding rapidly, offering services through virtualized hardware that is external to the company, which involves the use of a virtual space on servers, network connections and dedicated IP addresses.

Augmented reality

Augmented reality is a technology that exploits the technique of overlay, that is "overlap" and as for the IOT, it refers to a set of technologies more than a single device.
Imagine setting an object with a tablet, in addition to viewing this, it will be possible to have on the same image a series of additional information, such as texts or images that are superimposed on the real situation represented so as to enhance the amount of data detail in relation to that object.
As also reported by the BCG, these systems, currently under development, but with high market development potential, will be crucial for the workers of the companies, supporting them in some activities such as warehouses, logistics centers and sending of repair instructions on mobile devices.
For example, workers can receive repair instructions on how to replace a particular part as they are looking at the actual system that needs repairs.
This information can be viewed directly in the field of view of workers using devices such as augmented reality glasses.
Among the distribution brands that were precursors to use “Augmented Reality”, Lego and Tesco. Already several years ago, to avoid that the most curious customers opened the packages and to better understand the use of the content game, Lego used augmented reality as a form of smart packaging: *in a dedicated corner, framing a pack from the*

[84] (Software as a service)
[85] (Infrastructure as a service)

monitor you can see starting a sort of trailer with the characters in animation involved in a gag.[86]

All the toys represented in the APP are real, so for LEGO it is an advertising system in which potential users can test the LEGO constructions before buying them.

Tesco, the British distribution group, had instead started to use augmented reality on a promotions flyer.

From home, the user to the PC, through an AR marker or Club Card enabled by the operator, could thus frame the marker that corresponded to the object and, recognized the code, started the enhanced representation of the object. Displaying a 3D television as if you were really in store in front of the real object, was a way to add to the digital experience a series of important additional information (volume of the device and therefore its size, the types of inputs for accessories)

A better visualization of the product, combined with the buyer's freedom of choice, are undoubtedly the strong points of the AR used to boost retail sales.

In the mechanical workshops, on the other hand, the control of the engine parts or the electrical system for all monitoring and maintenance activities benefits from the Augmented Reality, as this offers detailed information in overlays, with respect to each single part on which it is necessary to perform checks or interventions.

This information can be fixed or appear as pop-up signs alongside the components for which further explanation is needed, or as a video-tutorial which, through an overlapping film, shows a technician who correctly performs the intervention procedures on the machine

The same applies to maintenance activities at plants such as boilers, hydraulic systems, electrical or gas systems and so on. To support the work-force automation, a tablet or a smartphone helps the technicians in their work, explaining to the new staff the correct procedures or helping as a virtual help desk the operator in case of very unusual anomalies and outside the work of routine (virtual training).

Siemens, for example, developed the "Comos" software for the virtual training of the Comos plant operator who uses a realistic 3-D environment with augmented reality glasses to train the personnel of the plants to manage emergencies[87]. In this virtual world,

[86] www.lego.com

[87] BCG, *Industry 4.0: The Future of productivity and Growt in Manufacturing Industries*, 2017.

operators can learn how to interact with machines by clicking on a cybernetic representation.[88] They can also change parameters and retrieve operational data and maintenance instructions.

Augmented reality also finds applications in museums, can be used to support public administrations to communicate with citizens or as an emotional journey within a site of historical and artistic interest. Within a "smart city", ideally the application of augmented reality, activated through touch points in key points, is to support the identification of offices in complex buildings, to understand how to fill out a form without making mistakes. fields, displaying a static display within a museum, how one was actually immersed in that context.[89]

Additive Manufacturing

The name originates from the layered processing that makes the 3D printer, the protagonist of this technology, which involves the laying of thin layers of powder that are melted and aggregated, layer by layer, until the final product.

Therefore, the product is obtained by "addition" of material, as opposed to the traditional production which involves the construction of a finished product through the "subtraction" of material from plastic, metal ....

From the 80s to today, 3D printing has evolved constantly. Companies have recently begun to adopt additive manufacturing, which is believed to produce important effects especially in the field of prototyping (in terms of efficiency and time savings), in the production of individual components and in the spare parts chain.

3D printing determines a significant change for several reasons: it allows the creation of a customized product, the production of complex shapes that with the traditional production methods can find limits in the shapes and sizes of the molds, the flexibility in the use of the same supply chain productive for different achievements and above all the speed of change required by the increasingly evolving market demand.

[88]BCG, *Industry 4.0 : The Future of productivity and Growt in Manufacturing Industries*, 2017.

[89] http//:www. Digital4.biz/executive/realtà_aumentata: una_tecnologia_tantissime_applicazioni, luglio 2015

I will raise briefly on an aspect that I will go deeper in detail later, to describe how the personalization of the product, considered so far "not accessible" to mass consumption, thanks to the use of 3D, can be expanded and become "out of series" within reach all.
The concept of mass customization means creating a "unique" piece to suit every consumer that does not involve, however, the creation of a "special" mold that would bring the cost of the final product to a level too high and destined only to a high-end market.
The effect that the 3D printer exerts on production costs is also taken up by economist Irene Petrick[90], that proposes to support not only the classic economies of scale, but also the "economies of one", namely the advantages for companies deriving from the reduction in fixed costs, to the advantage of variable costs, and the increase in the possibilities for opening businesses artisans, to be able to extend their specialization to new market segments, thereby creating competition and new development opportunities.
The economist believes that the new organizational structure that could arise, could allow a revitalization of work organizations, based on productive decentralization and on horizontal relations in the exchange relationships established by the network of companies.

Therefore, 3D printing is not a substitute for traditional manufacturing, but integrates it and completes it, allowing greater product differentiation, for the reasons described above, and therefore an element favorable to specialization. So, it's not just about production. With the use of "additive manufacturing" it is easier to create complex shapes, moreover, it is possible to insert creativity into current products, thus facilitating the emergence of companies, which have in industrial design their strength.[91]
There is a change that does not just concern production, but also flexible design, through the possibility of co-designing the product and then realizing it with the 3D printer, in a parallel way and with several companies, each specializing in a phase of the production cycle.

[90] I.J. Petrick, T.W. Simpson, *3D Printing Disrupts Manufacturing: How Economies of One Create New Rules Competition* , Research Technology Management, 2013 Volume 56, 2013 - Issue 6-

[91] A. Magone e T. Mazali, *Industria 4.0 Uomini e macchine nella fabbrica digitale* , Guarini e Associati, March 2016

As stated by Stefano Micelli, Professor of Economics and Business Management Ca ' Foscari, a new category of small and medium-sized producers is emerging, offering a new concept of manufacturing, able to mix technological opportunities and consolidated know-how, individual creativity and culture of the territories.
And with reference to our country, the possibility of including the quality, taste and creativity of Made in Italy, within the new technological and distribution contexts.[92]
Many rocket companies, including Italian ones, are already using additive manufacturing to apply them to new projects that reduce the weight of the aircraft, reducing the costs for raw materials such as titanium.
For example, the Avio Aero plant of Cameri, the only one in the world that combines the production of powders with 3D printing, with the additive process, with which the machines are powered. Here the turbine blades are produced for the most advanced and powerful engine in the world, the GE9X, for the new Boeing 777X aircraft.
The whole process allows you to obtain products with superior performance compared to traditional manufacturing technologies: better material properties, weight reduction and consumption. But even more, Avio Aero's engineers are no longer subject to traditional limitations and can think about components in a new way, with lower manufacturing costs, greater product yield and no warehouse waste.

Cybersecurity

Analyzing in detail the technologies enabling by Industry 4.0, also our national plan, signed by the Minister Carlo Calenda, puts cybersecurity as an integral part of any choice, system or solution. The summaries from the Ministry for Economic Development put cybersecurity at point 8 but, in reality, each of the individual clusters brings cybersecurity as an enabling factor.
I dwell on the explanation of this point, as I believe, in light of the work done so far, that cyber secutity is the central pivot through which Industry 4.0 can actually develop.

"*Since its creation the Internet has been understood as an" ungoverned space ", a place not regulated by national and international political authorities. Moreover, given its*

[92] S.Micelli, *la Manifattura ai tempi del Bip*, Il Sole 24ore, April 2 2014

"artificial" and technological conformation, most of the objective responsibilities fell on the initiatives undertaken by private companies. This freedom "from the state" has produced its effects until cyberspace has begun to expand and has produced geopolitical dynamics. "[93]

The increase in connectivity as the status of "Always on", the IOT, the Clouds and the Big Data, dramatically increase the chances of attack by cyber criminals who aim to steal data of importance for companies. Therefore, as well as Industry 4.0 offers more and more opportunities for companies, at the same time companies must protect their systems to avoid the risk of finding themselves unprepared in the face of the attacks and find themselves with a "boomerang" effect, due to the improper use of new technologies.[94]
The cybernetic space (term used to indicate the environment in which the operations that make use of the Internet are carried out), makes the national and international markets more open, and on the other hand, exposes the same most vulnerable countries to the attacks of their computer systems, often in places physically distant or otherwise external to the organizations affected.
The evolution of cyber threats, on the one hand see completely new criminal activities such as online financial fraud or the escape of access credentials, on the other hand, traditional criminal activities that exploit new technologies.

The traditional model of crime groups is replaced by new networks aimed at specific targets, using cyber criminals, who are guided by profit selling to criminal groups, advanced and sophisticated (10-20%), or basic (80- 90%), capable of hitting individuals from companies to government agencies ("cyber as a service").
Therefore, the overall scenario is moving towards the structuring of an organization of cyber criminals, gradually becoming more specialized and of ever-larger size that will also include organized crime organizations, activists and terrorist groups, with the exchange of skills within these groups.
The main types of attack are:

[93] A.L. Clunan & H. A. Trinkunas, *Ungoverned Space*, Stanford University press , 2010

[94] https://www.agendadigitale.eu/sicurezza/la-cyber-security-nei-sistemi-di-controllo-scada-che-ce-da-sapere/).

- theft and manipulation of data: the growing digitization of information, big data and IOT, such as archiving and processing data, increases the level of risk associated with intrusions;
- counterfeiting of sites: they will increasingly assume the characteristics of legal websites, reducing the possibility of recognition by consumers of counterfeiting.
- cryptocurrency and recycling: the bit coin is currently the most well known and widespread cryptocurrency that represents an alternative and expanding payment method, mainly used by companies with e-commerce activities.

Criminal activities can exploit the possibility of increased illegal trade favored by monetary exchanges outside traditional financial flows controls.

At the national level, in Italy the perception of the need to implement cyber security strategies, both in the corporate and government fields, is still very low. The development of competitive digital strategies can't be separated from the application of high security standards. Although we have been talking about cyber since 2000, it is only recently that progress has been made regarding the definition of a governance structure and organizational capacity for data protection.

In the Prime Ministerial Decree of 24 January 2013[95], the foundations are laid for the definition of the international strategy, which defines the 3 different levels of intervention: policy direction and strategic coordination, support and link between the competent bodies, crisis management.

By examining the subject from within companies, most of the attacks can be traced back to the human factor (H), both aware and unaware of its actions. The technological solutions we have, by themselves, can't guarantee the total security of a system.

It is necessary to create and spread that culture of defined and institutionalized IT security that contributes to avoiding the behavior of employees and managers who can create flaws in the security system.

The theme of the perception of the risk that each of us can have in front of a situation is obviously very complex to manage in terms of standardization of the concept

Cybercrime, through an action that would seem to be aimed at hitting a person (this is the case of spear pushing, in which the victim receives more emails in perfect detail and

[95] http://www.gazzettaufficiale.it/eli/id/2013/03/19/13A02504/sg

personalized), has the objective of guaranteeing him the possibility to access within the perimeter of the organization and to download information necessary to carry out much more complex attacks.

The evolution of digital technologies, combined with other key enabling technologies (cyber in the first place), is totally changing the way of designing, manufacturing and marketing.

Digitization provides a unique opportunity for industries, and at the same time, a unique opportunity to attract further investment in Europe.

Targeted public interventions, such as those envisaged by our plan and other national plans, have an important role in creating the ideal conditions for adaptation to digital evolution to take place in all sectors. Even more so in a competitive environment strengthened by competition rules. Public policies must strive for the development of digitalization in all sectors, from construction to healthcare to services.

The aim of the targeted policies is that any industry in Italy and in the rest of Europe must be able to fully benefit from digital technologies regardless of the sector in which it operates from the place it is located and its size.

The MET[96] has conducted between October 2017 and February 2018, a sample survey of 23,700 companies from all Italian regions, aimed at taking over the current industry photography at a territorial, dimensional, sectoral level, and at the level of strategies, behavior and economic performance. The study deepens the detection of the involvement of companies in the use of technologies, as well as the type of technology used most and the investments made and next, of each company, in the digital field.

In the global scenario of the survey, the role of public policies seems to have been incisive and sometimes even decisive.

57.5% of companies used at least 2 incentives for the development of technologies and a high proportion of companies used at least 2 interventions included in the Enterprise 4.0 plan.

[96] MET was founded has been established in 1992 by a group of scholars coming from several Italian universities (such as University of Rome- La Sapienza, University of Trento, University of Udine, University of Naples – L'Orientale, University of Perugia and LUISS- Guido Carli – Rome). MET is a private and independent research centre, not part of any government, university or company. To study the Italian industrial structure and its evolution during recent years, with a particular interest for small and medium enterprises (SMEs), as well as through the assessment of the underpinning industrial policies at the European, national and regional levels. https://www.met-economia.it/

Chapter 2: Theoretical Framework

We are, now, at the beginning of the industrial revolution. As we have just explained, the most commonly used terms to describe this development, it's the rapidly and fast changing of the global industrial landscape due to the Industrial Revolution 4.0.

From the business point of view, the key drivers of this transformation include improving customer experience, increasing speed to market and reducing costs.

So, first of all it is important to define what "transformation" really means. To do so, we will start from a concept given us from "The Guardian" journal: "*Transformation is a whole scale change to the foundational components of a business: from its operating model to its infrastructure. What it sells, to whom and how it goes to market.*"[97] Based on that is clear to explain that a transformation touches every function of a business model.

For what concerned our specific analysis, the attention will be on how the organizational models of companies will change and how will be implemented this challenges trough new business models. The transformation based on that starts considering that business go through transformation when they have failed to evolve, businesses should accept radical changes and restructures visible from outside and so driven by external factors and by inside the company, such as a turnaround.

As starting point the new organization model move to a digital concept in which the innovation and the challenges for each sector is given by the new digital approach for companies. Therefore" digital transformation" is a visible wholesale restructure to avoid a tipping point caused by digital technologies and downstream market effects.

Nowadays the new technologies never been considered more abundant or affordable. These could be used to create new business value due to the capability to collect them, distribute the information, share that and make decisions based on real data and so to be more predictive in the analysis of what will be done to achieve the objectives. The models can be used for product optimization and to operate and control the manufacturing process.

But considering our research question in which the possibility to create new works and reinvent the role of HR inside the economic world it is not so simple and will be completely disruptive in some cases, the role of new technologies used in the

[97] What is digital Transformation? The Guardian, November 2013, www.theguardian.com

organizational models can be considered one of the changing aspects able to generate the new approach for humans at work and ,at the same time, the real needs to develop new skills to realize the improvement and innovations.

So, this new digital transformation has to follow three different steps to be implemented. The figure below explains in detail the needs to understand the new industry trends, the business priorities and also the new IT priorities.

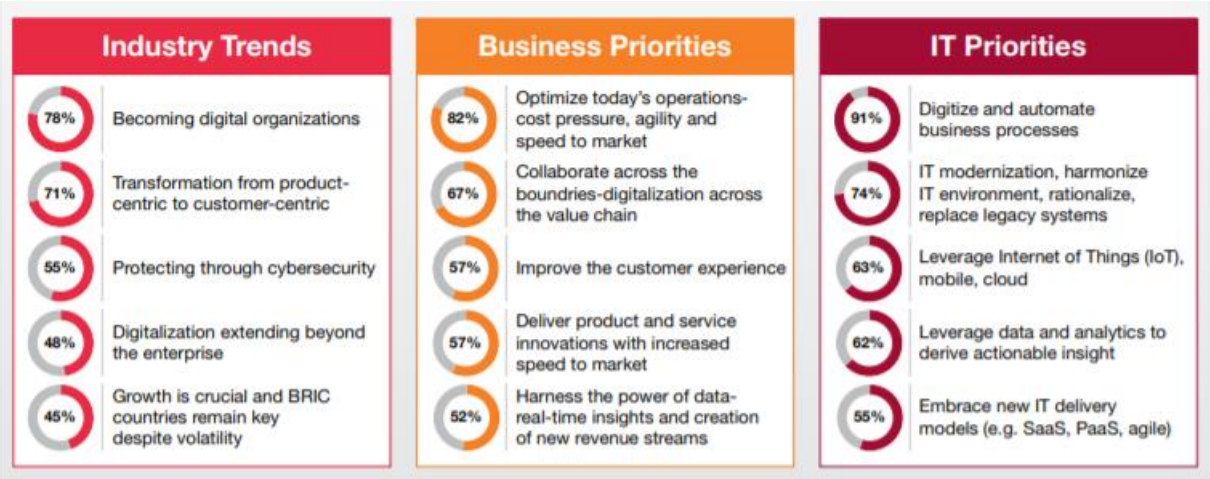

Figure 10: Industry 4.0, *Making your business more competitive*, (CGI,2017)

To go deeper in the argument in this new economy order, the Industry 4.0 is able to transform business in several ways.

From the corporate strategy point of view, the changes are on what the companies operates. They will impact on the product and services portfolio and so companies will need to well understand the impact of digital transformation through their businesses. For what concerned the supply chain the new models of sharing information and integrations of operations (OT and IT) make easy for companies to collaborate. At the same time digitalization will move from being an innovative trend to becoming a core competency in which will be more and more difficult define the role of the leader and to make correct strategic decisions align the IT investment portfolio with business priorities and maximize return on investment. The new figure of the leader is now difficult to define his role, that will be analysed later in the next chapter, focused on the role of the HR in the Industry 4.0.

To create a digitally-integrated and intelligent supply chain enables an un-precedent level of collaboration and real-time visibility to satisfy customer expectations, Industry 4.0 creates different solutions of implementation of new business models, particularly referred to manufacturing sector in which the digital manufacturing characteristics explained before takes a fundamental role.

The evolution of organization into the manufacturing sector should connect departments, customers, suppliers, partners, production equipment and products through our products and service life cycles directed to the innovation cycles.

The most used models in manufacturing for new organizations in Industry 4.0, are explained with the concept of:

- predictive maintenance model; "*using sensors to determine when equipment needs to be serviced can prevent breakdowns and reduce routine maintenance co*sts"[98]
- the energy management; "*managing energy consumption results in greener operations, lower energy costs, lesser unplanned downtime and more consistent quality"*[99]

These attitudes start to be used to generate the possibilities to help organizations to monitor the end-to-end manufacturing process, address bottlenecks, reduce waste and energy costs and remove operator intervention.

The revolution in the organizational models is driven first of all by the greater flexibility and robustness, related to the value chain in Industry 4.0 that will be more fluid and flexible, and with adaptable business structures in which is important to maintain the ability to generates the internal developments in order to the challenges in the external environments. Companies have to move to a new concept of "*Fractal company*"[100] for Warnecke that will create the concept of open innovation models that is, now, our real focus of analysis.

A Fractal company is characterized by self-similarity, self-organizations, self-optimization, goal orientation and dynamics as winning attributes of flexible and adaptable manufacturing organizations. At the same time for Fractal businesses the high performing ICT systems and digital tools represents a key success factors. Starting from

[98] Industry 4.0, *Making your business more competitive*- CGI,2017
99 Industry 4.0, *Making your business more competitive*- CGI,2017
[100] Warnecke, *the fractal company, A revolution in Corporate culture*,1993

that models Fractals can be considered the base of the new structural and organizational building blocks of Industry 4.0.

New businesses of Industry 4.0 respects 3 pillars:

1) Networked manufacturing
2) Self-organising adaptive logics
3) Customer integrated engineering

All of that are also into the principles explained for Fractals company but now there is the needs to innovate and develop that to a more digitalized attitude. Companies need to manage the increase of complexity, fast and interactive environment with the well combination of internal and external knowledge in order to create an improvement of goods and services, new processes and new marketing methods in a completely renewed organization of company.

So that, this attitude could be used to define the new direction of companies towards new kind of Open innovation thinking.

Open Innovation

To explain well, what really means "Open innovation" is important to consider the presence of external resources fundamental for companies.

What are external resources?

"*Suppliers of inputs that come from outside a business. Using external sources to acquire the inputs into its manufacturing process means that a business is exposed to market price changes in those inputs when producing its goods*."[101]

This definition comes from the theoretical meaning of what really means an external resource. But now, one analysed the general concept in the specific attribution for what concern the open innovation systems, the external resources are considered the assets used by companies to generate innovations and increase profits by assets, information, innovations and capabilities obtained by external actors and not creates or owned inside the company. With this concept we come back to the approach of mixing internal and external resource to generate innovations. The presence of the first one is not less important than the second one.

[101] www.businessdictionary.com/definition/external-sources.html

Important is to evaluate the benefits given us by the use of external resources in the new economics models.
Many advances have been made in terms of understanding the process of including external knowledge in internal innovation projects as well as exploiting internal knowledge through external partners.

The discussion wants to evaluate and understand the real nature of the innovation given by these external resources, which is related to degree of newness. The resource question in analyses could be explained testing the effect of internal and external collaboration on the degree of newness with incremental or radical in innovation projects.

-Incremental innovation: "*concerns an existing product, service, process, organization or method whose performance has been significantly enhanced or upgraded"*[102]

-Radical innovation: "*it is an innovation that has a significant impact on a market and on the economic activity of firms in that market. This concept focuses on the impact of innovations as opposed to their novelty. The innovation could, for example, change the structure of the market, create new markets or render existing products obsolete"*[103]

Historically, firms have organized R&D internally and relied on outside contract research only for relatively simple functions or products. Today, firms are executing nearly every step in the production process, from discovery to distribution, through some form of external collaboration.

In particular, new market rules have led companies to move from vertically integration model (Hayes and Wheelwright, 1984) to horizontally one, which has consequently shifted competition from the level of single firms to that of networks of companies.

These various types of inter-firm alliances take on many forms, ranging from R&D partnerships to equity joint ventures to collaborative manufacturing. All of that in this new concept of "Open Innovation" where the ideas and innovation have to flow in and out the company and market freely without any boundaries.

[102] WORLD BANK & OECD, the innovation Policy Platform-Radical and Incremental Innovation
[103] WORLD BANK & OECD, the innovation Policy Platform-Radical and Incremental Innovation

Within the innovation management literature, the topic in analyses: the role of collaboration between companies, has been the subject of much interest for a lot of economists.

The link between innovation and collaboration is often as a source of competitive advantage argue that collaboration can affect a firm's innovative output positively by providing the three substantive benefits: knowledge sharing, risk reduction, and speed of development.

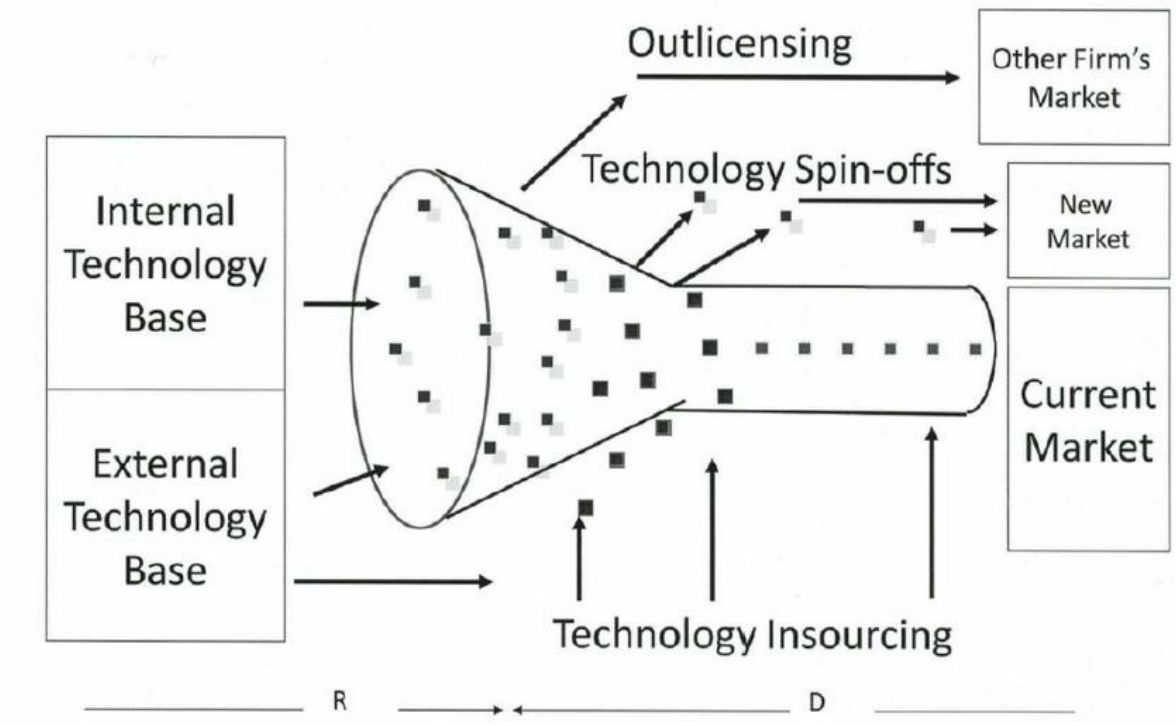

Figure 11: *The open innovation model* (Chesbrough 2012), p.23

This link is becoming progressively more important as fast-changing market conditions that creates the need for organizations to sustain continuous innovative activities to be in line with the market. This need also lays the foundation based on Chesbrough theory that

a shift from closed innovation principles to Open Innovation principles is essential for business survival in this era.

Discussing the importance of integrating different sources of knowledge in the innovation process, Chesbrough notes that it is no longer sufficient, at now, to focus only on generating innovation in a closed innovation system existing solely within the boundaries of a firm, but that innovation should take place in an Open Innovation system in collaboration with sources from the external environment that represent the only way to gain value. This observation has interesting consequences for the way in which innovation should be perceived, as it highlights the importance of considering the application of an inter-firm perspective rather than merely an intra-firm perspective for creating innovation.

The concept of inter-firm performance for Open innovation is in accordance with the dynamic capability view of the firm, and so the new Open model uses that for their activity process. Openness to using external sources of information and ideas in the firm's innovation processes and interactions between different partners is considered to be of great importance both in order to explore and to build up new capabilities (Von Hippel, 1988; Chesbrough, 2003). In particular, the organizational capabilities of using these signals to reach and find good opportunities are considered as essential contributions to innovative performance and long-term competitiveness.

Furthermore, with this concept we are able to determine not only how the Open Innovation paradigm affects the degree of newness created but also to provide evidence on the particular patterns of collaboration which favour high degrees of newness.

The concept of Platform

So now the concept of Platform, as something new that could be generated, it is possible to highlights. The evolution of new levels of newness created provide to define inside this concept of Open Innovation the expression of Platform model.

But now, when we talk about Platforms we are going to referred to a complicate Ecosystem.Today, platform ecosystems are communities able to create new value through the potential to increase the production and create dynamic and sophisticated models

thanks to collaboration and competition among participants. In this Ecosystems the Platforms arises and in our specific resource question can be analysed in their for as; "Technological Platform".[104]

To start with the right foot is important to explain in detail what is a Platform and to show the structure of that digital tool to be able to understand better how it possible to create value due to this trend.

"*Platforms are defined as products, services, ortechnologies that are similar in some ways to the former but provide the foundation upon which outside firms (organized as a "business ecosystem") can develop their own complementary products, technologies, or services*"[105]

In detail, we develop an analysis of the business ecosystem's organizational form from the structural and cognitive properties.
The structural property involves "*the selection and functional integration of the organization's components and establishes the properties of the architecture that connect them*"106, while the cognitive property "*deals with the knowledge infused through the architecture and assigned to the various organizational units interacting within the organization*"107

Within this framework, it follows that understanding how a business ecosystem emerges and, eventually, develops, requires exploring how the architectural knowledge of Platform supporting its organizational form emerges and evolves. For what concern the theory of Platform the architectural knowledge is about representation of the interdependencies between technical and non-technical components of an ecosystem. But moreover, the result of the infrastructure used to create the Platform it's the result of identification, selection, combination, and interaction of the various components that make up its organizational form based on the activities of the participating organizations. To explain better this concept we can use the words of Moore:" *the infrastructure of business ecosystems, the nature of modules, the particular technological choices that are*

[104] M. Iansiti,R. Levien, "*Strategy as Ecology*", Harward Business Review, 2004

[105] Annabelle Gawer, Michael A. Cusumano, "*How Intel, Microsoft, and Cisco Drive Industry Innovation*" Harvard Business School Press, 2002

[106]P. Barbaroux, A.Attour "*Architectural knowledge and the birth of a platform ecosystem: a case study*"2016

[107] P. Barbaroux, A.Attour "*Architectural knowledge and the birth of a platform ecosystem: a case study*"2016

embedded in the modular design, and the openness or proprietary nature of the interfaces between modules has a great deal to do with who participates and how" 108

The skeleton of the architectural structure of a Platform refers to the mix of: "heterogeneous business and technological elements"that involves private and public organizations in the creation of a process that use technical capacity, associated knowledge bases, and markets trends .
We can identify four dimensions of architectural knowledge: technology awareness, use context sensitivity, business model understanding, and boundary-spanning competence. the first three types that have been mentioned indicate the need to develop an architectural knowledge that covers the interdependent series of dimensions connected to the organizational form of a business ecosystem. this concept is based on the thought of Moore already taken up earlier in the text. however, namely technology, collaborative relationships and the market. Moreover, each dimension can be associated with tangible and intangible resources that allow the definition of a business ecosystem.

In fact, the technological dimension of architectural knowledge includes the trajectories of innovation of the participants and the form and modular organizational infrastructure of the business ecosystem. The collaborative dimension of architectural knowledge is nothing but the expression of the concept of collaboration and the set of initiatives that allow it to be realized.
Finally, the fourth dimension oriented to the market of architectural knowledge is characterizing the space for business opportunities, customer feedback and the various financing tools and institutions necessary to facilitate the birth (and further expansion) of a business ecosystem in which Platforms can position themselves.

Consider a world in which companies need to collect and reach a big amount of every day updated information, the presence of this new Business Model to create relationships and so commerce between operators, could be considered as a saver for companies. The information present in the world in all the different sectors of actions are not simple to collect and transform in real potential value for companies.

[108] P. Barbaroux, A.Attour "*Architectural knowledge and the birth of a platform ecosystem: a case study*"2016

Not only the information/neweness is important but the maximization of their value in the sharing that info inside the target society.
How this new model differs from the past especially in the new way to determine the role of the consumer and the producer in the relationship?

If in the past the only way to communicate and share information could be the newspaper or the world of mouth, only later the radio and TV. In the current era, there are no people without living with a technological device such as a cell phone or tablet through which he / she remains connected 24 / 24h to the network. In this way, the possibility of communicating a message / information can occur at any time and in every place, globally adjusting the knowledge of the whole world and thus eliminating the barriers that in the past hindered the exchange of information.

With this view of the world today, the new Platform are able to create the new phenomenon known as "Platform Revolution".109
Analyzing this revolution from the business point of view, we can bring out the role of two figures:
- consumer
- producer
Necessary in order to understand how, through the Platform, the company is able to increase its internal value and relations with consumers, obtaining greater chances of success and profit growth.
From the business point of view (Producer) the research aspect aims to understand the price movement in the market, the consumer preferences and the trend of the demand as the general trend of the market. This research activity, today, is possible for companies or single investor through the Platform tool.[110]

The other side of the coin brings out the use that the consumer can make of this tool. on the basis of how the platform provides the information concerning the company, every little curiosity and information regarding the same can be obtained from the circumstances. Platform, a technical tool, allows not only the exchange of information

[109] G.G.Parker,M.W. Van Altyne, S.P. Choudary,"*Platform Revolution*",W.W.Norton&Company Ltd,2016
[110] www.platformleadership.com

but also the possibility to operate in carrying out more operational functions going to make direct contact with the company.

In this way the concept of the value-creation through the combination between external and internal resources find its direct application

Moreover, rising the use of platforms by major companies increases the value-created both for company itself and for consumers. The big global giants like Apple, Google ... that start exchanging information through this new digital device, revolutionize the entire economic sector we are talking about. The revolution has positive effects if those involved are taking the results generated and maximizing their usefulness.

What are the real potential useful use of Platform?

Stating that, Platform is an infrastructure accessible to everybody in which the is possible to create interaction and the governance conditions are simply established.
The structure of each Platform it is different based on the aim of that creation is realized by specific company. The easy access and the simple way through which the user can access and use the disposal and all the function that the platform gives make more attractive, useful and productive the technological disposal. The final purpose to answer to our research analyses is to matching needs among users making it easier to exchange goods, services, value for all the participants without distinction of class or economic capability. The connection with the evolution of digital technology gives the the prospects for the future are growing. Platforms will evolve hand in hand with technological developments that are generated so as to become efficient at the highest levels.

A CASE STUDY EXAMPLE; a Mobile war Microsoft vs Apple

In the contest of Platform, the mobile handset has experienced exponential growth since year 2000. As technology advanced, so did the potential to integrate numerous extra functions. It is expected that the global amount of revenues for this sector will increase in the future to create a worldwide mobile commerce market that could reach revenues for 210,8 billion.

Both from the point of view of the mobile and in the production of computers, the requests lead to the creation of ever more innovative devices.

Due to the enormous market potential Apple and Microsoft wanted to tap into the mobile scene. Characterized by different core capabilities and positions the two giants needed to transform their current offering for mobile uses in current era, winning them a competitive advantage.

Microsoft was be criticized for not moving the company much beyond the PC platform. So, Microsoft starts suffering for a decrease for its share price and market value that start to decline while the new dispositive of Apple has been growing sales at 50 or more annually in recent years and surpassed Microsoft in market value back in 2010. Apple was growing so fast because, unlike Microsoft, it evolved beyond the slow-growing PC business and became a major player in newer, more rapidly growing markets of smartphones, tablets, digital content, and soft-ware product distribution.

So, Apple has successfully expanded its smartphone integrating offers providing a lot of app to make more competitive its technological disposal and connected them in a Platform software for sharing the information. Microsoft to rise its market value used its strong operating system knowledge to create mobile solutions as Platform model. For people, in the current era, smartphone need to perform various duties such as; e-mail, messages, what's app, e-commerce activities, interactive games and at the same time bank's operations, investments. This start to be able to be realized with the new Platform feature that these companies start to adopt.

Apple gains success soon after the launch of the first IPhone in 2007, through which offered a unique experience with its hardware and software features. Apple needed to provide a software developer kit and test the appropriateness of applications. To be able to work Apple creates also an App Platform in which all the functions, activities, games and information could be sharing from all the people who are holding an Apple device. This platform provides payment and free applications which generate potential for success and allow profit growth. So, the "App Store" became a lucrative market for

service providers, start to be a giant success and it possible to register that after only one month later the platform store opening, Apple reported sales of about 30 million.[111]
On the other hand, Microsoft also survived disruptive technological transitions and daunting business-model challenges.

These challenges are:
-character based tographical computing
-the Internet
-Software as a Service (SaaS) and cloud computing
- mobile computing, and social networking
- survived global antitrust scrutiny and major violations (for example, with Netscape and Internet browsers).

Microsoft loses value compared to Apple because it finds more obstacles in the launch of innovative technological devices. Billions of dollars in losses from MSN and Bing have prepared for about 15 years Microsoft for the online world of "cloud computing"[112] financed by advertising revenue, even if this threatens its traditional packaged software business. Furthermore, Microsoft has adopted a new technique of subdivision of windows (operating software) into smaller modules so as to ensure greater organization and acquisition of information and receipts from the Internet. these changes also allow the creation of ”Windows Azure” cloud.
“Windows Azure” cloud offering and SaaS versions of major products have had good receptions in the marketplace.
Microsoft start to rise and become more competitive in the market but it is not able reach the same amount of value that Apple reach.
Principles of Industry 4.0 in the expression of Platform models are used by both companies in different way with different results but at the same with the final purpose to use the digital revolution as promoter of success and value creator.

[111] https://www.apple.com

[112] Annabelle Gawer, Michael A. Cusumano, *Industry Platforms and Ecosystem Innovation*, 2013 Product Development & Management Association

Chapter 3: Research Methodology

When we talk about Industry 4.0, we talk about “Today”, about a process that has just begun; the Revolution is still ongoing. Starting from this statement, the analysis I have carried out to search for material and information necessary for the preparation of my work has been varied and absolutely stimulating. Treating an ongoing topic of affirmation is somewhat complex, but for other aspects it is really very interesting. Being able to be protagonists of such a radical change, makes us assume a privileged and conscious role of what will be the next evolutions and decisions on the future world of work. The research included in the paper is a combination of multiple surveys and documentation that have been carried out byrenowned consulting firms, academic studies, ministerial publications, International organizations, papers opinions in time as well as selected interviews of academics and business professionals.

To focus on the research methodology carried out, trying to give an answer to the research questions presented in the introduction.

“How is it possible to create new jobs, even more, create new jobs of the future? How can these principles be implemented considering a new organizational scheme of the company based on Industry 4.0?”

“Are new technologies a threat or not? Is there an actual risk of man-machine replacement? “

Starting from the first part of the elaboration of data, the research is conduct trough a "qualitative" approach. Papers and websites have been reviewed to reconstruct the transition from the "Steam Age" to the "Internet of Things", both historically and economically. The aim of the paper is referred to a general overview of multiple revolutional data and effects generating in the world by the application of Industry 4.0 innovative aspects. I start with Calenda Plan because it represents an official document to show the effects generating in Italy by the industrial revolution 4.0, compared with others European counties, using surveys and numerical data to show the results of the implementation. It has been taken up again by the publication of the MEF and the MISE, in this regard. In this part the approach was mixed; alongside qualitative analyzes, numerical data and percentages were used to make the phenomenon described as "measurable".

As regards to the topic I interviewed Dr. Nicola Liguori, External Relations Committee Leonardo (ICE), who explained to me the work done by the research body in collaboration with KPMG, with the aim of highlighting how "Industry 4.0 represents an opportunity for Italian companies if the tools made available are exploited in the right way ".

KPMG has interviewed a panel of over 200 companies and most, about 70% of respondents, confirmed that Industry 4.0 is an opportunity.

The main objective of the survey was to evaluate the knowledge of the Plan, the appreciation of the instruments of the super amortization and depreciation and the consequent increase in investments, the real situation of the professional technological training and the push to increase it in the immediate future. The nine enabling technologies of the IV industrial revolution have been described starting from the definition in the BCG paper, which considers them the nine fundamental pillars on which change is based, and through the documentation found on technical websites and specialized magazines of sector. It is chosen in my research thanks to the complete overview of the enabling technologies generating from the revolution.

The work was done, giving a brief description of the single technology without going into too much technical detail, not pertinent to this work, but above all finding application of practical cases of companies, possibly Italian, such as Generali, Comau, but also Lego, Tesco etc. I have however tried to highlight the applicability of technology in the most common and practical areas, from the organization of the city, to the health sector, to the manufacturing company.

The research was carried out by consulting texts on the subject and by gathering information on the sites of the mentioned companies, in order to deepen the state of the art in applicability.

Digitization is the starting point that then leads to transformation 4.0. To address the topic, I drew inspiration from an Adapt bulletin, published on the newspaper “Il Sole 24 Ore” that defines the advent of digitization, as "The Great Transformation": as it is thanks to this transformation that the individual as "worker" and the company will give importance to the changes produced

Based on the same topic, I mentioned the article by Steven Wilczek, on the risk / benefit in the use of technologies and I tried, through the study conducted by PWC and the World Economic Forum, to answer the question posed by the magazine for companies " INTERNAL AUDIT ", of the month of December 2017 , "Is the end of the work coming

soon?"; in this case I gave space to quantitative research, statistical data and percentages about man / robot replacement. An important analysis conduct by Frey and Osborne is the starting point to measure the real amount of value about the substitution of human work by robot. The research is done using some algorithm to show the results. The topic has been expanded introducing also the theories of illustrious personalities, not necessarily "insiders", such as Pope Francis, Obama, Bill Gates, and Trump that through their points of view offer us an overview about the possible risks and benefits arising from the development of revolutionary principles. I read carefully and gave food for thought from the book "Industry 4.0 - Men and machines in the digital factory" A. Magone, T. Mazali – Guerini e Associati, 2016 "in which the concept of factory of the future is presented, as well as its new requirements in terms of flexibility, adaptability and cross-sectorality. I think that the choose of this book is fundamental because it represents a journey through Italian companies on the study of the phenomenon, applicability and problems. The same importance is given to another book publication "The fourth Industrial Revolution" by Klaus Schwab founder of World Economic Forum. This book contains one of the most advanced analyzes in the field of technology and applied research, but also because it opens up a perspective on the working world of the future.

Also in the text, through the analysis of the cases Tabby and Tesla, choosen because are representative innovative and radical change producers of automotive. I have analyzed which are the skills that are required to man to remain the participatory, proactive and reactive protagonist of the factory, even if understood as a "smart" factory. The "human capital" is not put aside, but included in a winning way in the production process. Still on the theme of the centrality of man as a "worker", the reflections of the well-known contemporary sociologist, Manuel Castells, have been useful to me;"The power of Identities" paper, in which the concept of identity and globalization is analyzed in the era of the Information Technology revolution.

Concerning the general and didactic part related to soft / hard skills, I have consulted several ADAPT bulletins, on the importance of skills for the enhancement of human work in the changing phase. I used Adapt because is a non-profit organisation founded in 2000

by Prof. Marco Biagi with the aim of promoting studies and research in the field of labour law and industrial relations from an international and comparative perspective.[113]
The part concerning the existing GAPs and how to fill them is inspired by a research by CapGemini "The digital talent gap", 2017, in addition to the analysis of the data contained in the survey carried out by Global HR Business that produced data on the application / dissemination of digital skills.
Moreover, a series of observations on the topic have been analyzed in comparison and reported in the text as the principles that the American giant Nike claims about the importance of human participation in the production process.

Throughout the document, we mention the in-depth Survey. Having to analyze a real situation and to measure a phenomenon, the quantitative survey allows us to analyze the research in an accurate and direct way. In my case I have often used surveys of renowned consulting companies such as KPMG or PWC.
In order to give a concrete answer to my research questions, whose contents were developed in the last chapter, I decided to conduct a data analisys personally, interviewing the company BMC Air Filter.
The survey was conducted by me according to this operating scheme:
-List and company contact within companies that are entering the universe 4.0;
- Study of the questions to be submitted through a structured questionnaire and directly through an interview with a company representative.
The questions were formulated both in reference to the research questions presented in the introduction to the thesis, and in a more descriptive way, leaving the interviewee the possibility to express concepts based on personal experience deriving from company's transormations.
- Formulation of the Questionnaire
- Interview and information gathering
- Study of collected data (both quantitative, intended as numerical data required in the answers, in order to obtain measurable and comparable data, both qualitative, more exploratory, such as the study of the worker's behavior in relation to certain phenomena)
- Results and conclusion

[113] www.adaptbulletin.eu

A representative example of questions used to obtain results from Air Filter Company are:

1) *With reference to the technological innovations adopted. Indicate for each of these the greatest benefit. Assign a number from (1 to 13) to indicate the benefit of each of these technologies:*
2) Flexibility
3) Make-to-order
4) Reduction of time -to market
5) Reuse of products and production systems
6) Increase in production
7) Reduction of production waste
8) Optimization of costs
9) Enhancement of human capital and better integration of skills
10) Interconnection
11) Increase of informations about digital devices
12) Increase of informations related to productive processes
13) Increase of informations about distribution of products

	1	2	3	4	5	6	7	8	9	10	11	12	13
Autonomus robots													
simulation													
big data													
system int.													
internet of things													
cybersecurity													
cloud													
additive manufacturing													
augmented reality													

2) What are the skills required for the "worker" following the introduction of the technological innovations adopted? Assign a value from (0 to 4)

WORKERS

	0	1	2	3	4
Problem solving					
Team working					
Decision making					
Flexibility and negotiation					
creativity					

3) *Does the activity carried out by your company think it could have a negative result with the digitalization brought about by the Revolution 4.0?*

Chapter 4: Empirical Findings

4.1 General overview on the impact of digital technologies: Risks and Benefits

The 4th industrial revolution is not only changing what we do but also what we are. The impact that this "Great Transformation"[114] will have - as defined by Enaudi in 1974 with regard to that process capable of affecting every economic and social aspect of the ecosystem in which human beings work - will be attributed to a multiple sphere of participants.

This concept will change the identity of individuals in different aspects, starting from the way of conceiving privacy, time and the development of the skills useful to one's career. Furthermore, it will modify the way to relate or simply the whole enhancement that technologies will guarantee to human potential. This phenomenon is reaching levels of change in times never seen before in history, creating in the human being the contrast between feelings of excitement and fear at the same time.

Framing the analysis from the point of view of technology is allowing companies to achieve things in a simpler, faster and more efficient way, providing opportunities for growth and development that are not aimed exclusively at the company as a whole, but at an individual level of the HR factor working within it. At present, where the phenomenon of digital transformation 4.0 finds a greater understanding from Human resources' people, we realize how the possibilities that are being offered are greater, the stakes are higher and therefore it is necessary to consider the threshold of a radical change and the necessary adaptation of human beings.

At the same time, there is the risk of splitting the population into two distinct groups: those who will adapt to changes and those who remain anchored to tradition and will tend to oppose them. This possibility of separation can be considered a struggle between those who want to win and those who are won. Adapting to technological progress becomes fundamental in order to benefit from the improvement that devices, platforms and new forms of digital transformation (the reference to the nine pillars previously described),

[114] La grande trasformazione del lavoro, ADAPT for NOVA, Il Sole 24 ore

especially in some sectors such as the engineering sector, will lead this population band, while the part of population that does not fit will be excluded.

Therefore, in the social field, the possible adoption only by a small number of categories of people could generate class conflicts and tensions causing a risk in the generation of the future that is divided into those born and raised in a digitized context (Digital native) and those who, on the contrary, must adapt and will thus always be a step behind..

Even before, framing the figure of the worker within the new concept of "Enterprise 4.0"[115], it is important to understand how the development of technologies, which inevitably is attacking the world sphere, will impact on the concept of identity and if this will fall into violence on the characteristics of the worker even in his personal sphere.

Taking up an article by Stephen Wilczek we extrapolate the statement: "While the short-term impact of artificial intelligence depends on who controls it, the long-term consequences depend on whether it is controllable or not (...). We should all ask ourselves what we can do now to increase the chances of exploiting the advantages and avoiding the risks "[116].

However, the advent of the digital revolution brings with it numerous doubts from the population that despite the change from the innovative point of view of the principles 4.0 is afraid that not only benefits will emerge but also risks of great depth.

If the industrial and technological progress has always led to the increase of wealth in the different eras, at the same time it has caused the elimination and replacement of many trades. It is for this reason that, even today, the advent of artificial intelligence in the economic chain seems to be considered a problem that can lead to global unemployment.

[115] Industry 4.0: Building the digital enterprise- 2016 Global Industry 4.0 Survey-, PWC, 2016

[116] Stephen Hawking, Stuart Russell, Max Tegmark, Frank Wilczek," transcendence Looks at the implications of Artificial Intelligence-But Are We Taking AI Seriously Enough?2 The Independent, 1 May 2014.

4.2 Is the end of the job? Opinions in support or contrast. The affirmation of important figures in the world

So before framing the man in the new "Enterprise 4.0"[117] we ask ourselves the question: is the end of the work coming? Will companies with their functions continue to exist?

To answer these questions we start from the statements that the economist Jeremy Rifkin expresses in this regard. According to the scholar, it is expected that only 5% of the adult population will manage the entire world economic system because they will be in possession of a job. For what concerns the remaining part, 95%[118] of the population, it will be unemployed because replaced by robots and could become dangerous for society.

Even an analysis of the World Economic Forum does not report positive results in the first place. A net loss of about 5 million jobs is estimated due to the Robots. On the same subject, PWC states that in the future 28%[119] of humans can be replaced by Robot activity. This is how it is defined that the jobs that will lose their place in the economic and social field will be those with a lower level of specialization, but that currently give employment to more than half of the global population.

The forecasts are drastic and negative and therefore it seems that we will reach a reality characterized by unemployment and poverty.

Every job is likely to be replaced by technology today. These are the words expressed by Barack Obama in his speech at the end of his mandate on the State of the Union. So you can see how even the thought of a leader has reached with simple and decisive words that fear that we have expressed of what can be a real danger: the replacement of people with robots and sophisticated new generation technologies.

Another witness and real concern is found in the words of Pope Francis who defines it as a cultured danger. The Pope speaks of this in a message to the World Economic Forum in Davos, discussing the effects of the fourth industrial revolution. And the message of

[117] Industry 4.0: *Building the digital enterprise*- 2016 Global Industry 4.0 Survey-, PWC, 2016
[118] *AFuture that works: automation, employment, and productivity,* McKinsey Global Institute, January 2017
[119] Internal Audit, *La fine del lavoro è prossima*?, N. 95 Ottobre/Dicembre , 2017

the Pontiff is clear: "man must guide technological development, not be commanded by it!"[120]

But will it go like this?

We mentioned earlier, and analyzed in the study of industrial revolutions, as history teaches us that, on the contrary, innovative changes and the advent of new technologies have always brought positive repercussions in the world of work. The automation of processes will lead to a reduction in costs with subsequent price reductions and increased sales. Increased profits increase wages, workers consume more and this generates a necessary increase in production and demand for new jobs. Therefore an economic growth.
Even the words of Barack Obama did not limit themselves to picturing only a negative scenario, but they tried to find a way out: the education of people. Also, in this case there are studies that support this thesis, demonstrating the higher the level of worker training, the lower the risk that his work will be replaced by robots.

Another perspective that presents to us the same theme was provided by the founding genius of Microsoft Bill Gates. As mentioned by the powerful figure of Gates in the coming years, then with a look at the future of companies, the advent of technology 4.0 and the forms of digitalization applied in different sectors will result in an estimated loss of millions of jobs. Only in the United States of America estimates to reach eight million, while they seem to rise to 15 for Great Britain, considering these oscillating values, it is considered a total of 5[121] million jobs that will cancel their "activity" since replaced by robots. Man will be replaced by machines, more agile, efficient, proactive, smart. It is however to be considered how the phenomenon will find greater application within the warehouses and factories where the trade, which is currently carried out by man, is basically an automatic and repetitive activity that does not require the use of a capacity and a human mind with features that cannot be developed within a software. A Robot created with the highest levels of innovation is able to repeat the same actions going to improve the performance compared to the same activity performed by man.

[120] G.Lehonard, *Technology vs. Humanity,www. techvshuman.com*

121 PMG, *Perspectives: What Is On The Horizon For Industry 4.0*, Forbes, Apr 3, 2018

This case allows us to regulate the phenomenon in such a way as to note in particular the shift of the human work force towards those jobs in which the machines cannot excel; some examples are the instruction where the physical presence of man is always required to spread knowledge or assistance to no self-sufficient elderly people.
In addition, the founder of Microsoft believes it is necessary to apply the tax known as "tax on robots" which has the function of saving the tax revenue from the automation of production processes using robots. The "tax on robots" seems to be for Gates necessary for the evolution of the corporate economic system. Gates states: "Today, if a human being earns 50 thousand dollars a year, working in a factory, he must pay taxes. If a robot performs the same tasks, it should be taxed at the same level "[122].
Through this statement, that in part can be considered as a sort of provocation towards robots producer / user companies, it is considered necessary to tax the robot if this device replacing the human activity is placed at the same level as the worker. In this way, tax treatment must respect the same plan. Bill Gates also states: "I do not think that the companies that produce robots would be angry if a tax were imposed. The use of artificial intelligence can generate profits with savings on labor costs "[123].

Therefore, in reality a double taxation would be a tax to be paid for those who produce the robots and then one that will be paid by the companies that buy them and install them to replace the activity of man.
Another contrasting view is that one provided by Donald Trump, President of the United States of America, who on the contrary, in his program foresees an overall reduction of taxation for companies. This is because he believes that by applying a sharp decrease in the tax burden for companies, workers would be encouraged not to leave the country and increase productivity.

This principle is in contrast to what was affirmed by Gates, which does not contradict the words of Trump in its entirety, but states how the progressive automation in its development of recent times will lead to transforming companies into large "empty" complexes where they are no more human resources but only Robots.

122 Robots will destroy our jobs – and we're not ready for it, The Guardian, January 2017, www.theguardian.com

123 Kevin J. Delaney, The robot that takes your job should pay taxes, says Bill Gates, February 2017, www.qz.com

Much of the production where workers are missing is in the manufacturing sector, although at the same time the service sector is losing jobs.

The discussion is still open and being a constantly evolving phenomenon, it does not find a reason or a wrong to one side or the other. We need to wait and see how the system will evolve. Currently we can dwell on what has already been implemented or is being implemented.

In this way, we see the other side of the coin. It seems certain that due to the advent of the Robots the whole system also in the legal field will provide for the review of the social contract between the Government, companies and citizens. It is not therefore a question of fearing the future of work, but of having the right skills to face it. If viewed in this light, technological development, far from neo-Luddite suggestions, is a possibility for a renewed centrality of the person in the market and in the workplace. On the contrary, without the construction of these new skills, technology can only destroy work, making man its slave or a designated victim. This does not mean that many current professions will not disappear – this is inevitable - but if we think that in the first half of the nineteenth century almost all workers were agricultural laborers, we understand that the disappearance of jobs does not mean that new ones cannot be born. So, following the waves that characterize the economy, the future reserves us new jobs based on new needs. Therefore, in such a way as to consider "the Great Transformation"[124] not only in its profound implications in the technological field, but also in the radical overcoming of those rules defined as "Aristotelian rules"[125] of labor law for human beings. It changes "the unit of place-work"[126] that is the work in the premises of the enterprise, "time-work" understood as the work in the arc of a single timeline and "action-work" that is the concept of an activity mono-professional.

In the reasoning just carried out, I would like to report how the Revolution in analysis does not focus solely on the concept of process automation but even more in constant interaction, thanks to sensors and platforms interconnected to the Internet, research, design, production, products and services, which affects the overall production and the concept of demand in terms of sharing and reciprocity (sharing economy) compared to the old production process and the use of goods.

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[124] *La grande trasformazione del lavoro*, ADAPT for NOVA, Il Sole 24 ore

125 M.G.Greco, *Il rapporto di lavoro nell'impresa multidatoriale*,2017

126M.G.Greco, *Il rapporto di lavoro nell'impresa multidatoriale*,2017

Think that everything possible only through new juridical rules or through pre-established techniques will not take us far. The law will always be overcome by reality and the technique will become obsolete in a short time. Faced with the risk posed by automation, it is necessary to bet on the novelty that the workers can always bring, and to do this, it is necessary to leave it room, without fear. Often in our country this has not been done, merely thinking that with some regulatory intervention the economic-social scenarios could be modified, and the results were not and are not particularly satisfactory.

4.3 The new concept of "Industry 4.0" and the role of HR inside

It is therefore important to look at and support the efforts and ideas of those corners of the working world, both by employer associations, as in the case of the courageous platform for the renewal of Federmeccanica's[127] industrial relations, and trade unions, such as for the efforts of the FIM-CISL on the role of training and personal welfare in the new digital manufacturing, to seek together and in a shared way not to undergo change, but to grasp the great challenge for the future of work.

This is how we first relied on an old idea of Supply chain and value chain which, even if, over time, acquired not only a national, but on a global expansion. This is a concept of "factory" marked by its own boundaries.

The analysis takes us hours to show what are the "factories of the future"[128] to then go to insert the figure of the new worker 4.0.

The factory of the future breaks down all possible boundaries and limitations that existed before, it is considered as one; "Interconnected city with a high density and concentration of resources, technologies and skills*"*[129] breaking completely these barriers that separate the walls from schools, universities, research and development centers, startups with the aim of fueling network logic intended as multiplication of value.

[127] *Federazione sindacale dell'industria metalmeccanica italiana*
[128] A.Magone,T.Mazali, *Industria 4.0 Uomini e macchine nella fabbrica digitale*; Guarini e Associati,2017
[129] P.Khanna, *Connectography, Le mappe del futuro ordine mondiale,* Fazi, 2016

The new factory which, as we have seen, has the possibility of not being considered in its physical aspect but in the reality that is created around, like the Platforms, can "determine an increase in competitiveness even in the presence of small dimensions" inherent this formative aspect to date with the concept of enterprise 4.0 we are not moving in a direction of training only for the person in order to contrast the levels of unemployment through professional retraining and appropriate interventions but in a deeper way through the radical change of conception and design contexts, production and development.

The "Fordism" and "post-Fordism" paradigm has been completely overcome both in the organizational models of the work activity but even more in the basic concepts of "business" and "work" going to abolish the vertical scheme and taking a horizontal approach. and reticular made of exchange and cooperation.

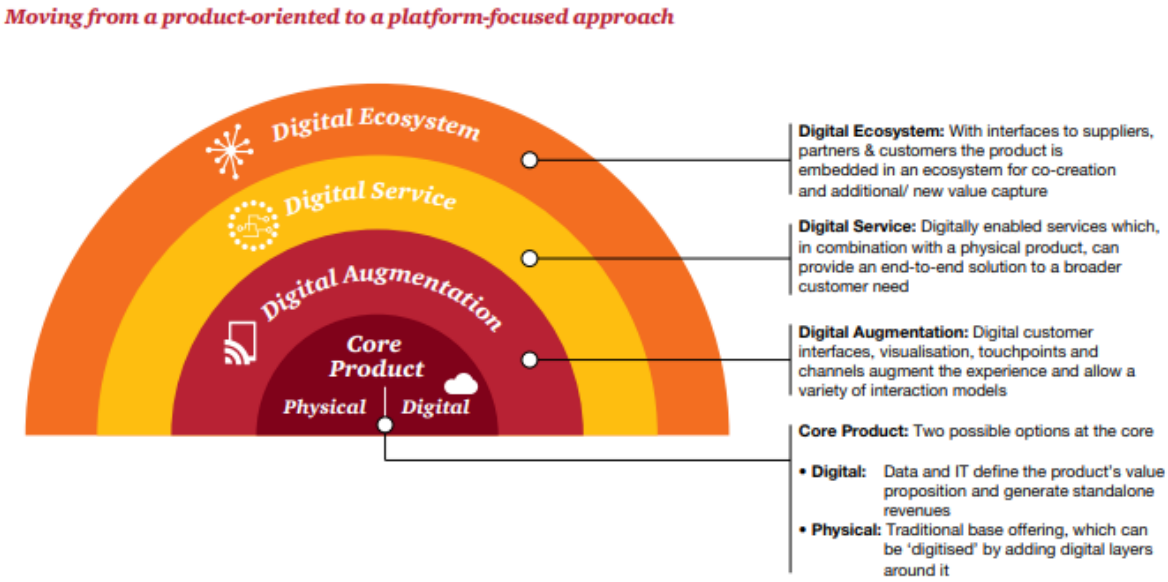


Figure 12 – Moving from a Product-oriented to a Platform-focused approach (Source: Capgemini/Counsulting, 2017)

The new supply chain is revolutionized considering the inclusion of enabling technologies as substitutions and introduction of a new way of working in the new ecosystem.

Of fundamental importance in our study is to consider the centrality of man within the "factory of the future".

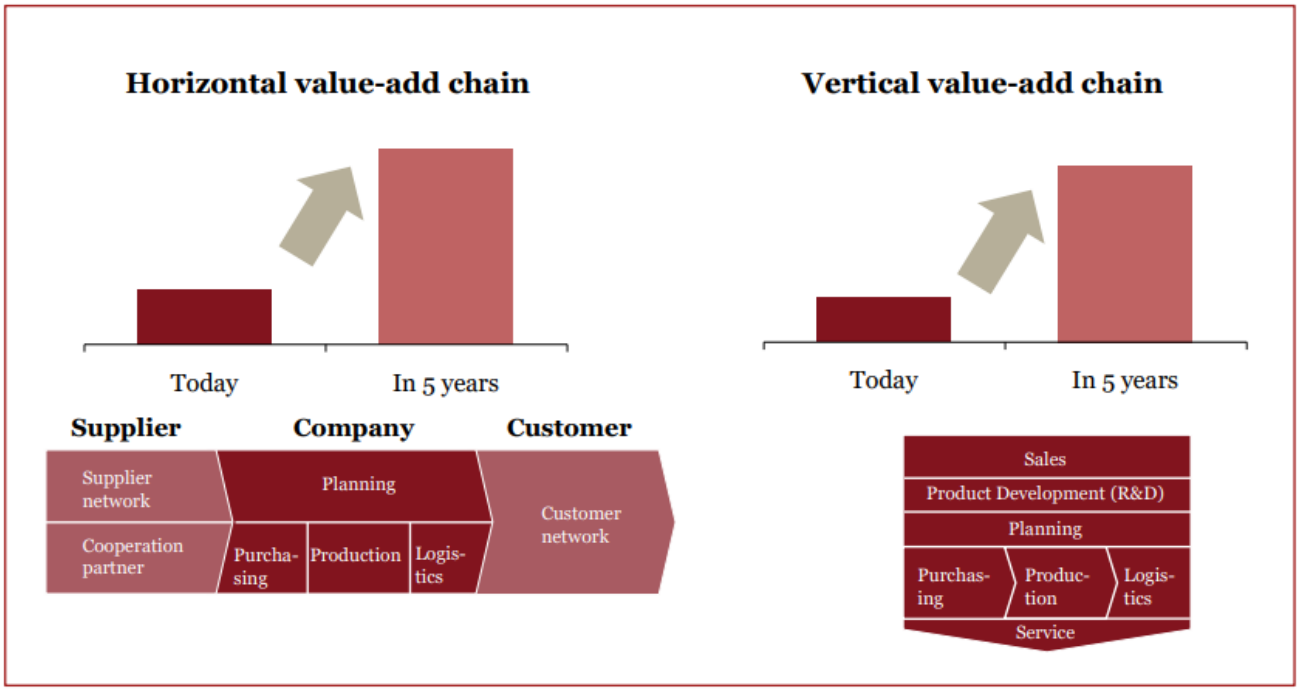
This factory of the future combines a culture today based on digital with "knowledge based" systems that therefore require a pervasive use of sensors, flexibility and adaptability, with the passage already enunciated by vertical specialization to the horizontal process generating a general increase in complexity. At the same time, it continues to evolve together with the products, processes, innovations and needs of man, creating a reflection on the focal point in analysis.

Man is at the centre of the vision of the company for the achievement of the goal, it joins the concept of "Human oriented" for the worker that allows to carry out activities of: "simulation and visualization of the process, different activities for different types of workers, different levels of skills, age, education and training; a regional balance or working conditions in line with lifestyles, remuneration, flexibility of working time; development, management and capitalization of knowledge *".*[130]

In this way we come to think of a factory that is at the same time a vehicle for technical innovation and social innovation, emerges as an opportunity to create a new culture of work geared to the interests of the worker.

Industry 4.0 creates new types of interactions between people and machines. This is going to change the nature of work and organization. Stefan Gerlach with the Fraunhofer Institute for Industrial Engineering IAO that shows us that: "Mobile-assistance systems and smarter machines. Production shifts can have different starting times for each worker. In the future, machines that have the potential to maintain full-time employment. "That affirmation need to explain the increase in variability in production schedules. Important at the same level the need to rethink decision-making authority.

[130] A.Magone,T.Mazali, *Industria 4.0 Uomini e macchine nella fabbrica digitale*; Guarini e Associati,2017



Source: Industry 4.0 survey, 2016

Figure 13 – Horizontal and Vertical Value chain and the projection in the future (Source: Capgemini/Counsulting, 2017)

An example could be a robot coordinator should not wait for instructions in industry 4.0 it's also an integration of a company's IT department and the operational departments, I know that software developers fully understand how their solutions are being used in production and operators to fully understand how their production solutions are affected by these solutions. I know that interactions between developers and operators must be designed in a way that seamlessly handles complex IT tasks. Companies must also ensure that humans remain responsible for innovation and coordinate overall processes, rather than trying to automate everything, so these critical capabilities.

Companies with industry 4.0 need to consider new approaches between human and machines.

A starting point for this analysis is the concept of automation:" With automation we mean all those technologies able to manage mechanical systems and physical or logical processes with variable complexity, reducing the need for human intervention. The continuous development of technology generates a growing fear of the man-machine substitution effect and the effects that this phenomenon could have on countries, companies and people"[131]

Based on that, we are going to show how different research brings different results on the amount of percentage value of the level of substitution man and machine given by automation of activities.

Based on the studies that will be presented below, a very high number of workers would be at risk of unemployment today. Bringing the scholars, Frey and Osborne, first and foremost to our data, then moving on to the theories Arntz, Gregory and Zierahn[132] and again Mckinsey[133], PwC[134] and the theories of Klaus Schwab.[135]

The starting theory starts from the assertion that computerized activities are those characterized by routine, where the worker is equipped with rule-based skills and therefore without the need to incorporate elements of coherence, human skills and creativity into the production process. Now," algorithms for big date are rapidly entering domains reliant upon pattern recognition and can readily substitute labour in a wide range of non-routine cognitive tasks."[136]

This will change the nature of work across industries and occupations.

The methodology used by these two researchers is based to the estimation of the probability of computerisation for 702 detailed occupations distinguish between high, medium and low risk works depending on their automation. The result is not completely positive; it is slightly negative because according to the estimates 47% of total US employment is in high-risk category. This level of automation will be reach in one or two decades, so, really soon. Another aspect of their research is that a high level of education and the increase of wages will bring a negative relationship with the probably of

[131] C.B.Frey, M.A.Osborne"*The future of employment: How susceptible are jobs to computerisation*?",Oxford University 2016

[132] E.Arntz, T.Gregory, U.zierahn ,OECD Social, The risk of Automation for Jobs in OECD Countries, 2016, www.oecd-ilibrary.org

[133] M.Chui,J.Manyika,M.Miremadi,Four fundamentals of workplace automation, Meckinsey,2015

[134] *Il futuro del lavoro tra uomo e macchina,* Epoche Times, April 2017, www.epochtimes.it

[135] K. Schwab, *The Fourth Industrial Revolution*, Franco Angeli, 2016

[136] C.B.Frey, M.A.Osborne"*The future of employment: How susceptible are jobs to computerisation*?",Oxford University 2016

computerisation. For these reasons we can see how the level of low, medium and high risk of automation is divided for each category of jobs.

In the figure below is simple to notice the level of employment affected by computerisation.

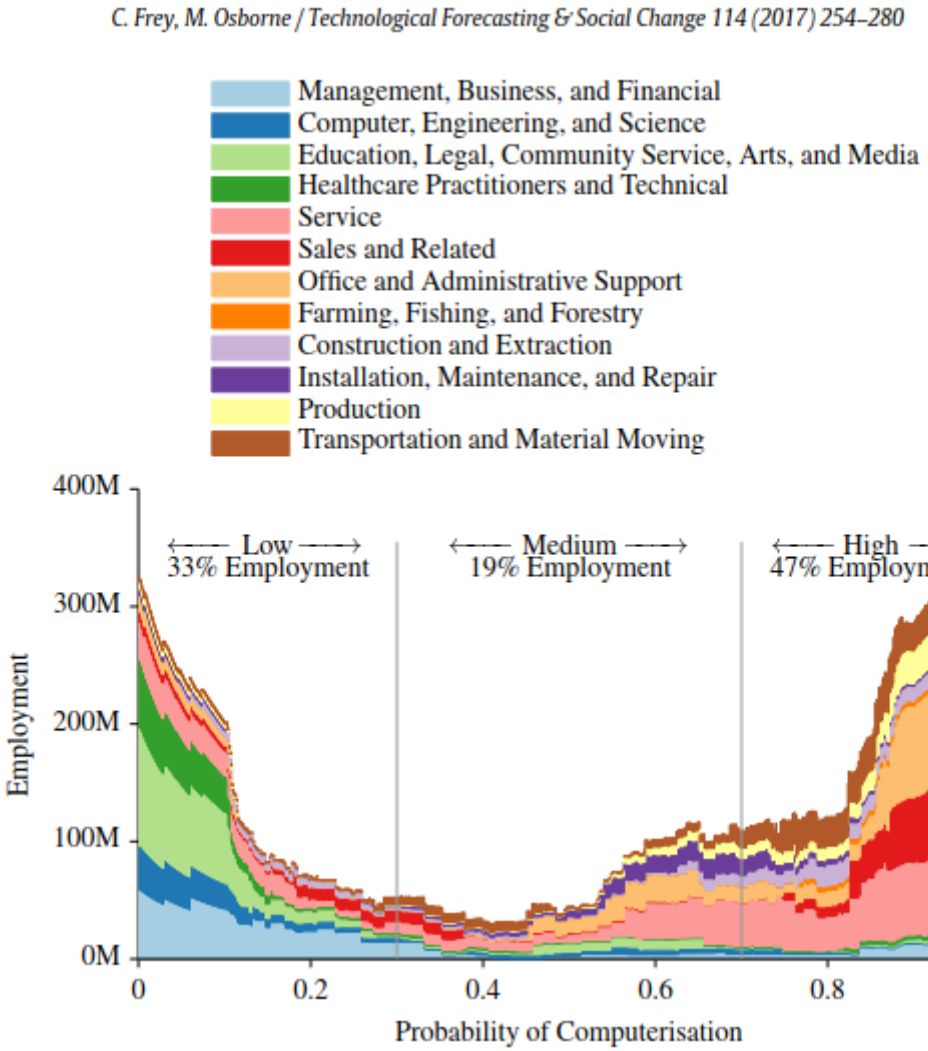


Figure 14: C.Frey,M.Osborne,*Technological forecasting and Social Change*, 2017

33% of all sectors is in the lowest category, while the data referred to the medium one is lower – namely 19% - and the highest value is reached in the last section, represented by 47% of work areas.

The negative results obtained by the theories of Frey and Osborne have inspired other researchers to find solutions of this phenomenon.

A first example is all those using the occupational- based approach that consist to divide the world of jobs for occupations and not for categories of activities for each sector of jobs.

The first study conducted by Arnt, Gregory and Zierhan with a theory based on a task-based approach that allows analyzing different daily activities within the same occupation. In this way, the level of job replacement percentage is much lower than that of Frey and Osborne.
The analysis carried out by researchers at the "Center for European Economic Research" in Mannheim. This analysis examined 21 countries of the OECD (also Italy) and reported that only 9% of workers currently employed are at risk of being replaced. The danger of substitution given by technological progress is greater for countries that invest in technology and communication, education and corporate training.

Even this theory is not entirely true. Studies conducted by the Ministry of Economic Affairs of Germany report much more pessimistic forecasts defining that the impact of the level of automation depends on the level of relative prices of capital and labor and on how companies react to capitalize on these opportunities. Their data show that 18%[137][138] of all companies are aware of the phenomenon of industry 4.0 but only 4% is affected by the principle of computerization of activities within it.

Therefore, the two analyses are in contrast for the results of the automation in the field of work inside the company.

One of the surprising results of the PwC study[139] is that the US financial and insurance sector would be almost twice as automatable as the British one (61 percent of jobs versus 32 percent). The PwC attributed this disparity to the fact that the average level of education of financial professionals in Great Britain is much higher than that of the United States. In addition, the US financial sector focuses more on the domestic market, which is more predictable and therefore automated.

[137] E.Arntz, T.Gregory, U.zierahn ,OECD Social, *The risk of Automation for Jobs in OECD Countries*, 2016, www.oecd-ilibrary.org

[139] *Il futuro del lavoro tra uomo e macchina*, Epoche Times,April 2017, www.epochtimes.it

Another view of this phenomenon is given by the research of the consulting group McKinsey.

The company define that 45%[140] of the activities that individuals perform can be automated by adapting the currently available technologies. These results are based on data from their US market, structuring the analysis on 2000 individual work activities and assessing on each of these 18 possible capabilities that could potentially be automated. Thus, it states that 13% of assets in the US economy can be automated. Different is the result obtained for activities that can be completely automated using the current technology, i.e. 5%. In this case it can be stated that 60% of occupations can reach 30% more than the level of automation of their activities. Only 4% of labor activities reach a high level of creativity but only the 29% of these reach the impact of emotions as result of the effort. So, based on that, the greater the level of creativity required for an activity, the lower its possibility of being automated.

At least the theories reported by Schwab state that 30% of the auditing activities are specifically carried out by machines equipped with artificial intelligence. Based on the sample of subjects interviewed, 75%[141] expect this figure to be reached and expanded by 2025.

What is required in return for the domain worker to continue to be the protagonist of the new factory?

Employees will be working on a greater variety of tasks unrelated to their core education, recruiters will have to look beyond formal degrees to identify workers with the relevant skills for specific roles.

[140] M.Chui,J.Manyika,M.Miremadi,*Four fundamentals of workplace automation*, Meckinsey,2015

[141] K. Schwab, *The Fourth Industrial Revolution*, Franco Angeli, 2016

4.3.1 Tesla and Tabby Case study

Let us start from a practical example where the developments of the 4.0 industry in the manufacturing activity of motor vehicles foresees not only the importance of the consumer in his role of protagonist, but also the concept of "customer-centric" of the industry 4.0 with the involvement of the consumer to the ability to realize applications and digital devices that will take care of the user's needs expressed through co-design practices. In other ways, it means to favor the passage from passive user-consumer to user-co-producer defined "Prosumer" by Alvin Toffler (futurologist). In this case we proceed to modify the type of marketing by integrating it directly into the design using sales feedback and at the same time modifying production in real time in compliance with the concept of "customer-responsive".

To give an example, let us consider the case of the "Tabby" car which, taken as a refraction of production 4.0, incorporates inside on the one hand the possibility to choose a specific configuration, while on the other one the "do-it-yourself"[142] production of the vehicle.
Let us go into detail to explain better what we are talking about. The project was conceived by two designers, an Italian Ampelio Macchi and a Chinese Francisco Liu. This project is an integration between the cultural model of mobility and open source ethics, based on the concept that even hardware can become an open source, providing technical drawings that may be subject to revisions by the user. This is why it represents the concept of worker 4.0 at the center of the process basing the relationships on the network reticular model and spreading the key words of collaboration, coproduction and sharing.
Unlike the production of "Tabby" we find the "Tesla" case (a phenomenon that involves the ecological sphere of automotive production in the world).

Tesla Motors is an American car company founded in 2003 by a group of engineers from Silicon Valley that developed a high-performance electric car by starting a production based on an out-of-the-ordinary system. The starting point of the production activity that

[142] A Magone,T.Mazali, *Industria 4.0 Uomini e macchine nella fabbrica digitale*; Guarini e Associati,2017.

refers to the principles of the industry 4.0 is its strategy based on the alliance that has led it to share, rather than maintain control, technological innovation with research centers, suppliers and with other automakers like Lotus, Toyota and Daimler, to build cars without owning all the necessary assets for what remains one of the most complex and diversified industries in the manufacturing world.

Tesla[143] is the first company operating with patents (open source philosophy) and making it available to anyone including competitors. The declared objective with the opening of patents is to push the stakeholders to propose improvements and innovation in a continuous research of technological and organizational development that has led it to be declared in 2015 by Forbes the most innovative company in the world. It works in a context of radical uncertainty and this is why it focuses on innovation and speed, even in the forms of specific work put in place, where selection is hard, the objectives to be achieved challenging and the population consisting of a large part from "Pioneers" and, on the other, "Talents" following a traditional scheme to date also attributed to the manufacturing world.

So, going back to the centrality of man as a user and consumer is accompanied by the centrality of the worker's participation in industry 4.0; thus, it can be said that both outside and inside the factories we can find the same culture of participation.
A fundamental aspect to be linked to the new peculiarities that the worker / consumer 4.0 must have depend on changes in the tools used in the work and the culture that derives from it.
The concept of "Participatory culture" defined by the sociologist Henry Jenkins in 2007 emerges for worker 4.0, with which the concept of social network is identified as fundamental also in the factory model 4.0.
The worker 4.0 described to cover the role of worker of the future is called "Participative" and "Proactive" going to contrast with the typical worker of the factory of the past defined instead "Strong" and "Resilient"[144]. These concepts interpreted as the basic characteristics in defining what will then be the overall skills of worker 4.0 are introduced as early as 2003 by the sociologist Manuel Castells in the essay "The power of identities" going to explain the changes in society and the different crises of the 'institution.

[143]www. teslamotorsclub.com
[144] A Magone,T.Mazali, *Industria 4.0 Uomini e macchine nella fabbrica digitale*; Guarini e Associati,2017.

The worker thus passes from a subject who built his own identity through a process based on resistance to the logic of domination from which it was excluded and which could be the victim of a new conception of design identity where it is achieved by adopting the configuration of activities through networks to proactive and resilient worker figure.
In order that the development of the skills can be effectively applied, the necessary training activity must be considered, to which the HR are subjected during the training phase in the company, but even more so from the background they have inherited and that have been built up over the years.
This concept of worker assumes the characteristics of facing positively traumatic events, of crisis, reorganizing one's life before the difficulties. Therefore, in simple words, we can say that with industry 4.0 the worker cannot only resist events, but also react to survive. This position of the worker also leads to a concept of "subjectification" that means that responsibility is shared. In fact, this leads to the affirmation of how we must become co-responsible, thus giving a new form to the cost-benefit ratio of actions and expectations.
The worker 4.0 enters a third way that is created between the resistance-design attitude and the individualism of contemporary society that is the presence of a "Team".
The Team is functional, flexible, but also ephemeral, the 4.0 team operates within a defined timeframe and linked to the needs of a fast and reconfigurable production exactly according to needs. The team that foresees the release of all the characteristics of each member changes and develops rapidly under our eyes, calling into question roles, cultures and sedimentary practices, proposing new forms of balance.

If the team is an expression of aggregation of workers returning to the individual who works in the factory the role of the worker called "blue collar" completely assumes the characteristics of a media user. This is valid not only for digital media but also for how the worker deals with digital media as well as for the ability to produce participatory content and models. On the opposite side of the factory, hierarchy is the engineer of a new conception and the technologist who gives intelligence to the machines are defined as Pioneers.

The connecting thread between these ideal types creates a connection between two extremely different figures: on the one hand the presence of figures who, despite having

a knowledge of the commonly used digital tools, are able to insert themselves in "smart" times in the production chain ; on the other hand, the presence of exceptionally rare figures that are able to manage the complexity and risks that are created in the areas defined as "virgins" of the application of innovations and techniques 4.0. Important to date is that there is not the unique presence of only one of these two figures but that they blend harmoniously inside the factory 4.0 points and their more or less massive presence within the company depends on the different environments of work from the history and perspectives of the factory.

If we have previously said how the "blue collars" create action teams, it is fundamental to define how the relationship between "blue collar" and "white collar" changes. The hierarchy is modified together with the basic principles, reaching the collaboration and cooperation of the subjects belonging to different levels of the hierarchy.
The worker of the past that we can define as "worker-craftsman" slowly loses its function and centrality in the production process at the time of the transition to the digital factory.

4.4. Skills

The skills required no longer provide that you can learn directly in the field through imitative learning "on the job" but that digital knowledge, etc., are the result of a preventive study that allows you to apply them immediately.
Thus the "worker-craftsman" becomes a "user" who naturally imports in his work the digital skills and practices acquired in everyday life within his work. Even more, we have seen how the insertion of new digital devices and the familiarization of these with the workers becomes solid, creating a man-machine relationship that simplifies the steps of the work.
Therefore, it is as if a slippage had occurred that explains the fortune and the primacy of digital instruments in the factory: the equipment, languages, practices of everyday life give shape to the languages and practices in the work and no longer the opposite. First of all, as stated by "Alstom", "our future in terms of skills goes towards computer literacy. This choice allows us to eliminate written information, not always received and

memorized by people with schooling, nationality and distant biographies. Today there is a mixture of things, people and cultures that requires more visual teaching *"*[145].

In this way, first of all, the worker is required to be familiar with the communication tools that ensure speed in learning.

4.4.1. Soft Skills vs Hard Skills

With the aim of putting a point to the definition of the new worker 4.0 and specifically dictating the essential skills required, let us start by affirming that the companies that managed to manage the crisis that has upset traditional production systems and forced the world of work to make radical changes were those that have created new business models and new organizational models, investing in their staff and intervening not only on their hard skills, but also on soft ones.[146]

Based on the research carried out taking into consideration several companies, 10[147] fundamental skills emerged in the context of soft skills that can be listed in order of importance attributed based on the cases examined.

The list below shows them;

problem solving in complex situations,

critical thinking,

people management,

team working,

emotional intelligence,

decision making,

service orientation,

negotiation and cognitive flexibility.

Each of these has a different value based on the importance they have in the reference work context.

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[145] A.Magone,T.Mazali, *Industria 4.0 Uomini e macchine nella fabbrica digitale*; Guarini e Associati,2017

146 Niuko-*Innovation and knowledge, soft Skills che generano valore: Le competenze trasversali per l'industria 4.0*, franco Angeli Management 2017

[147] S.Salvati, *Industry 4.0: l'importanza delle soft skills per la valorizzazione del lavoro umano*, www.bolletinoadapt.it

The lineup of the "Best three skills"[148] is very significant. These have been best defined by a study carried out considering a current social context and are:

- Problem solving in complex situations is the transversal competence to which 52.94% of the sample we are considering attributes greater value, thus placing it in first place;
- Problem solving in complex situations would also take second place in this ranking, as voted by 23.53% of the sample as the second most important soft skill. In examining the social competences that could occupy the second place, one understands therefore that there is no soft skill that is able to keep the comparison with a percentage equal to or greater than that of problem solving. In fact, if we excluded the problem solving and we considered the transversal competency most voted in second place, we would observe, with 17.65% of the champion's votes, an ex aequo between team working (we have already described it as a new form of network developed with industry 4.0), decision making and cognitive flexibility;
- Creativity is the soft skill that wins the third place with 29.41% of the votes.

These three main skills report jointly analyzing them and considering them as a capacity of an individual worker 4.0 all the characteristics necessary to implement the digitalization and technological innovation that this revolution provides. The complexity is given by the continuous change of events and situations and the necessary condition of companies / factories to adapt to these changes in order to be in step with the needs of the market. For this reason, if the technical skills required by the introduced innovation are so important, two transversal skills that we find accompanying problem solving with decision making are equally important.[149]

These are complementary competences because they correspond, in order, to the ability to identify the root and cause of the problems that arise (especially unexpected and unexpected problems) and, consequently, to be able to make decisions that can lead to the solution. Problem solving can take a double form, depending on the degree of difficulty and unpredictability that prompt it. A first, more ordinary form, which deals with the resolution of predictable problems, i.e. problems that have already emerged in the past and for which solutions are known and are therefore simple to deal with. This first form of problems will be increasingly residual in the context of Industry 4.0 in which, through

[148] S.Salvati, *Industry 4.0: l'importanza delle soft skills per la valorizzazione del lavoro umano*, www.bolletinoadapt.it

[149] Capgemini, *Skill Evolution for the digital Age*, Capgemini/Counsulting Analysis,2013

machine learning, production systems will be able, through artificial intelligence, to prevent problems and to learn the solutions to be put into practice. Then there is a second event from which the need for problem solving activities is generated and is linked to more complex problems, which have not come up earlier and which require non-standard solutions. These are not only technical problems, since the latter will in the long run also be reabsorbed by the potential of machine learning, but mainly concern problems of a relational nature, related to the relationship with customers (both in the planning phase and in phase for the provision of after-sales services) and the relationship with the supply chain.

We imagine the demand for a highly personalized product that requires a reorganization of some elements of the production processes, or an error in the provision of a service which results in a consumer dissatisfaction. To solve a problem of this type, a set of transversal skills is necessary that lead to a collection of information and therefore the ability to understand the roots of the problem and not only its surface manifestations, the identification of potential solutions analyzing the pros and against, the identification of the criteria with which to opt for a solution or another. We define decision making precisely the ability to know how to combine these fundamental elements for solving a problem in a very short time. There are some key elements that contribute to the construction of these transversal skills: Intuition and Reasoning[150]. Then there are some situations and conditions that make the exercise of decision making more difficult, in particular: lack or overabundance of information and lack of communication and coordination.

Finally, the importance attributed to creativity in industry should not be underestimated.4.0. studying How robots increasingly assume manual work, we will need to promote what differentiates the human from the machine (at least for now) in order to create the work of the future and renew the figure of the human being in the working context this is generated from creativity.[151]

[150] Niuko-*Innovation and knowledge, soft Skills che generano valore: Le competenze trasversali per l'industria 4.0*, franco Angeli Management 2017

[151] S.Salvati, *Industry 4.0: l'importanza delle soft skills per la valorizzazione del lavoro umano*, www.bolletinoadapt.it

"The new and disruptive business models are emblematic of our generation and are essential to tackle any crisis with momentum. When markets are in turmoil, those who know how to combine a rigorous method with strong creativity can not only survive, but also prosper. ”[152]

From this statement emerges the fundamental aspect of creativity in cases of uncertainty or crisis where common solutions, sometimes too general, do not find effective application because only a creative idea can actually give a breakthrough. Creativity goes hand in hand with the hope of generating company success. A good project does not perform in the same way as a model that brings with it a creative aspect. As the robots increase their activity in manual work, thus replacing man. It is necessary to understand that creativity is the fundamental aspect that must be sought in order to find what differentiates man from the machine. Otherwise, without creativity the two subjects could be placed on the same level and even consider the operation of the superior machine in qualitative terms with respect to human activity.

Referring to the concept of creativity in Industry 4.0, as stated by Klaus Schwab, "I am convinced of one thing in the future, talent, more than capital, will represent the critical factor of production". So, people with creativity will be able to increase the production factor, making the company with competitive advantage and superior performance compared to the average.

The uniqueness in the production and the set of distinctive factors that thanks to innovative aspects and creative events characterize the individual productions are those productive factors of importance for the company. Among these, the figure of the worker in his expression of "talent" is placed first. The talent is the one with distinctive and unique qualities and abilities that are not present in every person and which at the same time constitute for the company that owns the talented subject an instrument in more of distinction and advantage over the competitors.

"Learning is the source of youth. No matter what age we have, we must never stop growing.

[152] *Creare modelli di business* by Pigneur Alexander Ostrwalder, 2016

As long as we continue to learn, to open ourselves to new ideas and new ways of dealing with things, to deepen our knowledge of ourselves and of the world around us, we will practice the highest form of personal creativity.
We must know how to renew according to circumstances: it is this incessant creative act that allows us to remain young. *''*[153]

The proof that psychological and physical well-being are fundamental to creative thinking will transform the historical exchange of human health for economic growth. Creativity is not only given by the ability to wander with the imagination for the future of man but also for the future of the entire industrial economic system.

Renewing oneself through creativity not only allows one to remain young as a person but also to keep the core business of the company in which the person works young. Allowing to update and renew strategies and production schemes through solutions aimed at achieving the objective in ever shorter times and with the flexibility that is required. Creativity is thus a source of innovation and business success.
The ability to fine-tune one's soft skills must not be a single priority of those already working, but a particular feature that is also necessary for students or for those who for the first time have to face the working reality. Based on this expression, compulsory schools could be involved "in training" and help students acquire transversal skills, considering that they are normally not taught among school desks and that the school curriculum generally represents hard skills. To broaden the curriculum and provide soft skills, courses are included exclusively programs focused on soft skills, such as the introduction of extracurricular activities that are generally represented by; educational workshops, schools of music, art, dance and sport. And even more, the flanking of the theory of practice (role play, project work, school-work alternation).

The analysis of transversal skills and the use of soft skills can be interpreted in a negative way on new technologies, creating an "antidote" to robotization and unemployment. On this concept, three distinct groups of opinions provided by workers emerge. We have listed them here below:

[153] Cit, Ming-Dao Deng

1) transversal skills that are an "antidote" to the negative effects of robotization as since they are not formalized in terms of knowledge, they can never be developed and dominated by artificial intelligence and therefore human intervention can never be completely replaced;

2) Others believe that they are relevant in medium and high-level work roles, but that they do not act as an "antidote" to robotization, but rather as a tool through which to treat it and make it an opportunity, facing the relative risks;

3) Others still strongly believe that excellent soft skills not only represent an incredible accelerator of hard skills, but also that will allow a significant increase in employment through professionalization and the transformation of jobs.

The general skills that each worker 4.0 should have to operate fully must be the right combination of hard and digital skills and soft and transversal skills. In this way individuals adapt to the new organizational and production models that are spreading rapidly. Returning to digital skills, first necessary considering the digital one of the revolutionary pillars, are poorly developed both at the management level and at the level of employees and this represents a barrier to business renewal processes, considering that they have a highly strategic function in society. The greater the digital skills, the more exclusive and innovative it becomes a company, allowing it to acquire that greater competitive advantage over its competitors. Since the digital revolution requires very specific e-skills that companies rarely check for availability in a systematic way, it is considered necessary, even considering the social opinion, to predict that they are spread primarily in the scholastic world to educate as a child and allow them to acquire the skills that will be essential for their future. They are part of the school world, combining classical teaching with design and communication and socio-cultural aspects, inserting in the teaching programs hours of lessons dedicated to the knowledge of the digital world and artificial intelligence, and encouraging the realization of IT projects between school and business. In the business field we again define how the companies have indicated the

usefulness of the courses of specialization and updating, of the reverse mentoring, of the smart working and of the app for training purposes as an incentive to use digital tools.
From the results of this survey it therefore emerges that hard and soft skills have the same relevance for the growth and competitiveness of both the individual worker and the companies. In order to cope with the possible consequences of industry 4.0 on the labor market, it would be appropriate to implement training programs whose goals are both to fill the individual skills gaps, and to accelerate the changes taking place and overcome the resistance that often occurs. they meet in the uncertainty and turbulence phases.

4.4.2 The bridge for Skill's Gap

Regarding the theme of Skills, the central core of the elaborate, the development of digital skills remains the main point to keep under control by every single company. Digital skills do not find application only in the IT sector, but across the entire organization, creating a huge demand for digital skills. However, on this issue emerges a further problem that is increasingly receiving attention from the companies. Developing Digital skills is not easy. According to a report by Capgemini, about 77% of companies attribute the difficulty in adopting the digital principles of industry 4.0 since HR do not possess the digital skills necessary for the revolution to be implemented. According to the analysis carried out on data from several companies in the sector, we pay attention to how current approaches to digital skills development are being destroyed, finding more and more difficulties for companies to adopt
What caused this phenomenon of difficult application and diffusion of digital skills?

First of all, in companies, The Human Resources Function is Not Actively Involved in Digital Skills Development. The problem it is registered by only 30% of humans directly involved in digital skills while 60% is not present in programs of training and learning digital skills (all percentage values were provided by the Survey conducted by Global HR Business) [154].

[154] Global HR Business, "*Millennials Have Least Analytical Acumen, Gen Xers the Highest in Today's Workforce, New Survey Suggests"*, August 2013

Furthermore, the problem remains to understand who should fill this 60% gap[155] of the working population in the development of digital skills. This function is attributed to leaders, functional teams, IT developers.

Many companies are reluctant to adopt innovative principles. The research and dissemination activities of digital skills find multiple adoption skills that however are partially rejected by companies that prefer to maintain a traditional approach to the application of these methods. If training, recruitment and partnership are used by 63% of the companies, only 13% are launched in the use of innovative methods such as targeted company acquisition or an incubator approach. In addition, there have been many success stories of companies that have used innovative approaches such as acquiring companies and engaging startups through incubation. The gap is still difficult to fill because it is difficult to change the attitudes of business leaders when it comes to investing to get the basic tools on which the business is based.

On the subject of investments, we find a further gap present in a full-bodied manner in the corporate system for the dissemination of digital skills. Although aware of the organization and their managers and managers of the importance, today, to adopt digital skills, investments in this field are very poor. Almost all the companies (86%) believe that digital skills are of fundamental importance to obtain success and place themselves in a good competitive position but do not foresee any investment action. From the analysis carried out on several companies only 46% invested, also obtaining positive results.

Furthermore, the efforts made by companies in the training necessary for the development of digital skills are very limited. Only 4% commit themselves to training programs. We found that none of the companies surveyed more than 20% of its training budget on digital. Such a poor investment is clearly reflected in the limited reach of training. For an overwhelming 95% of companies, only 20% of their workforce benefited from trainings on digital.

Returning to the skills most requested by this further analysis, we can obtain results that are linked to the 10 skills previously stated. Companies in this case also see the use of big data, social media platform and mobile device, the skills that the worker must develop in the modern era. However, the training courses and even before the schools as we have

[155] *Skill Evolution for the digital Age*, Capgemini/Counsulting Analysis,2013

already analyzed are aimed at spreading such skills already in the very young age so that these can be well assimilated by the worker.

The new skills emerge from the analysis of the daily life of the population. An example of easy understanding is the use of furniture. The entire population, including each social class from the youngest to the adult population, uses a smart-phone to carry out a variety of activities throughout the day. The device in analysis is no longer considered a single tool that can allow a phone call between two users but a real means capable of interacting with a network of different subjects, buying from online shops, carrying out banking transactions, etc.

This is why our mobile analysis is one of the most important skills for digital transformation. Having in the company resources that are strongly trained in the use of mobile technological functions increases the ability to gain a competitive advantage and develop increasingly innovative systems that generate success.
Similarly, in a survey conducted with American executives, the development of a big data platform has been planned by numerous companies. This is the only ability to implement this data.

Another area of expertise is that of social media. Also, for the multiplicity of functions and with different ends. That is why companies need to focus on developing skills in the social media area.
In a survey conducted with respondents surveyed, (50,000 employees), only 13% of companies stated their efforts on social media as advanced. The skills required in this area are: understand transversal skills such as brand construction, community participation, virtual facilitation, online label and front-end engagement skills like social media awareness raising, community management, customer service and public relations.

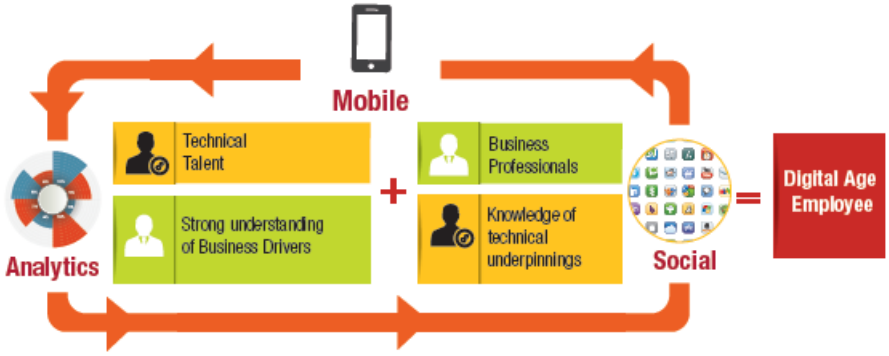

Figure 15– Skill Evolution for the digital Age (Source: Capgemini/Counsulting Analysis,2013

At this point, the analysis focuses on the ability that HR have to develop digital skills and combine them with the knowledge of the business in which they operate. it is therefore considered necessary to ensure that there is a combination of the two aspects, otherwise digital skills would be inefficient. in order for this to reach a positive result for the company, the leader aims at combining data skills with strategic and creative thinking, collaboration and communication skills. This is leading to a growing demand for individuals who possess technical skills along with business strategies and leadership skills.

In this way, the figure of the Leader stands out, who must be able to manage the resources and insert them in the most appropriate functions based on the skills / skills possessed in order to generate in combination with each operational area more or less successful. Not only does managerial activity tend to change according to new needs, but at the same time the figure of the leader who, while incorporating traditional principles, will be successful, thinking of him as the Leader of the future" *are going to be true hybrid professionals who have spent some time in IT but have shifted to operations and vice-versa."*156

Moreover, if we explore even more the demand for skills for the worker of the future, it is fundamental that in the next few years the HR will have skills in the field of information and communication technologies. Business professionals will increasingly need to be comfortable with digital tools and technologies to play their key roles. the use of IT tools already present in everyday life will become the basis of human relationships. This will

[156] Markus Nordlin, CIO Zurich Insurance, Capgemini/Counsulting Analysis,2013

allow him to have conversations with his colleagues through the proactive IT tools and that will allow him to better serve his clients.

To conclude, what does the professional digital expert of the future look like?
Future employees will have to combine excellent digital specialist skills with a deep understanding of the functional business. They should be comfortable with short delivery cycles and be able to operate through silos and within cross-functional teams. They need to make sure they are ahead of the technology curve and in roles where they can add value beyond what generates digital technology.
However, reaching an organization that is full of employees with these skills is not an easy task. Requires connection of the digital skills gap.
At this point, we try to provide solutions to achieve the implementation of this link and ensure that the organization is complete and operational.
The goal described is not easy to reach. The companies move differently trying to achieve the same result. The areas of competence, the set of HRs that make up the organization, the objectives, the value proposition and the competitive level to which the various companies are subjected allows each of them to develop different strategies. At the same time, a series of actions have been classified as necessary in order to stop the gaps in digital skills.

Training programs on digital skills help workers understand how to use and implement new technologies and platforms. An example of a company that develops strong training programs is P & G, this company develops programs that can train workers with training programs that lead the company to scale up for future growth. Also P & G and Google started an employee exchange program. "*The aim of the program was to foster innovation and cross-pollination of digital talent. Employees from both companies took part in each other's training programs and attended meetings where business plans were formalized. With this program, P&G gained expertise on digital and search marketing to effectively sell its products.*"[157]

[157] Direct Marketing news, "*Google, P&G swapping employees*", November 2008

Another example is that reported by Harvard on the Intel case; "Intel launched their Digital IQ training program in 2008"*The program comprised 60 online courses spanning areas such as social media measurement, brand identity in social media, mobile marketing and viral marketing. Within two years of its launch, over 20,000 employees had completed the Digital IQ training. Going a step further, Intel introduced another course, called Digital IQ 500, which licenses Intel employees to practice social media on behalf of the company*."[158]

If companies to achieve success and beat the competition look for figures with highly developed skills. that is, companies aim for the search for talent. Digital talent does not lend itself to easy recruitment. In fact, a survey[159] indicates that over 49% of candidates are more likely to consider a job advertised in an innovative way. The same survey found that over three-quarters of HR professionals believe it has become crucial to use new ways to recruit and retain talent.

The cosmetic company, L'Oréal, provides an example of this aspect. "*The L'Oréal "Reveal" website is the basis for the recruitment process. The website allows visitors to communicate with employees and take part in real-world troubleshooting scenarios within a virtual environment. The game setting allows visitors to collect points and receive feedback. Users with the highest scores compete for rewards and job opportunities with L'Oréal*"[160].

Moreover, if the recruitment processes lead a company to recruit resources with poor skills, it becomes necessary to leave the area of expertise or observe how other companies similar to them have conducted the research and recruitment of resources in order to take inspiration from them.

The connection that is made if a company has developed talent, it will then be logical that if I take it as a guideline also my company will create talents.

Another aspect are the targeted acquisitions of companies that help organizations quickly achieve complementary digital talents. The gap is reduced by buying several companies for their talent in specific areas / technologies to constitute a complete package of skills thanks to external subjects.

[158] Source: Harvard Business Review Blog, "*Intel's social media training*", February 2010
[159] Rullion Solutions, "*Game On*", March 2013
[160] Rullion Solutions, "*Game On*", March 2013

Even more in field 4.0, we find the presence of partnerships that allow companies to take advantage of the digital experience of other organizations. These partnerships allow companies to engage the best talent or services for their digital initiatives. the partnership allows two companies operating in the same field and complement each other to be integrated through cooperation.

Finally, we take the development of niche startups as an example of access to external digital talent. These initiatives give companies the opportunity to examine more ideas that they have not been able to focus on or develop due to the lack of required skills within the company.
For example," *Nike has partnered with Techstars - a boot accelerator - for their Nike + Accelerator program, to offer selected startups the opportunity to build products on the Nike + and NikeFuel platforms. The program aims to take advantage of the Nike + platform to support digital innovation. Selected companies have access to development tools, office facilities and technical platforms and Nike's support to create solutions. Nike also supports selected companies by providing access to a select list of Nike executives and external mentors"*[161]. startups are a very successful tool that is developing and is playing a central role in companies 4.0.

Gaps are presents and companies will tend to fill them until they no longer have them. Moreover, their main purpose is to achieve the successful strategy for the development of digital skills.

Digital skills requirements vary from one organization to the other based on their digital maturity and transformational capability. Key focus areas will depend on individual business requirements as well as availability of resources. Organizations need to define a vision, identify future skill requirements, undertake a comprehensive skills gap assessment, take steps to bridge the gap and finally initiate actions to constantly evaluate progress in their journey to develop digital skills.

[161] Nike Accelerator website- www.nike.com

An itinerary is created that leads the companies to achieve this result. The main steps to follow are: Define vision and identify future skill requirements, undertaken skills gap assessment, Bridge the skills gap, constantly evaluate progress.

The first step leads to define a precise digital vision scheme that the company wants to achieve, taking into consideration what the business, IT team and HR team expects. Subsequently, the second step aims to reduce the gaps that are formed in reaching the prefixed objectives. organizations need to conduct self-assessment of their existing skills. Skills to levels of proficiency and determine the skills gaps. The third point focuses on the ways in which the connection can be created to avoid gaps.

The type of method used will differ based on the technology focus area, intensity of the skills gap as well as availability of resources. Companies should continue evaluating their programs as before but use real-time technologies to increase their agility in adjusting training content and couple it with more frequent talent performance evaluation. Similarly, if a training program is not producing the optimum levels of participation, methods such as gamification can be used to drive up engagement levels. The idea is to measure the impact of training on behaviours as opposed to focusing on training delivery. This last part represents the fourth point where the continuous monitoring of the progress and the adjustment of the programs constitutes the possibility to reach the goal also eventually adapting the training activities and shaping the market requests.

4.5 Jobs of the Future

The analysis of the skills and competences that the new 4.0 workers must have leads us directly to introduce what will be the future works, replacing some present ones now, and how they will be able to be implemented in more or less long times.

First of all, it is important to underline again the centric role of human people and consequently the human needs. At present, we have just analyzed that the work will change due to the concept of automation and artificial intelligent but at the same time that principles bring the world of jobs to the new future concept.
Back to the introduction in which was mentioned a famous Hollywood plotline, and considering that as an impossible reality, now it's not the same. The aspects described and the possible works mentioned are now something that can be realized by real world. Another example, common for all the population it's the chatting reality with SIRI, the device invented by Steve Jobs, initiator of Apple, so speak with an imaginary person, this is a simple application of AI. Artificial Intelligent, now, will be found in every job, profession and industry around the world.

"When machines do everything, lots of people wonder what will we do? What works will be left for people?

How will we make a living when machines are cheaper, faster and smarter than we are-machines that don't take breaks or vacations, don't get sick and don't care about chatting with their colleagues about last night's game? For many people, the future of work looks like a bleak place, full of temporary jobs (a "gig" economy), minimum wage labour and a ruling technocracy safely hidden away in their gated communities and their circular living machines." [162]

In this way, we are now going to take a vision that considers different aspects and analyzes the multiple principles and facts that allow us to provide an interpretation of how the world of work will evolve. First of all it is fundamental not to rely on a single vision, and that is why the analysis from which the works of the future will emerge is based on six

[162] Jobs of the Future: *A Guide to Getting-and Staying-Employed for the Next 10 Years*, Cognizant , November 2017

main pillars. These are the representation and the concrete application of the principles dictated by the 4th industrial revolution and adopted by the worker 4.0 in his specific activities for each sector.

The six pillars[163] are:

1) Work as always changed; a lot of jobs will die. Such as Telegraphics, nursemaids, travel agents, secretaries… these jobs and others in the past where all jobs that employed thousands of people, now it's not the same.
2) Lots of current work is awful; now in the world a lot of people do jobs that they hate, works that are dirty or dangerous because they need to gain money to survive. this aspect it is not positive for companies because one of the most important aspect in the profitable attitude of workers it's the motivation. For that trying to keep people in these new jobs can make that in a better conditions, creating a more enjoyable and lucrative works.
3) Machines need man; machines are able to do more than people, but at the same time there is always more to do. And in this way the incremental thinks and activities that need to gain the objectives can be realized only by human people. Therefore, there is a common threat that link man and machines. A simple example could be explained whit the question; Can a machine crate itself? This it's not possible, only by the human activities that can put together all the elements hardware and software to make the machine works.
4) Do not underestimate human imagination or ingenuity; in this world in which intelligent machines play a major role, man will continue to want to explore, they are conducted by a high curiosity. This attitude is the source of the creation of innovation and new works.
5) Technology will upgrade all aspects of society; technology is now the peripheral condition to many aspects of our work and lives. It is a set of aspects that start being fundamental and central to how we do everything and in the process, make the services and experiences we want much better. Therefore, for those many aspects of modern society that are still far from perfect, technology will be able to adjust this imperfection and try to make society better.
6) Technology solves-and creates-problems; this principle can be explain with the the way of saying "Wash, rinse, repeat". Start from this in the technology world we know that every solution begets a problem. If technology create a lot of solutions with innovation, AI and intelligent machines at the same time intelligent machines will address many problems in society, but in doing so, they will create lots of new problems will need

[163] Jobs of the Future: A Guide to Getting-and Staying-Employed for the Next 10 Years, Cognizant , November 2017

to work on addressing. A lot of that works give them profits so the way to gain money solving the problems.

Imagine and create new works it is not simple. Thanking in consideration an expression present on the publication of Thomas More's *Utopia* 501 years ago. Wrenching transformations are never easy, so a world without work is a fantasy that is no closer to reality now.

To imagine the future jobs we have to consider not only the aspects of industry 4.0 but also a big portion of fantasy and curiosity. These jobs could emerge within the major macroeconomic, political, cultural, business, societal, demographic, environmentalism, space exploration, cybersecurity, virtual reality aspects that have to be considered as starting point.

Industry 4.0 will be able to create entirely new job families while others become obsolete. Thus, to develop the debate about the industry 4.0, especially the effects provoked as the invention of robots, will give the analysis on how human labour remains a matter of debate among experts and their ability to survive with the presence of new digital tools.[164]

About this topic the research bring different consideration of effects, the paper of BCG "Man and Machine in Industry 4.0", the research made by Mckinsey Global Institute on the topic " A future that works: automation, employment and productivity" but at the same time Deloitte with "Achieving Digital Maturity", reported the results about the new digitalization and the impact on future jobs. The final consideration for what concerns the manufacturing sector will be that that can be that all the manufacturing works can be automated. Therefore, this statement would provide that the whole industry would be automated by eliminating the figure of the human worker.

This is not reality. An affirmation of Ingo Ruhmann a special adviser at Germany's Federal Ministry of Education and Research, explains "*Complete automation is not realistic. Technology will mainly increase productivity through physical and digital assistance systems, not the replacement of human labour"*[165]

Thus, the increased use of assistance systems are not a negative consequence but will bring qualitative changes and will likely be positive for the workforce. Start to decrease

[164]Jeanne Master, Future of Work: Three Ways To Prepare For The Impact Of Intelligent Technologies In Your Workplace, Forbes, July 6

[165] Man and Machine in Industry 4.0- *How will Technology transform the industrial Workforce through 2025*?- BCG, September 2015

the number of routine jobs will increase a lot the demand for jobs that requiring flexibility, problem solving skills and customization. That at the end are the most important new skills required by Industry 4.0 to be perfect workers.

However below we show a chart where there are a lot of works of the future. These jobs will create mass employment, providing work for a lot of people in offices, stores and factory floors displaced or disruptive by technology.

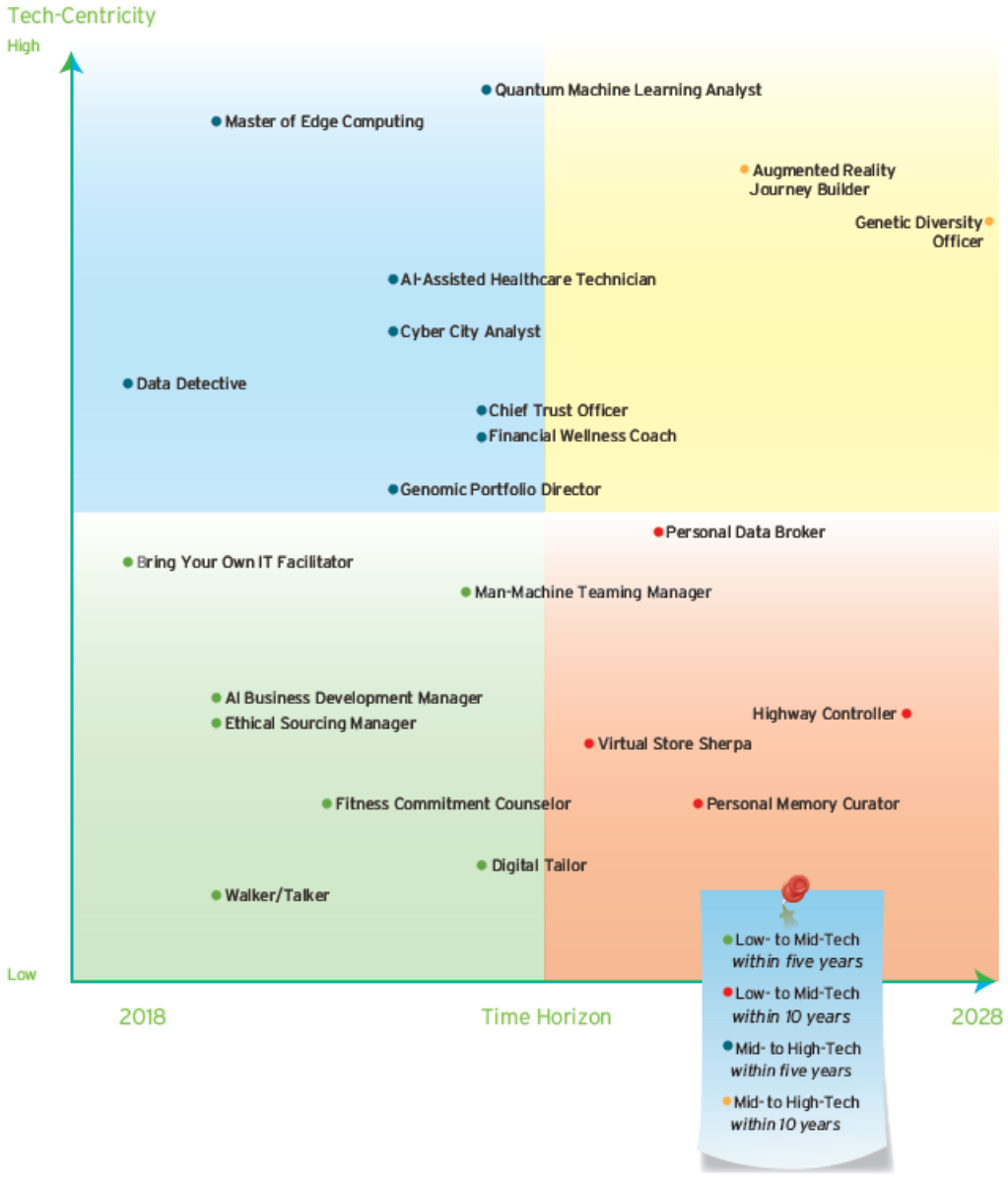

Figure 16 – 21 Jobs- The Road to 2028, Cognizant, November 2017[166]

[166] Jobs of the Future: *A Guide to Getting-and Staying-Employed for the Next 10 Years*, Cognizant, November 2017

This graph represents the 21 works of the future emerged by a research conducted by Cognizant.

These are some of the hypothetical works that can be develop in next years and will come probably common in daily life of the population when as has been hypothesized, many common works of today will disappear.

The graph shows the 21 jobs of the future that are positioned by a 10-year timeline of action and according to their "tech-centricity". Based on that, some are highly technical, while others won't require much tech knowledge at all. The examination of new jobs can be considered as the central analyses of the future of the society. Now it is reality but in the past we never know that one day (now) the population might be doing one of them.

Considering the development of an analysis based on papers belonging to different companies and research carried out in several areas the work of the future grows day by day, finding different facets and applications belonging to the field of reference. Returning to the research carried out by BCG the result of the creation of future works is based on the concept of automation and comes to define two new professions: "Industrial Data Scientist"[167] and "Robot Coordinator"[168]. From this study it emerged how to date the operators will be able to request less-machine-and product-specific training and an increase of skills and capabilities for using digital devices and software and accessing a digital Knowledge repository. Starting from the 21works defined by Cognizant the research of BCG and even more a set of insights made on different companies in different sectors, and even more so the complex journalistic world that has found ideas is for numerous articles on the subject. We can play with the fantasy that has become almost a reality, going to provide some small details, I will work on the future, imagining where our children could be positioned and hired. In addition to new emerging positions that will be those that require the use of digital skills there are others where existing skills can be used and defined as new activities of the future.

[167] Man and Machine in Industry 4.0- *How will Technology transform the industrial Workforce through 2025*?- BCG, September 2015

[168] Man and Machine in Industry 4.0- *How will Technology transform the industrial Workforce through 2025?*- BCG, September 2015

The fields of application are many, one example is the new figure, in the field of advanced management of offices, factories, plants and plants, the "Chief Digital Officer"[169], a figure able to coordinate processes and digital transformations and promote the culture in the company, also the "Cyber Security Manager"[170], the person entrusted with the management of data security in the company, closely related to another profession or the figure of the "Cloud Architect" who deals with the design and implementation of cloud architectures, web spaces that allow virtual management of entire information systems. If we move into the social media field, the new professions will be many, we start from the web developer, whose activity concerns the development of online platforms, with open source or paid languages, app developer, which develops app of various types, (video games, augmented reality, etc.) to software developers that program software for machines, from the simplest to the most sophisticated. Moreover, even if already present, the figure of the expert CEO who takes care of the positioning on the web and assists anyone who needs to be found by the search engines will still be requested.
Particular is the development of new work in the space field. Space takes a position and will involve numerous resources increasing the efficiency of its activity as well as the development capabilities that this allows.

Therefore, with the development of space tourism, moreover, there will be need of pilots specialized in space travel, of "galactic" tourist guides and of architects able to design housing solutions for space and for planets.

An industry where the 4.0 industry will provide professions that can make a radical change by simplifying the processes and times of realization is the medical field. In this context the digital professions are completely new and completely entrusted to the development of digital technology through robotics and artificial intelligence. Of fundamental importance, however, is to remember how in this sector digital work can never completely supplant the presence of a human figure. Memory surgeons will be born, able to add an additional mnemonic capacity to those who want to increase their own or

[169] P.Wellener,H.A.Manolian,S.Laaper, *Distinctive traits of digital frontrunners in manufacturingEmbracing the Fourth Industrial Revolution*, Deloitte, August 2018
[170] I.Consigliere**,** *Le professioni del futuro? Il cybersecurity specialist, l'open data analyst e il sustainability manager*, www.corriere.it

to help people suffering from sensory dysfunction because during their lifetime they have received an information overload that leads to the inability to learn other information. New “nanomedicine” specialists will be born with the task of revolutionizing medical care and health care through the creation of instruments in the subatomic "nanoscale". Finally, biotechnologies will combine genetics with the development of new medicines and clinical therapies and treatments will become increasingly personalized.[171]

Returning to what he said in his research BCG there will be the need for a figure "Robot Coordinator" that has the function of oversee robots on the shop floor and respond to malfunctions or error signals. If a robot must be taken out of service, the coordinator will replace it with a substitute in order to reduce production downtime.

And that of "Industrial Data Scientific" where specialists will extract and prepare data, conduct advanced analytics, and apply their findings to improve products or production. This figure has to understand both manufacturing and IT programs and must have strong skills to identify correlations and draw conclusions.
At this point, we are going to define that the jobs of the future are jobs “you make”, to solve problems and explore new opportunities creating a new world enchanted the digitalization in the new era.

[171] Previsioni. Industria 4.0, ecco le professioni vincenti, www.avvenire.it, September 2017

Chapter 5: Data Analysis

This section presents and analyzes the data collected through a series of questions conducted on a panel of 90 employees of the BMC S.R.L. company. The reference sample is a medium-sized Italian company with an annual turnover of 12ML euro. The dott. Bergami Managing Director of the company has kindly participated in the interview by answering the complex of questions concerning his company belonging to the manufacturing sector and which further operates in the field of services and mechanics.

The sections that constitute the set of analysis questions are developed on the main topics dealt with in the research questions of the elaborate, that is; The figure of the "HR" working within the company, the study of the benefits and risks that digitalization brings with it, the knowledge of 4.0 technologies and their application.
Even more the skills required to the HR figure that become the main study and the theme on which I focused my research in order to create not only a representation of new needs but a path that should be undertaken to make these skills can be developed in the working figures trying to provide ideas for applicability, dissemination, development and learning.
Finally, the company managed by Dr.Bergami was asked to indicate the general and overall level of knowledge for each category of worker within the company and how much this can improve in the future to increase the benefits of the fourth industrial revolution. The set of anal questions allows my work to obtain concrete and real-time data on the revolutionary aspects of change that the advent of digitalization has generated, new skills required, what are the obstacles to their dissemination or the missing aspects difficult to reach. In order to remain in line with the times of the economic system by creating a competitive line with other companies in the sector to understand the new business climate and the fear of replacing traditional work with a new "work of the future" (not found in case in analysis) and how effectively the phenomenon is realizable or not based on the organizational and production characteristics of BMC SRL
The level of knowledge of Plan 4.0 and the level of digitization for the company under analysis is placed on a medium category as well as the knowledge and consequent use of enabling technologies, characteristics of Industry 4.0, which register a level of applicability of the 37 % of the total.

The data reported in the use of the Plan confirm the average level of application of innovative technologies that the company applies in the various fields of application. The cybersecurity with a value of 80% and Simulation of 40% report a positive result for the rest of the lack of knowledge of the Plan allows to attribute a 10%, poor, to the implementation of other enabling technologies and also a lack of propensity to predict the future investments in this area.

The BMC company expects 5 years to invest solely in the Internet of Things, with shorter lead times, within one year it undertakes to improve its investments solely for cybersecurity and Autonomous robots. Overall, the framework described above shows that the measures implemented with the 4.0 plan have been implemented with scarcity by the company, in terms of benefits adopted by each technology applied the chart below shows a not entirely negative trend.

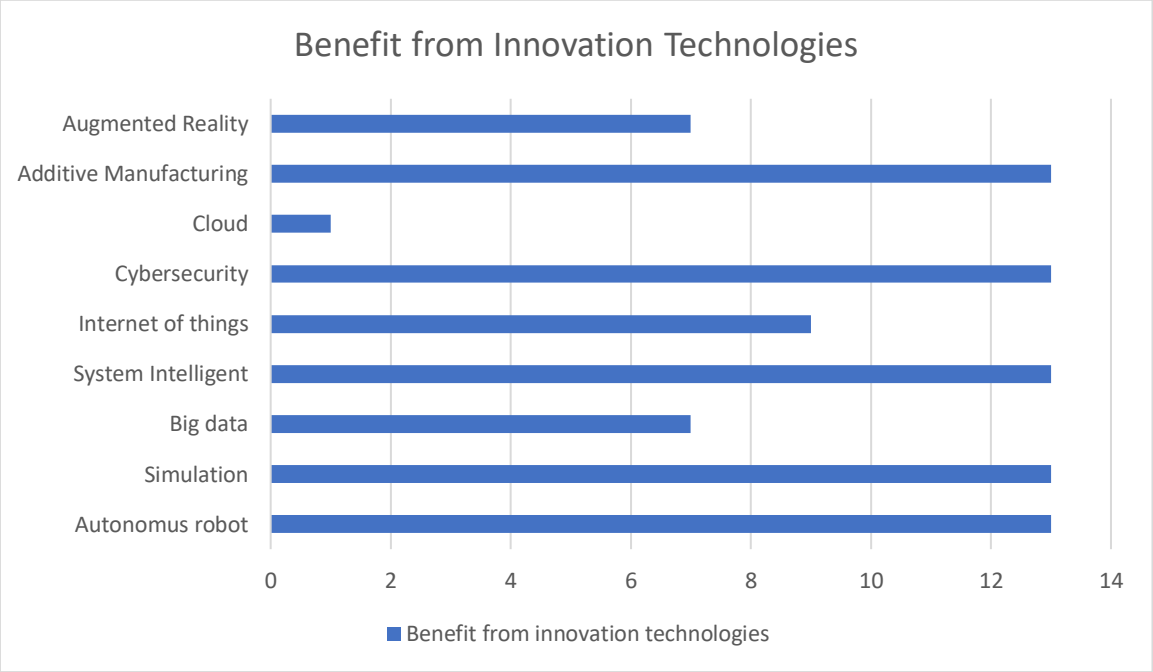

Figure 17: Source; My Elaboration, Benefit from Innovation Technologies (number from (1 to 13) to indicate the benefit of these innovative technologies)

The levels of diffusion of the instruments of the plan, based on this response from the company, allow us to observe how the diffusion of the principles 4.0 even if with a modest application cover the field under analysis in an almost homogeneous way. The perceptive and applicative axis of the instruments of the plan is mainly reduced to the use of 5

measures of equal merit; Additive Manufacturing, Cybersecurity, System Intelligent, Simulation, Autonomus robot. These values will tend to increase with the propensity that the company has to increase in the short term investments in the specific cybersecurity and Autonomus Robot.

A second part of the interview focuses on the HR figure and in particular on the level of training that the company provides. On the basis of the data obtained, the imposition of training activities reaches a level below 3%.
The graph below shows us visually what skills are required following the introduction of innovations and that should be developed for 3 categories of subjects belonging to the company: Workers, Employee, Manager.

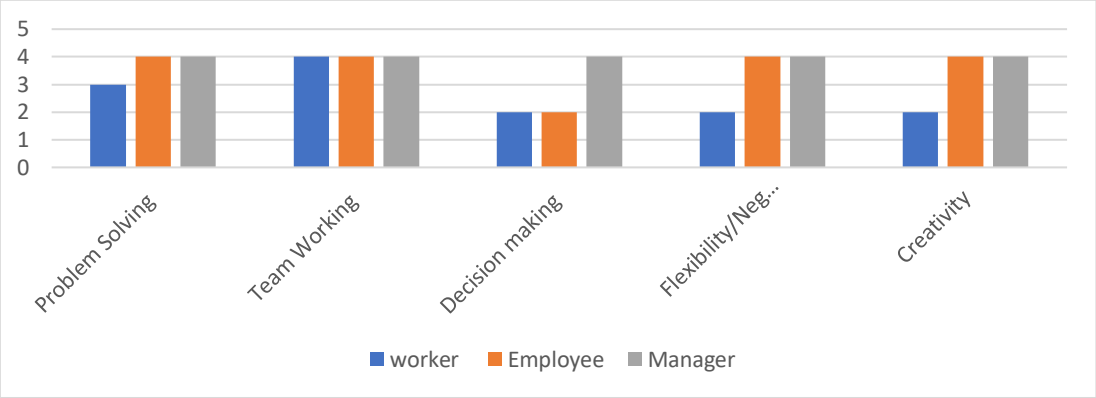

Figure 18: Source; My Elaboration, Skills for Manager, Employee, Worker

It is interesting to underline how the Manager (leader) in the company will have to be able to 100% cover all the required skills, maintaining a level at the top in terms of knowledge and ability to cope with future innovations and transformations. The employee reaches a level that is 20% different from the Manager for the "full" coverage request for the skills necessary for their function. On the other hand, it is inferior to report a wave performance, the set of skills required to the worker, which has a maximum value in the development of team building skills, greater in the problem solving function and poor in Flexibility and Creativity.

Also, in this perspective, the company states that the methodology used in doing training activities remains the traditional one without trying to experiment with digital courses, at the same time affirming that there would be total benefit in the adoption of principles 4.0, recording a risk level of 0.25% of the impact of digitization of HR jobs.

A datum to read together with that of the training activity and therefore the development of the skills necessary for the HR figures within the company is the set of gap that BMC meets in the skills development and knowledge of the 4.0 principles.

By positioning BMC in a global perspective and attributing to it the obstacles that the economic, social system reports, the graph below shows the trend of the Gap present in the analyzed company that prevent the development of skills for HR figures.

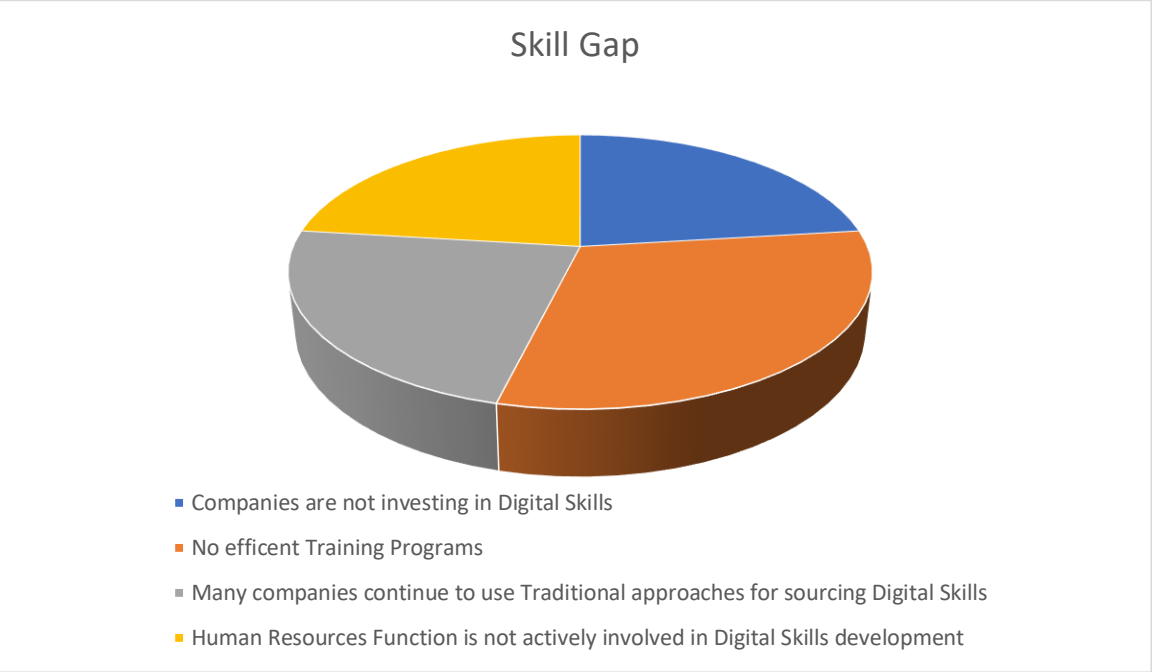

Figure19: Source; My Elaboration, Skill Gap

In this way, having reached a strategic conclusion on the results of the data analysis carried out on the BMC company, the advent of the fourth industrial revolution and the set of innovative principles that it brings with it seems to date has not generated a level of evident change. given the lack of knowledge of the principles of the plan and the lack of inclination to invest in these in order to make them known and apply them on the agenda. At the same time the mentality of the leaders is open to change and believes that

the contribution of these principles are beneficial and progress also in economic terms for the company.

It is essential to focus on the need to start a long-term, continuous and connected investment campaign in order to make the plan in question possible and profitable.

Conclusions

During my work we have been able to understand that the true Revolution 4.0 does not consist in introducing only technologically advanced machines, but knowing how to combine the different technologies, making them intrinsic in the new concept of "Factory"and above all let them interact with each other, to create a connected system in which machines, people and information systems are able to work together to create products, services, work environments, customized, smarter and cost-efficient.
The new technologies, as we have seen in the consultation of the BCG paper, are nine and are already available for the population and companies wishing to make use of them. The gap that companies have to fill in order to exploit the benefits of these are many.

The new technologies, as we have seen in the consultation of the BCG paper are 9 and currently used by those who exploit their usefulness; the gaps that companies have to fill in order to fully exploit the benefits are many.
These new technologies will have impacts on:
- the power in the use of data and the increase in connectivity;
-the value that comes from the data that, as we saw in McKinsey's report, is less than 1% for companies;
- machine / human substitution and their interaction

What will come out of all this? A loss of jobs or rather than an opportunity for the "new worker"?

The human capital of every Italian company, to date does not have adequate skills for new production processes. The figure of the worker and the company organization itself must be completely reinvented.
The new worker figure will have to be lean, creative, able to adapt to more than one reality at the same time or to several companies; also, the organization of the work will have to follow different schemes. For example, we think of the organization of working hours and data by "smart working" that allows companies to quickly move their employees from one project to another according to the needs dictated by the new business without having to think about their location.

The worker will interact more and more with his tablet connected to both the company network and the machine itself.

The digitization of work will require continuous digital training, a review of tasks, roles and responsibilities within the company. Also, the managerial figures will undergo modifications, as well as the distinctions at company organizational level (managers, middle managers, employees, workers). A working class will be needed with more distinctly transversal and widespread skills.

New professional figures will be born who have no connection with the old traditional factory concept. These are the new forms of work that arise from the development of the Internet and platforms, such as Amazon, Airbnb, Uber. These companies are characterized by a strong global competition that surpasses all those certainties in terms of job stability, security and protection, acquired in our decades of union history.

The logical thread that will unite all the new professions is the need to have high computer skills. And hence the gap between the skills required by new companies and those owned by workers. The problem is not the lack of training, but rather than the need to train the worker starting from the school age, and in a constant way, directing the training towards interdisciplinary study paths and adapting the contents to the needs expressed by the new working contexts.

The same objective must be placed for workers already within the companies, whose training must provide for the requalification of skills, in order to update knowledge in real time.

So, we asked ourselves if the work of the future will foresee more and more substitutions between man and machine.

''The creation of artificial intelligences increasingly connected and more and more able to operate autonomously, will never succeed in substituting man because the mental capacity of a person will always be difficult to replicate because it exploits a wide range of sensory data to stimulate one's reasoning skills to react to the various situations in which one can find oneself "(Pfeiffer, 2016)[172]: in a word, experience.

[172] R.Gray, How Automation will affect you – the expert's view, 2017, http://www.bbc.com

The robot can't work unless it is set by an experienced worker, so we do not talk about replacing man/ robot, rather than tiling, in which man will always be the one who designs and realizes.
The new worker will therefore be less and less tied to repetitive tasks and equipped, through training, with increasingly transversal skills, to be able to solve problems as they arise.

In this scenario we have also analyzed the fundamental role of the Italian Government, with the implementation of the Calenda Plan to support companies in the implementation of new technologies and preserving the workforce.The implementation of the Plan includes a set of support measures (Super- depreciation/amortization, Iper – depreciation/amortization, New Sabatini, Guarantee Fund for SMEs, Tax credit for R&D, Startup and innovative SMEs, Patent Box) planned in order to manage the investments.. trough a survey the plan registered a value of 78% of the Italian companies that already know and start to use the principles of the Calenda Plan.

Further the set of information obtained thanks to the interview to dr. Bergami, CEO of BMC company, allowed me to expand the field of analysis. Also, in this case we find that the company applies, at this stage, the 4.0 principles with a reduced propensity compared to actual capacities. Workers at the moment do not fear replacing their activities given the inclusion of digitization. Robots are not a threat. But only because there is still no perception of a real change. This will happen when the investments will be made in a constant and lasting way over time so that the result can be implemented and solidified in the processes. So, 4.0 is a feasible change that requires the company to create new synergies across the entire value chain from the vertical and horizontal point of view, the need to reorganize the organizational structure, but even more, an element fundamental to the success of change, the development of a new managerial culture that starts at the top and spreads throughout the entire company pyramid.

Valuing Human Capital is a concept already heard and already discussed, but never as in the case of Revolution 4.0 is of fundamental importance if we want this to be seen as a challenge, an opportunity for productivity but also for the worker, and not as a spectrum that can lead to job losses and tensions.

Acnowledgments

Come to the end of my long, tiring but very stimulating job, while I'm doing my first work experience, I can’t fail to thank all those who have allowed the success of my work.
First of all, Prof. Boccardelli who immediately showed me total availability and esteem, meeting my needs, even during my Erasmus period in Tallin.
I would also like to acknowledge Chiara Acciarini, who has been supportive and constant help during the whole drafting of the document, advising me but at the same time leaving me a lot of creative space in the development of the topics. Without her help I would not be able to contextualize the many ideas that I had and needed an organization so as not to be dispersive.
A special thanks to Dr. Nicola Liguori, of Leonardo Committee, because through the interview we had, he was able to give substance to the words written on a document.

I acknowledge Dr. Emanuela Stocchi of AISCAT for the European vision of the topics covered and for her total availability in clarifying some aspects.
Special thanks also to Dr. Bergami, for his availability and for having contributed with his experience and his kindness to the validity of this research trough the answers given me with the data analisys based on the results of Industry 4.0 in the company Air Filter.

I can’t help but thank the company for which I work, BDO ITALIA, and its collaborators, for giving me the opportunity to absent myself to carry out my research and advise me when necessary.

Finally I want to aknowledge my family, the strength that drives my life forward and of which I can’t do without to conduce every moment of life with a smile, courage and positivity. I owe them everything to them and I thank them for always believing in me, having invested in my studies that have led me to achieve small and great goals, and support me in all my choices.

In the heart always a special mind to my grandmother Anna that made me understand what are the important little things of the life and from the sky always smiles and caresses me when I need it.

This degree is for me one of the greatest goals of ever life! It is to all of you that I have mentioned and to whom I have not done it, but it is in my heart, that I owe my victory! Thank you all.

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The collection of technologies that deal specifically with processing, storing, and comm unicating information, including alltypes of computer and communications systems as w ell as reprographics methodologies. Copyright © 2003

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Department of Management *Chair of Corporate Strategies*

"How will industrial jobs evolve?" The new particular relationship between Man and Machine in the Industry 4.0.

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ACADEMIC YEAR 2017-2018

Executive Summary

"How will industrial jobs evolve?"-

The new particular relationship between Man and Machine in the Industry 4.0.

Introduction

Chapter 1: *The Industry 4.0 phenomenon*

Chapter 2: *Theoretical Framework*

Chapter 3*: Research Methodology*

Chapter 4: *Empirical Findings*

Chapter 5: *Data Analysis*

Conclusion

Introduction

You can imagine, create and build the most wonderful place on earth but people will always need to make the dream come true ".

Inspired by this famous quote of the greatest animator in the world, Walt Disney, this piece intends to analyze human capital and its value as a decisive and central factor both in the strategies and in the objectives of an organization.

The traditional concept of organizational model tends to change and replace an innovative form based on technological development, application of software systems and new efficiency, flexibility and speed of production.

The aim of my work is to analyze the radical change that is taking place with the advent of the 4th industrial revolution, underlining, with respect to the three industrial revolutions that preceded it, the speed of technology development, the digitalization of production processes and the fast interconnection.

Then I will illustrate the new technologies that are the protagonists of the phenomenon, that new companies cannot disregard if they want to fully exploit the benefits they can bring.

A disruptive evolution means that it is not only possible to improve the production by using new technologies such as digitalization but to reinvent the organization of the company, and guarantee the new tools and skills toward workers to be able to implement the principles of the 4.0 Industry and gain value. It is then useful to do well on how to reach the platform model and how the impact of the application of new technologies and platform models lead to create a transversal and innovative system, by eliminating the patterns of the old business organizations and providing a future for new professionals.

Stating this, we propose, firstly, to raise the question; how is it possible to create new place of work, even more, are new technologies a threat or not? Is there an actual risk of man-machine substitution? Create new works of the future?? How can these principles to be implemented considering a new organizational scheme of the company based on Industry 4.0? Are new technologies a threat or not? Is there an actual risk of man-machine substitution?

Chapter 1: The Industry 4.0 phenomenon

It is difficult to establish a starting date for the revolution 4.0; the beginning is now, it is still ongoing, only afterwards will it be possible to indicate the founding act.

It is possible to start from the assertion that in history there have been several revolutions, leading the world to be as it is at present and simplifying the life of society. The first, the second and the third industrial revolution are the starting point that allows us to reach the last revolutionary wave in analysis. Starting from the origins and stating how each revolution has a specific connotation based on population, geographic area and timing of implementation. However, if the association with past innovations has implemented within the economic-industrial system, the effects of 4.0 are still in the experimental phase of implementation and evaluation.

It should be noted, however, that the 4th industrial revolution does not exclusively concern the possibility of having always connected digital tools, its field of application is much wider; we witness the simultaneous development of different innovations from the scientific field (DNA sequencing), nanotechnologies, renewable energy, quantum computing.

What does it mean for industry 4.0?

This revolution 4.0 is the economic and mechanical paradigm to create value; as it is indicated in a simple phrase, industry 4.0 means "to paradigm shift in companies' manufacturing strategies."

In this developing context, the Italian Plan (Calenda)[173], taking into consideration the initiatives of other Countries that more or less have implemented programs to support the Industrial Revolution number 4 and therefore the development of the new Industry 4.0.

On the basis of what it is expressed, the world is subdivided into three approaches at the 4.0 industry, having indeed a more German approach, an Italian one and finally a French one. The three models also involve other Countries and, to make the situation easier to perceive, it is possible to divide countries in the following way based on the models adopted by each of them.

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MEF , *Piano Nazionale Industria 4.0,* 2017-2020 , *Investimenti, Produttività, Innovazione,* 22 Maggio 2017

MEF, Piano Nazionale Impresa 4.0 , *Risultati 2017-Azioni 2018,* 19 Settembre 2017

MEF, Piano Nazionale Impresa 4.0 , *Guida agli Investimenti*, 19 Settembre 2017

• Research oriented model: Germany, Japan and the United States
• "Enterprise oriented" model: Italy
• Mixed model: France and United Kingdom

If the world can be unpacked in three different models, we have to say that in most cases the model followed is the German one, therefore we will start with our Italian Plan to develop the analysis of the phenomenon and then to subsequently move deep into the analysis of Germany and France.

The "*Impresa 4.0*" National Plan represents a major opportunity for all companies that are ready to take advantage of the unprecedented incentives offered by the Fourth Industrial Revolution.

The Plan in Italy provides for a wide array of consistent and complementary measures promoting investment in innovation and competitiveness - all measures that have proved their effectiveness in the past have been strengthened under a "4.0" logic, and new measures have been introduced to meet new needs.

The National framework defined by Minister Calenda in the aforementioned part makes it possible to consider the phenomenon of Industry 4.0 as an "Industrial Revolution" which, by striking the global economic and industrial system, modifies relevant aspects of their economies in a radical way and at a speed without precedents. The plan intervenes in order to achieve the objectives in different areas of actions; Innovative investments, Enabling infrastructures, Public support tools.

The implementation of the Plan includes a set of support measures planned in order to manage the investments and the framework provides six distinct corrective measures: Super- depreciation/amortization, Iper – depreciation/amortization, New Sabatini, Guarantee Fund for SMEs, Tax credit for R&D, Startup and innovative SMEs, Patent Box.

Germany, a pioneer country of Revolutionary Advent 4.0, develops in a precise and detailed way, through a Digital Agenda promoted by the Government, a set of rules: rules for living, working and doing business in the new digital age.

The pivot on which this path (Digital Agenda) is leveraged is a new economic and innovation policy designed by the German government to allow the implementation of the principles within an entrepreneurial community, social partners, civil society, the university system and research, overall with the imprint of the German co-management culture.

The technologies developed by the German model and considered the pillars of the revolution are three and they are connected to the use of the Internet as an instrument.
Internet of Thinks, Internet of Things, Internet of Energy.
In France, "*Industrie du Futur*" the main aimed at the modernization of French industry and the transformation towards a world marked by digital. France subdivides research projects into 9 different clusters with specific areas of intervention. The clusters can be grouped as: Data economy, Intelligent objects, Digital trust, Production of intelligent food, New resources, Sustainable cities, Eco-sustainable mode, Medicine of the future, Transportation of the future
The merit of the implementation of the "*Industrie du Futur*" plan is attributed to the presence of an Association that plays a fundamental role, allowing the effective transformation of the new technologies obtained from research into the field and applying them to the real productive factory. At this point the analysis follow the dissemination of the Industry 4.0 Plan in the Italian industrial system by the survey conduced by KPMG.[174]
The survey is conducted on a sample of 330 Italian companies, located throughout the Country, without distinction of sector according to the Confindustria Committee, leads us to investigate qualitative aspects regarding the revelations generated by the work where it is possible to recognize that the industry paradigm is entering into the heart of the production processes and is introducing itself into the culture of companies of various types.
At this point emerges that concept, found several times, where the only real limit to the possibility of innovating production from a digital point of view is given by the creativity of the entrepreneur, who together with the entire hierarchical structure plays a fundamental role in the progress of possible results, given the immense potential of the extension of the phenomenon.
With regard to entrepreneurial skills, Italy, through the National Industry 4.0 Plan, organizes the entrepreneurial activity through a "natural" development where the entrepreneur aims at making investments in the perspective of a real business transformation.

[174] Comitato Leonardo, Kpmg, *Industria 4.0 per un'impresa globale: la dimensione del fenomeno, le implicazioni per il paese, le policy*, 13 November, 2017

The business areas that are expected to have a more significant impact are strongly confirmed as follows: the efficiency and flexibility of production; increasing the added value of the products / services offered; the customization of the offer.

In order to fully understand the evolution of the concept from Industry 4.0 to Enterprise 4.0, this work can't ignore the analysis of the technologies that represent the starting point, the fulcrum of the analysis. We have to use the terms used by BCG in the paper "Industry 4.0: "The Future of Productivity and Growth in Manufacturing Industries", the 9 founding pillars of Industry 4.0 on which the concepts expressed up to now are based: Big Data and Analitycs, Autonomous robot, Simulation, Horizontal and Vertical System integration, The Industrial Internet of things, Cybersecurity, The Cloud, Additive Manufacturing, Augmented Reality.

Chapter 2: Theoretical Framework

We have just explained, the most commonly used terms to describe this development, it's the rapidly and fast changing of the global industrial landscape due to the Industrial Revolution 4.0. from the business point of view the key drivers of this transformation include improving customer experience, increasing speed to market and reducing costs.

So, first of all it is important to define what "transformation" really means. "*Transformation is a whole scale change to the foundational components of a business: from its operating model to its infrastructure. What it sells, to whom and how it goes to market.*"[175]

Based on that is clear to explain that a transformation touches every function of a business model. These technologies could be used to create new business value due to the capability to collect them, distribute the information, share that and make decisions based on real data and so to be more predictive in the analysis of what will be done to achieve the objectives. The models can be used for product optimization and to operate and control the manufacturing process.

But considering our research question in which the possibility to create new works and reinvent the role of HR inside the economic world it is not so simple and will be completely disruptive in some cases, the role of new technologies used in the organizational models can be considered one of the changing aspects able to generate the

[175] https://www.theguardian.com/.../2017/.../robots-jobs-employees-artificial-intelligence

new approach for humans at work and at the same time the real needs to develop new skills to realize the improvement and innovations.

The revolution in the organizational models is driven first of all by the greater flexibility and robustness, related to the value chain in Industry 4.0 that will be more fluid and flexible. Companies have to move to a new concept of "*Fractal company*"[176] for Warnecke that will create the concept of open innovation models that is, now, our real focus of analysis. the principals characteristics are: self-similarity, self-organizations, self-optimization.

New businesses of Industry 4.0 respects 3 pillars: *Networked manufacturing, Self-organising adaptive logics, Customer integrated engineering*

Now there is the needs to innovate and develop the concepts at the base of the strategy of Fractal Company into a more digitalized attitude. Companies need to manage the increase of complexity, fast and interactive environment with the well combination of internal and external knowledge in order to create an improvement of goods and services, new processes and new marketing methods in a completely renewed organization of company.

To explain well, what really means "Open innovation" is important to consider the presence of external resources fundamental for companies.

What are external resources?

"*Suppliers of inputs that come from outside a business. Using external sources to acquire the inputs into its manufacturing process means that a business is exposed to market price changes in those inputs when producing its goods*."[177]

Analysed the general concept in the specific attribution for what concern the open innovation systems the external resources are considered the assets used by companies to generate innovations and increase profits by assets, information, innovations and capabilities obtained by external actors and not creates or owned inside the company.

The discussion wants to evaluate and understand the real nature of the innovation given by these external resources, which is related to degree of newness. the resource question in analyses could be explained testing the effect of internal and external collaboration on the degree of newness with incremental or radical in innovation projects.

Resource question can be analysed in their for as; "Technological Platform".[178]

[176] Warnecke, *the Fractal company, A revolution in Corporate culture,*1993

[177] www.businessdictionary.com/definition/external-sources.html

[178] M. Iansiti,R. Levien, "*Strategy as Ecology*", Harward Business Review, 2004

To start with the right foot is important to explain in detail what is a Platform and to show the structure of that digital tool to be able to understand better how it possible to create value due to these trends.

"*Platforms are defined as products, services, or technologies that are similar in some ways to the former but provide the foundation upon which outside firms (organized as a "business ecosystem") can develop their own complementary products, technologies, or services*"[179]. For what concern the theory of Platform the architectural knowledge is about representation of the interdependencies between technical and non-technical components of an ecosystem. But, moreover, the result of the infrastructure used to create the Platform it's the result of identification, selection, combination, and interaction of the various components that make up its organizational form based on the activities of the participating organizations. The skeleton of the architectural structure of a Platform refers to the mix of : "heterogeneous business and technological elements" that involves private and public organizations in the creation of a process that use technical capacity, associated knowledge bases, and markets trends .[180]

Consider a world in which companies need to collect and reach a big amount of every day updated information, the presence of this new Business Model to create relationships and so commerce between operators, could be considered as a saver for companies.

What are the real potential useful use of Platform?

Stating that, Platform is an infrastructure accessible to everybody in which the is possible to create interaction and the governance conditions are simply established.
The structure of each Platform it is different based on the aim of that creation is realized by specific company. The easy access and the simple way through which the user can access and use the disposal and all the function that the platform gives make more attractive, useful and productive the technological disposal. The final purpose to answer to our research analyses is to matching needs among users making it easier to exchange goods, services, value for all the participants without distinction of class or economic capability.

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[179] Annabelle Gawer, Michael A. Cusumano, "*How Intel, Microsoft, and Cisco Drive Industry Innovation*" Harvard Business School Press, 2002

[180] G.G.Parker,M.W,VanAltyne,S.P.Choudary,PlatformRevolution, W.W.Norton&Company Ltd, 2016

Chapter 3: Research Methodology

The research included in the paper is a combination of multiple surveys and documentation that have been carried out byrenowned consulting firms, academic studies, ministerial publications, International organizations, papers opinions in time as well as selected interviews of academics and business professionals.

The work is structured trying to give an answer to the research questions presented in the introduction.

“How is it possible to create new jobs, even more, create new jobs of the future? How can these principles be implemented considering a new organizational scheme of the company based on Industry 4.0?”

“Are new technologies a threat or not? Is there an actual risk of man-machine replacement?

Especially important was the study of the survey conducted by KPMG and discussed by the Leonardo Committee in a document. thanks to this research I had the opportunity to deepen the work thanks to the contribution of Dr. Nicola Liguori.

Moreover, the data collected during the entire project was extended by the survey conducted by me through the interview with the company BMC Air Filter whose results are reported at the end of chapter 4.

Fundamentally important is the contribution to the information obtained from the book "The Fourth Industrial Revolution" by Klaus Schwab and “Industria 4.0, Uomini e Macchine nella Fabbrica Digitale” by A. Magone and T. Maziali, that embraces a variety of topics and offers a careful and complete vision of the phenomenon 4.0, thanks to his experience as an academic, entrepreneur and political observer.

Chapter 4: Empirical Findings

As the industry is transformed, the role of HR within it will also undergo radical changes. So before framing the man in the new enterprise 4.0 we ask ourselves the question: is the end of the work coming? Will companies with their functions continue to exist?

The forecasts are drastic and negative and therefore it seems that we will reach a reality characterized by unemployment and poverty. Every job is likely to be replaced by technology today. The discussion is still open and being a constantly evolving phenomenon, it does not find a reason or a wrong to one side or the other. We need to

wait and see how the system will evolve. At the moment we can dwell on what has already been implemented or is being implemented. It is not therefore a question of fearing the future of work, but of having the right skills to face it. Without the construction of these new skills, technology can only destroy work, making man his slave or a designated victim. This does not mean that many professions of today will not disappear, it is inevitable that this happens. So, following the waves that characterize the economy, the future reserves us new jobs based on new needs. The future needs a future concept of factory.

This factory of the future combines a culture today based on digital with "knowledge based" systems that therefore require a pervasive use of sensors, flexibility and adaptability, with the passage already enunciated by vertical specialization to the horizontal process generating a general increase in complexity. At the same time continues to evolve together with the products, processes, innovations and needs of man, creating a reflection on the focal point in analysis.

Industry 4.0 creates new types of interactions between people and machines. These principles are going to change the nature of work and organization.

Some researches show data in relation to the substitution level of the man / robot work given by the automation of the activities. First af all the theories of Frey and Osborne[181] reported negative results about this phenomenon. The methodology used by these two researchers is based to the estimation of the probability of computerisation for 702 detailed occupations distinguish between high, medium and low risk works depending on their automation. The estimates 47% of total US employment is in high risk category.

[181] C. Benedickt Frey, M.A. Osborne, *The Future of Employment: How susceptible are Jobs to Computerization?*,2013

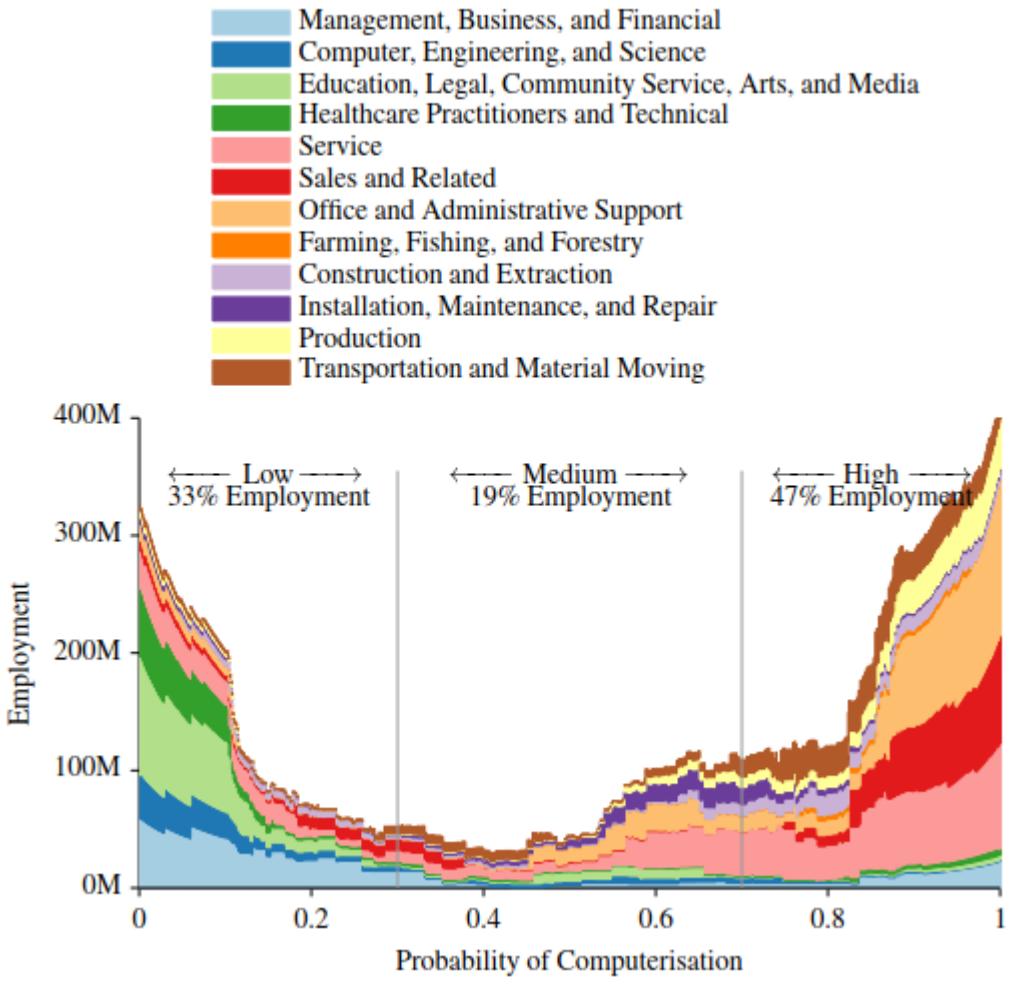

Figure 18: C.Frey,M.Osborne,*Technological forecasting and Social Change,* 2017

The 33% of total sectors of occupation is positioned in the low category, lower is the date reffered to medium one that it is represented by 19% while the highest value is reach in the last section and it is represented by 47% of areas of work.

Different are the values reached by Arnt, Gregory and Zierhan where only 9% of workers currently employed are at risk of being replaced. Also, this theory is not entirely true, the studies conducted by the Ministry of Economic Affairs of Germany reports that 18% of all companies are aware of the phenomenon of industry 4.0 but only 4% is affected by the principle of computerization of activities within it.

Another view of this phenomen is given by the research of the consulting group McKinsey[182], the 45% of the activities that individuals perform can be automated by adapting the currently available technologies. At least the theories reported by Schwab

[182] McKinsey Global Institute, *A Future that works: automation, employment, and productivity,* January 2017

state that 30% of the auditing activities are specifically carried out by machines equipped with artificial intelligence. Based on the sample of subjects interviewed, 75%[183] expect this figure to be reached and expanded by 2025.

What is required in return for the domain worker to continue to be the protagonist of the new factory?

Employees will be working on a greater variety of tasks unrelated to their core education, recruiters will have to look beyond formal degrees to identify workers with the relevant skills for specific roles.

The Tabby and Tesla[184] case is a practical example where the developments of the 4.0 industry in the manufacturing activity in motor sector. where the consumer in his role of protagonist is able to realize applications and digital devices through co-design practices. The "worker-craftsman" becomes a "user" who naturally imports in his work the digital skills and practices acquired in everyday life within his work. Even more, we have seen how the insertion of new digital devices and the familiarization of these with the workers becomes solid, creating a man-machine relationship that simplifies the steps of the work.

With the aim of putting a point to the definition of the new worker 4.0 and specifically dictating the essential skills required, let's start by affirming that the companies that managed to manage the crisis that has upset traditional production systems and forced the world of work to make radical changes were those that have created new business models and new organizational models, investing in their staff and intervening not only on their hard skills, but also on soft ones.

Based on the research carried out taking into consideration several companies, 10 fundamental skills emerged in the context of soft skills that can be listed; problem solving in complex situations, critical thinking, people management, team working, emotional intelligence, decision making, service orientation, negotiation and cognitive flexibility. Each of these has a different value based on the importance they have in the reference work context. These three main skills report, problem solving, problem solving in complex situations and creativity, jointly analyzing them and considering them as a capacity of an individual worker 4.0 all the characteristics necessary to implement the digitalization and technological innovation that this revolution provides.

[183] K. Schwab, *The Fourth Industrial Revolution*, Franco Angeli, 2016

[184] https://www. teslamotorsclub.com

On the basis of this context start to be fundamental that workers and at the same time students will be involved "in training" to acquire transversal skills.

The general skills that the individual worker 4.0 should have to operate fully must be the right combination of hard and digital skills and soft and transversal skills. In this way individuals adapt to the new organizational and production models that are spreading rapidly. Returning to digital skills, first necessary considering the digital one of the revolutionary pillars, are poorly developed both at the management level and at the level of employees and this represents a barrier to business renewal processes, considering that they have a highly strategic function in society. The greater the digital skills, the more exclusive and innovative it becomes a company, allowing it to acquire that greater competitive advantage over its competitors

Hard and soft skills have the same relevance for the growth and competitiveness of both the individual worker and the companies.

Developing digital skills is not easy. According to a report by Capgemini, about 77%[185] of companies attribute the difficulty in adopting the digital principles of industry 4.0 since HR do not possess the digital skills necessary for the revolution to be implemented. Because only 33% of workers are involved in trainings programs while the others are not present in programs of training and learning digital skills. Furthermore, the problem remains to understand who is destined to fill this gap of 60% of the working population in the development of digital skills. This function is attributed to leaders, functional teams, IT developers. The research and dissemination activities of digital skills find multiple adoption skills that however are partially rejected by companies that prefer to maintain a traditional approach to the application of these methods. If training, recruitment and partnership are used by 63% of the companies, only 13% are launched in the use of innovative methods such as targeted company acquisition or an incubator approach. The gap is still difficult to fill because it is difficult to change the attitudes of business leaders when it comes to investing to get the basic tools on which the business is based. At this point, the analysis focuses on the ability that HR have to develop digital skills and combine them with the knowledge of the business in which they operate, otherwise digital skills would be inefficient. In order for this to reach a positive result for the company, the leader aims at combining data skills with strategic and creative thinking, collaboration and communication skills. This is leading to a growing demand for

[185] Capgemini, *Skill Evolution for the digital Age*, Capgemini/Counsulting Analysis,2013

individuals who possess technical skills along with business strategies and leadership skills.

Coming to a conclusion, what does the professional digital expert of the future look like? Future employees will have to combine excellent digital specialist skills with a deep understanding of the functional business. They should be comfortable with short delivery cycles and be able to operate through silos and within cross-functional teams.

The document provides more practical examples of application on the topic such as; the case Intel described by Harvard research and P&G, L'Oreal, Nike and Google analysis. The attention moves on the necessity for companies to the search for talent. Digital talent does not lend itself to easy recruitment.

Organizations need to define a vision, identify future skill requirements, undertake a comprehensive skills gap assessment, take steps to bridge the gap and finally initiate actions to constantly evaluate progress in their journey to develop digital skills. [186][187]

An itinerary is created that leads the companies to achieve this result. The main steps to follow are: Define vision and identify future skill requirements, undertaken skills gap assessment, Bridge the skills gap, constantly evaluate progress.

The analysis of the skills and competences that the new 4.0 workers must have leads us directly to introduce what will be the future works, replacing some present ones now, and how they will be able to be implemented in more or less long times. First of all it is fundamental not to rely on a single vision, and that is why the analysis from which the works of the future will emerge is based on six main pillars. These are the representation and the concrete application of the principles dictated by the 4th industrial revolution and adopted by the worker 4.0 in his specific activities for each sector.

The six pillars are: Work as always changed, lots of current work is awful, Machines need man, don't underestimate human imagination or ingenuity, Technology will upgrade all aspects of society, Technology solves-and creates-problems.

To imagine the future jobs we have to consider not only the aspects of Industry 4.0 but also a big portion of fantasy and curiosity. These jobs could emerge within the major macroeconomic, political, cultural, business, societal, demographic, environmental space exploration, cybersecurity, virtual reality aspects that have to considered as starting point.

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[186] BCG, *Man and Machine in Industry 4.0- How will Technology transform the industrial Workforce through 2025?,* September 2015

185 BCG, *Industry 4.0: The Future of productivity and Growt in Manufacturing Industries, 2017.*

Industry 4.0 will be able to create entirely new job families while others become obsolete. So, to develop the debate about the industry 4.0, especially the effects provoked as the invention of robots, will give the analysis on how human labour remains a matter of debate among experts and their ability to survive with the presence of new digital tools.
The final consideration for what concerne the manufacturing sector will be that all the manufacturing works can be automated. This statement would provide that the whole industry would be automated by eliminating the figure of the human worker.
Considering the development of an analysis based on papers belonging to different companies and research carried out in several areas the works of the future grow day by day, finding different facets and applications belonging to the field of reference.
Returning to what he said in his research, BCG[188] there will be the need for a figure "Robot Coordinator" that has the function of oversee robots on the shop floor and respond to malfunctions or error signals.
At this point we are going to define that the jobs of the future are jobs "you make", to solve problems and explore new opportunities creating a new world enchanted the digitalization in the new era.

Chapter 5: *Data Analysis*

This section presents and analyzes the data collected through a series of questions conducted on a panel of 90 employees of the BMC S.R.L. company. The reference sample is a medium-sized Italian company with an annual turnover of 12ML euro. The dott. Bergami Managing Director of the company has kindly participated in the interview by answering the complex of questions concerning his company belonging to the manufacturing sector and which further operates in the field of services and mechanics.
The sections that constitute the set of analysis questions are developed on the main topics dealt with in the research questions of the elaborate, that is; The figure of the "HR" working within the company, the study of the benefits and risks that digitalization brings with it, the knowledge of 4.0 technologies and their application.
The level of knowledge of Plan 4.0 and the level of digitization for the company under analysis is placed on a medium category as well as the knowledge and consequent use of

[188] BCG, *Man and Machine in Industry 4.0- How will Technology transform the industrial Workforce through 2025?,* September 2015

enabling technologies, characteristics of Industry 4.0, which register a level of applicability of the 37 % of the total.

The data reported in the use of the Plan confirm the average level of application of innovative technologies that the company applies in the various fields of application. The cybersecurity with a value of 80% and Simulation of 40% report a positive result for the rest of the lack of knowledge of the Plan allows to attribute a 10%, poor, to the implementation of other enabling technologies and also a lack of propensity to predict the future investments in this area.

A second part of the interview focuses on the HR figure and in particular on the level of training that the company provides. On the basis of the data obtained, the imposition of training activities reaches a level below 3%.

Also, in this perspective, the company states that the methodology used in doing training activities remains the traditional one without trying to experiment with digital courses, at the same time affirming that there would be total benefit in the adoption of principles 4.0, recording a risk level of 0.25% of the impact of digitization of HR jobs.

By positioning BMC in a global perspective and attributing to it the obstacles that the economic, social system reports, the graph below shows the trend of the Gap present in the analyzed company that prevent the development of skills for HR figures.

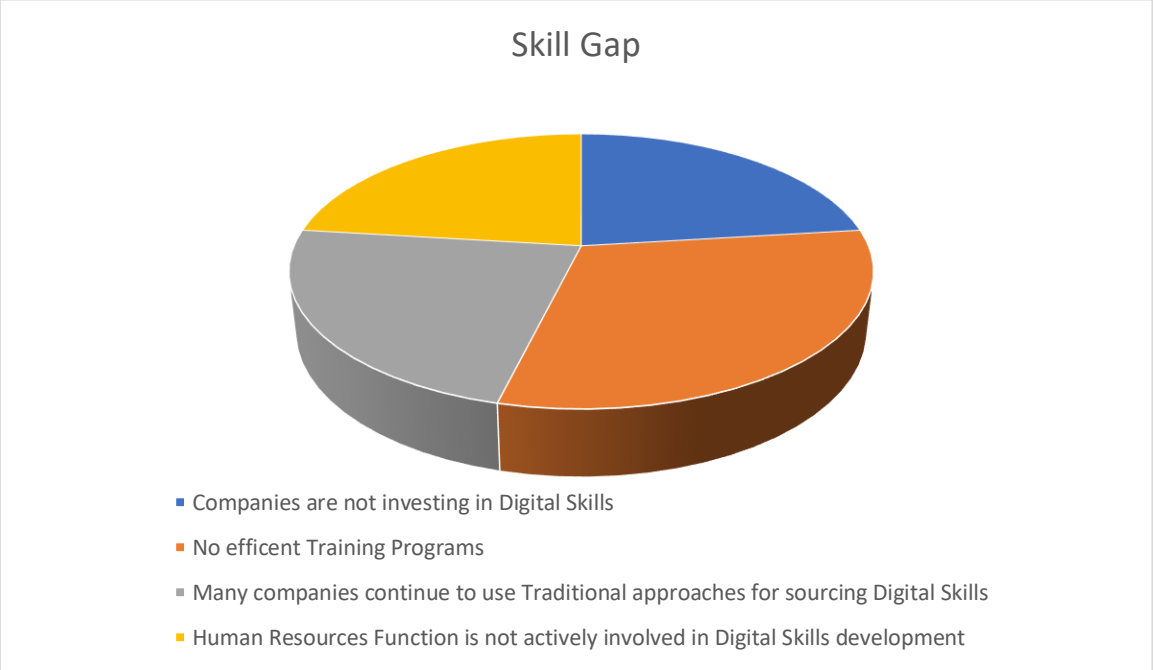

Figure19: Source; My Elaboration, Skill Gap

In this way, having reached a strategic conclusion on the results of the data analysis carried out on the BMC company, the advent of the fourth industrial revolution and the set of innovative principles that it brings with it seems to date has not generated a level of evident change. given the lack of knowledge of the principles of the plan and the lack of inclination to invest in these in order to make them known and apply them on the agenda. At the same time the mentality of the leaders is open to change and believes that the contribution of these principles are beneficial and progress also in economic terms for the company.

It is essential to focus on the need to start a long-term, continuous and connected investment campaign in order to make the plan in question possible and profitable.

Conclusion

During my work we have been able to understand that the true Revolution 4.0 does not consist in introducing only technologically advanced machines, but knowing how to combine the different technologies, making them intrinsic in the new concept of "Factory"and above all let them interact with each other, to create a connected system in which machines, people and information systems are able to work together to create products, services, work environments, customized, smarter and cost-efficient.

The new technologies, as we have seen in the consultation of the BCG paper, are nine and are already available for the population and companies wishing to make use of them. The gap that companies have to fill in order to exploit the benefits of these are many.

These new technologies will have impacts on:

- the power in the use of data and the increase in connectivity;

-the value that comes from the data that, as we saw in McKinsey's report, is less than 1% for companies;

- machine / human substitution and their interaction

What will come out of all this? A loss of jobs or rather than an opportunity for the "new worker"?

The human capital of every Italian company, to date does not have adequate skills for new production processes. The figure of the worker and the company organization itself must be completely reinvented.

The new worker figure will have to be lean, creative, able to adapt to more than one reality at the same time or to several companies; also, the organization of the work will have to follow different schemes.

The digitization of work will require continuous digital training, a review of tasks, roles and responsibilities within the company. Also, the managerial figures will undergo modifications, as well as the distinctions at company organizational level (managers, middle managers, employees, workers). A working class will be needed with more distinctly transversal and widespread skills.

New professional figures will be born who have no connection with the old traditional factory concept. These are the new forms of work that arise from the development of the Internet and platforms, such as Amazon, Airbnb, Uber. These companies are characterized by a strong global competition that surpasses all those certainties in terms of job stability, security and protection, acquired in our decades of union history. The logical thread that will unite all the new professions is the need to have high computer skills. And hence the gap between the skills required by new companies and those owned by workers. The problem is not the lack of training, but rather than the need to train the worker starting from the school age, and in a constant way, directing the training towards interdisciplinary study paths and adapting the contents to the needs expressed by the new working contexts.

The same objective must be placed for workers already within the companies, whose training must provide for the requalification of skills, in order to update knowledge in real time.

So, we asked ourselves if the work of the future will foresee more and more substitutions between man and machine.

''The creation of artificial intelligences increasingly connected and more and more able to operate autonomously, will never succeed in substituting man because the mental capacity of a person will always be difficult to replicate because it exploits a wide range of sensory data to stimulate one's reasoning skills to react to the various situations in which one can find oneself "(Pfeiffer, 2016)[189]: in a word, experience.

[189] R.Gray, How Automation will affect you – the expert's view, 2017, http://www.bbc.com

The robot can't work unless it is set by an experienced worker, so we do not talk about replacing man/ robot, rather than tiling, in which man will always be the one who designs and realizes.

The new worker will therefore be less and less tied to repetitive tasks and equipped, through training, with increasingly transversal skills, to be able to solve problems as they arise.

In this scenario we have also analyzed the fundamental role of the Italian Government, with the implementation of the Calenda Plan to support companies in the implementation of new technologies and preserving the workforce.

Further the set of information obtained thanks to the interview to dr. Bergami, CEO of BMC company, allowed me to expand the field of analysis. Also, in this case we find that the company applies, at this stage, the 4.0 principles with a reduced propensity compared to actual capacities. Workers at the moment do not fear replacing their activities given the inclusion of digitization. Robots are not a threat. But only because there is still no perception of a real change. This will happen when the investments will be made in a constant and lasting way over time so that the result can be implemented and solidified in the processes. So, 4.0 is a feasible change that requires the company to create new synergies across the entire value chain from the vertical and horizontal point of view, the need to reorganize the organizational structure, but even more, an element fundamental to the success of change, the development of a new managerial culture that starts at the top and spreads throughout the entire company pyramid.

Valuing Human Capital is a concept already heard and already discussed, but never as in the case of Revolution 4.0 is of fundamental importance if we want this to be seen as a challenge, an opportunity for productivity but also for the worker, and not as a spectrum that can lead to job losses and tensions.

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