POLITECNICO
DI TORINO

Master's Degree in Engineering and Management

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Industry 4.0 as an opportunity for small and medium enterprises to join the digital transition.

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Academic year 2018/2019

“To those who think that all this sounds like science fiction, we point out that yesterday's science fiction is today's fact. The Industrial Revolution has radically altered man's environment and way of life, and it is only to be expected that as technology is increasingly applied to the human body and mind, man himself will be altered as radically as his environment and way of life have been.”

Theodore Kaczynski, Industrial Society and Its Future "Control of Human Behavior”.

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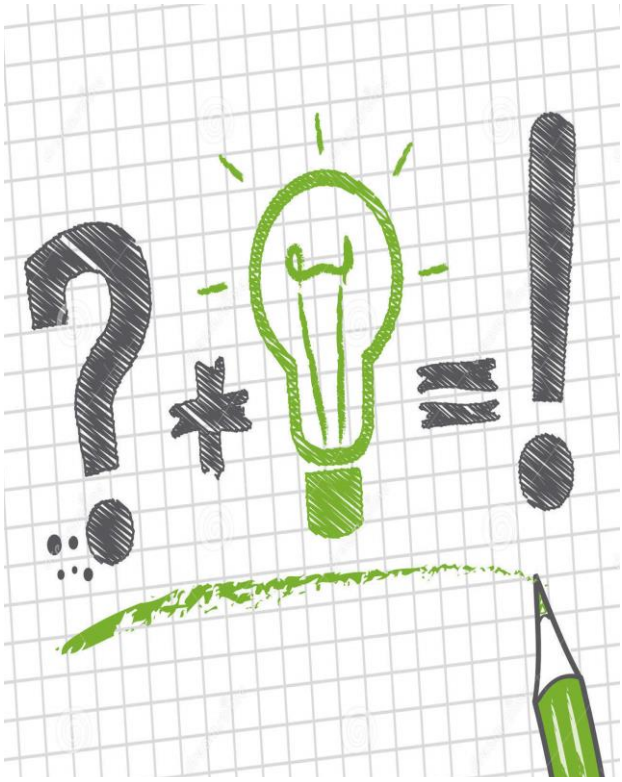
Abstract.

Joining the Fourth Industrial Revolution is possible and necessary for all companies- large, medium and small; because it means more productivity, less costs and increased efficiency in the processes and results. In addition, it is vital to improve the working and social welfare conditions of workers. If you want to be competitive in the immediate future, the key is to join on the era of digital transformation.

At the beginning of the document, the reader will be introduced to the concept of Industry 4.0, then, will be taken through a background of each industrial revolution, extracting the main opportunities that at the moment were taken for the enterprises which decided to join the transition.

Once arrived in the Fourth Industrial Revolution, the main pillars and fundaments of this new era will be described, along with its advantages/disadvantages, problematics and challenges. Two big companies from different markets will be analyzed to explore and understand the opportunities this new era brings for those SMEs who are willing to join the transition aiming to achieve competitive advantage over its competitors.

Afterward, two innovative Italian startups that have introduced pioneers products to the market applying in new ways some of the main pillars of the Industry 4.0 will be described and the reader will be able to understand the opportunities these two Startups are aiming to get from the digital transformation the worldwide industry is now facing.



1.

PROBLEM STATEMENT

1. Problem Statement.

Is it possible for small and medium enterprises to exploit advantages of being part of the technological transition the fourth industrial revolution is bringing?

The dilemma arises from the companies need to optimize production processes without necessarily incurring in excessive costs for their implementation. Meaning, improving quality, production times, decrease costs, improving prices, productivity, etc.

It is also intended to expose specific cases and demonstrate the benefits that would be obtained from the implementation of some of the technologies of this industrial transformation, such as IoT, AI, process automation, big data, cloud computing, etc. compared with the current situation or other alternative procedures that could be carried out by these companies to optimize their processes.

How to do it?

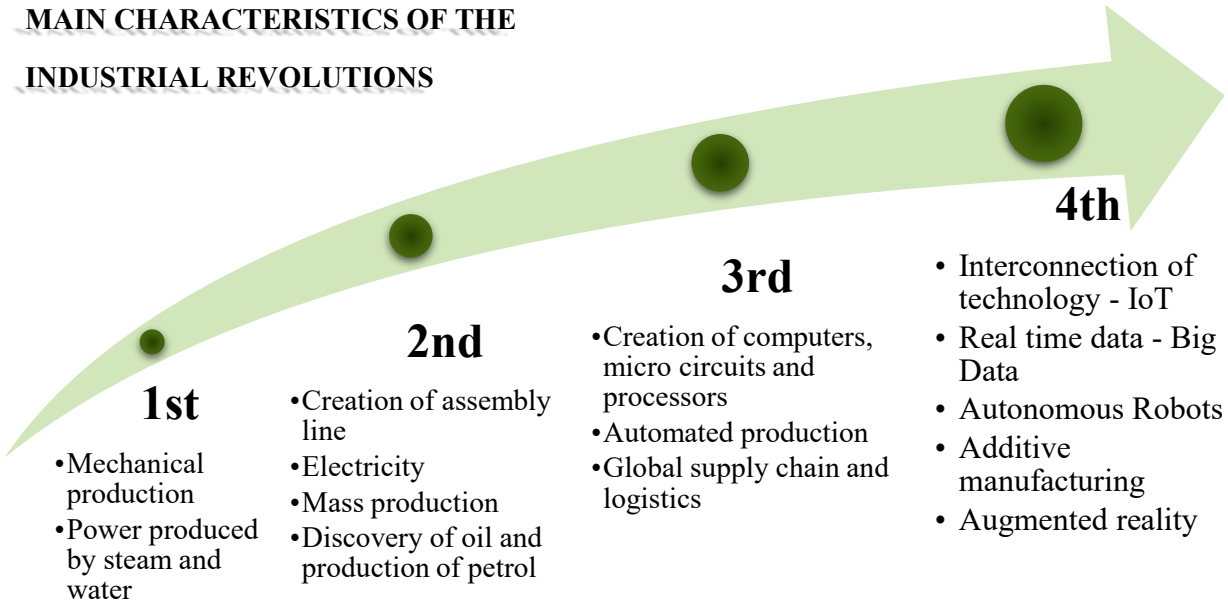
The idea is to develop a research of the current situation of two Italian small enterprises -Cases C and D- taking as an example the level of industrial transformation of two international companies -Cases A and B- and then confront it with the fourth industrial revolution, exposing also the potential opportunities for SMEs to get into the new industrial era and its benefits by implementing some of the pillars of the Industry 4.0.

2.

INTRODUCTION

2. Introduction.

There is no other certainty than the one which leads us to realize the changes that the society has suffer through time, because the reality that keeps pushing forward transforming human thinking turns out to be fleeting; what was thought as known, brings new doubts demanding to be solved in an automated approach. Automation and systematization had as main goal that every single daily activity should follow a logic step by step method at the lower possible risk allowing to obtain and transform the raw materials needed for such production, transportation and commercialization. From this moment, begins the human need to evolve, explore its desires to transform thoughts into interactive systems to adjust its routines, giving a twist to its unconformities.



"El final del Siglo XX trae una nueva transformación. El despliegue de la electrónica y la informática en los procesos industriales permitió automatizar las líneas de producción y que las máquinas reemplazaran a las personas en tareas repetitivas." [The end of the XX century brought a new transformation. The deployment of the electronic and computer science in the industrial processes allowed to automatize the production lines and the machines to replace people in repetitive activities.] (del Val Roman,2016, p.3)

In this way, emerged the interest from the individual to improve its quality life through adaptation, thinking on the necessity that the daily activities focused to the production and trading of goods, should take less effort and time leading to mechanize and systemize the procedures.

At the beginning men were interested on introducing equipment to help the daily development of such activities; afterwards, expanding its level of investment and execution by producing and developing more tasks and using better equipment that provide more accurate results, from that point the economic activities and the dynamic participation of the industry apply on its teams, methods for the reception and transformation of data through electronic and computer science to achieve what it is known nowadays as Industry 4.0.

This concept emerged in Germany in 2011, referring to an economic governmental policy based in high-tech strategies; characterized for the automation, process digitalization and usage of electronic technologies and manufacturing data.

That is how the emerged cyber-physic systems (CPS) that for Fernández and Perez (2014) are defined as “un campo que aúna conocimientos de diversas ingenierías: industriales, telecomunicaciones e informática, entre otras, y de diversas disciplinas: psicología, sociología, economía y teorías de la decisión.” [a field which gathers a wide range of engineering fields like industrial, telecommunications, computer science, and from disciplines like psychology, sociology, economy and game theories] (p.101). that nowadays became into the fourth industrial revolution, leading intercorrelated and qualified systems to the interaction society.

In the same way Cortés (2017) states: That the Industry 4.0 represents an approach towards innovation of new products and processes, through smart factories fully integrated in working networks along the value chain, enhancing new methods of cooperation and social infrastructure (p.5)

““La cadena de valor es un instrumento y modelo teórico que permite describir el desarrollo de las actividades de una organización empresarial para generar valor al cliente final.” [The value chain is an instrument and theoretical model which describes

the way a company develop its daily activities to generate the value on the products to the final client] (Vergiú, 2013, p.18)

Thus, the fourth Industrial Revolution appears as a provider of organizational activities leading to a competitive advantage, stablishing the technology as organizational growth tool that has as main goal to improve the way a company is managed. Production makes a shift, turning into an essential factor for commercialization but the objective to supply needs at its fullness becomes a challenge for small and medium corporations.

Traders extended their level of investment for the execution of the mass production scale and the implementation of more accurate equipment; consequently, economic activities and an active participation from the industry will care not only about higher production rates but also in fulfilling a wider range of customer requirements with its products and services.

At the end, the whole new range of tools and equipment that were adopted were not enough to achieve all their ambitions, neither to adjust nor handle the variable market; therefore, enterprises decided to integrate the new equipment with intelligent systems to improve the reception and analysis of data. It will strengthen the agility in developing processes, giving the initial step to the integration computer science and electronic systems, what we know nowadays as Industry 4.0.

Once they understood the business growth level that could be achieved, new concepts came up playing a new role in the system. Strategies and policies of organizational expansion, market trends, customer requirements that were welling to acquire a product or service, led to renew and reinvent the whole workflow and processes of the corporations.

Marketing, outsourcing, bench marketing, among other strategies and tools of the modern administration adjusted to the technology trends were mandatory and repetitive activities to supply the demand became to be handled automatically by a machine that processed information through data bases and operative systems which identified and prioritized the required modifications in the product features to make them offer a better service.

Technology is no more than a system with a commercial and productive strategy used by enterprises to fulfill the needs or requirements, services or products as faster as possible to their potential users, customers, suppliers, stockholders, and all stakeholders.

The process is defined by Pulido Porras as “el arte de ver, averiguar y especialmente reconocer conexiones entre las entidades observadas mediante la cibernética, la hermenéutica y el constructivismo” [Art of seeing, researching and recognizing the corelations between all parties through cybernetic, hermeneutic and constructivism] (p.4) then are linked with electronical, mechanical and communicative systems giving them a common sense and order so the role in society of human being can be regulated.

Cybernetwork for Pulido Porras (2011) is “la ciencia que se ocupa de los sistemas de control y de comunicación en las personas y en las máquinas, estudiando y aprovechando todos sus aspectos y mecanismos comunes” [science in charge of control and communication systems in individuals and machines, studying and taking advantage of the mecanins and characteristics shared.] (p.6); analysis of the interaction between man and machine.

On the other hand, hermeneutic for Pulido Porras (2001) is “hace referencia directa a lenguaje o al descifrar e interpretar un mensaje; quien determina el sentido de la comunicación no es el emisor sino el receptor” [makes reference directly to language and to decrypt and interpretate the messag; the one who determines the sense of the message is not the emitter but the recipient] (p.7), in other words, the act of communicating a message, needs to be well explained, ordered and expressed but first and foremost well understood, because since the recipient is who receives the message, has the faculty to dispose its perception, which could lead to misunderstandings and confusions during the exchange of information.

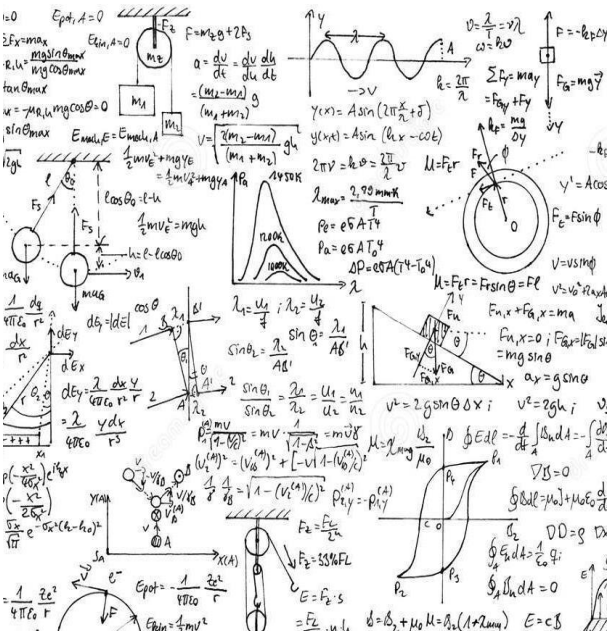
Finally, constructivism is defined as “un conjunto de elaboraciones teóricas, concepciones, interpretaciones y prácticas que junto con poseer un cierto acuerdo entre sí, poseen también una gama de perspectivas, interpretaciones y prácticas

bastante diversas y que hacen difícil el considerarlas como una sola" (Pulido Porras, 2011,p.9) [set of theories, conceptions, interpretations, and practices that beside being coreleated to each other, are quitely different making them hard to be considered as one.].

Nowadays, the dispute for marketing positioning between hundreds of thousands of enterprises working in different sectors of the economy, causing a constant war in the business world seeking to achieve more power and convincement than its rivals.

Strategic planning is a tool that executives and companies use to assure its resources to be used managed in the most efficient and optimal way se they can contribute to the business plan.

Contemplating that Industry 4.0 is led by massive data storage and the advance use of technologic tools and equipment, is binding to understand a few concepts that this new generation has brought. In order to do so, corporations must design their strategies in a very clear and competitive approach so they can somehow measure the effectiveness of their plan to improve it with the future decisions, always aiming to generate more value to its business.



3. Theoretical Framework

3. Theoretical Framework.

3.1 Small and Medium Enterprises (SMEs)

According to the European commission an enterprise is an entity which exerts an economic activity, independent to its legal form. Therefore, to be autonomous, professional or a trader organization it is not going to be a factor in the classification of SMEs.

There are three main criteria to determine the kind of enterprise, which are the number of workers, the turnover and the accountable balance sheet. The limits are determined as is shown in the following table:

Company category	**Staff headcount**	**Turnover**	or	**Balance sheet total**
Medium-sized	< 250	≤ € 50 m		≤ € 43 m
Small	< 50	≤ € 10 m		≤ € 10 m
Micro	< 10	≤ € 2 m		≤ € 2 m

Table 1, SMEs classification

3.1.1 Importance.

Small business has provided one of the best alternatives for economic independence; it can said that this type of enterprise has been a great opportunity, through which disadvantaged groups of population have been able to start up and consolidate themselves on their own merits.

The importance of small and medium-sized enterprises lies in their ability to generate jobs and in its ability to adapt to sectors that need to be promoted within a program that takes into account balanced geographical development.

3.1.2 Problematic of SMEs.

One of the main problems encountered by SMEs when they try to implement the technologies that belong to the fourth industrial revolution relies in being able to identify where they are at in terms of maturity of the technology used in the company. Since most of the maturity models available are made thinking about big companies and not in the interest of small and medium enterprises, they usually struggle interpreting the results that they obtain from the other models. Maturity models are becoming fundamental for companies for self-assessment and benchmarking with other companies. Nevertheless, researching on Industry 4.0 in SMEs has highlighted the difficulties encountered in the transition towards Industry 4.0 and some concern in using tools designed for bigger companies, for example: the fact that current tools developed for bigger corporations are difficult for SMEs to interpret, and specially that SMEs implementing Industry 4.0 are often “Industry 2.0” companies or moving between 2.0 and 3.0

While it is true that SMEs employ a significant share of the economically active population in the manufacturing sector, their contribution to added value and exports is minimal. Many of them owe their existence precisely to the fact that there is no possibility of obtaining paid work in other activities, so the number of SMEs is growing in times of crisis.

This is an essential difference compared to the industrialized countries and the big exporters like Asia, where the founders of the company, almost without exception, have specific know-how in technology and/or business administration and do not establish themselves without identifying promising opportunities on the market.

3.1.3 Hurdles for SMEs.

The problems of SMEs differ in intensity by the size of each enterprise and where it is located. This is indicating that there are certain problems that have to do with more structural aspects of company size and there are others that are more related to the global environment.

The first problem that can be mentioned relates to limited demand and competitiveness, representing a clear manifestation of the strengthening of competition for this area. Limited demand is pointed as one of the main problems, appearing in some European regions affecting smaller companies the most. Moreover, excessive competition, rise production costs and decrease profits. In the case of developing countries with a poor income distribution and unemployment or underemployment; poor articulation production or low density of the national productive fabric and low insertion into external markets; in addition to the high presence of informal companies, competition between them is higher and occur unfairly in small markets. In addition, the opening of their economies with a growing flow of imports from bigger markets like Asian where the production cost is quite smaller, it intensifies the situation. Poor income distribution affects to a large amount to the entire non-tradable sector closely related to micro and small business. In the EU probably the limited demand has to do with the trend that carries the dynamism of the occupation and wages, the investment process and the deepening of the export process. The SMEs are closely linked to the investment process like metallurgy and construction sectors in the EU itself and the export process too. Perhaps more intensive efforts are needed to achieve an expansion of markets beyond the borders of the community market itself.

3.1.4 Advantages and Disadvantages.

Big companies have the advantage of a greater saving on the overheads, of a better productive organization, of a less waste of raw materials and of time because more than one shift can be used. They similarly can become better known on the market because they can support expensive advertising campaigns. Also, can organize study offices and experimental departments which allow them to achieve significant internal savings, resulting in lower production costs.

On the other hand, the small enterprises have the advantage of the unit of direction, which leads to a greater caution and care in every phase of the job; the final product or service is technically more attention into details. Small enterprises also have the phenomenon of improved individual performance compared with the better overall performance of large enterprises due to more efficient production tools. SMEs also

maintain a great flexibility so that they easily adapt to the size of the market, increasing or reducing their offer when necessary.

Regarding the disadvantages, they maintain high operating costs, and do not reinvest profits to improve equipment and production techniques. They do not hire skilled and trained personnel because they cannot afford high salaries, also the quality of production is not always the best, often poor because quality controls are minimal or non-existent. Those are the main reason for which achieving a level of an Industry 4.0 is so difficult for SMEs.

3.2 Key pieces for the foundation of the Industry 4.0

3.2.1 Simulation.

Process which requires putting together a virtual model on which a computer calculates the most probable scenarios and then get the most likely results of a specific situation, through the consideration of different economic, political, geographical, demographic and, in general, each element that could contribute or participate during the manufacturing of a product or service.

Industrial organizations typically do not employ this powerful methodology for the next stage of the value chain: manufacturing the product. As a result, organizations lose opportunities to study the behavior of their manufacturing processes and systems before they are implemented. Since commissioning of new manufacturing facilities, production lines, and processes is often costly and capital intensive, applying simulation methods to manufacturing can offer enormous benefits, including:

- Identifying manufacturing bottlenecks as well as opportunities to increase productivity.
- Recognizing opportunities for cost savings such as optimization of direct and indirect labor.
- Validating the expected performance of new or existing production facilities or value chains

Figure 1, Plant simulation software

3.2.2 Augmented and Virtual Reality.

Through a software it is possible to build digital realities you can interact with. There are two realities: virtual reality and augmented reality. Both systems combine elements of a real environment with virtual elements to create a mixed reality you can interact with in real time. In the case of augmented reality, it allows digital information to overlay on the real image, in the industrial environment it is used to reduce training times and facilitate complex maintenance tasks, knowing where the safe exit is in the event of an emergency and thereby reduce work hazards.

Says Pablo Coca Valdés "… permite vincular los diversos mundos que en el concepto de industria 4.0 están siempre presentes que es el mundo virtual, el mundo digital y el mundo real… tiene múltiples aplicaciones en aspectos como seguridad industrial, control y monitorización de procesos" […allows to link the various worlds that in the concept of industry 4.0 are always present which is the virtual world, the digital world and the real world…] [1]

[1] Industry 4.0 Virtual Reality and Augmented Reality, Source: www.nodocast.com

Virtual reality digitally generates an environment which completely replaces physical reality, allowing the worker to interact naturally with a virtual environment, simulation is the main advantage of this technology as it allows you to design environments that are experienced as reality. It facilitates worker's learning processes, as well as reduces product development costs. Says Pablo Coca Valdés "… nos acerca a esa posibilidad de tener la fabrica digital, que en ultimo termino consiste en poder experimentar y probar cambios en el proceso productivo y productos experimentando en el mundo virtual que tiene unos costos infinitamente menores a comparación hacerlo en un entorno real" [… brings us closer to that possibility of having the digital factory, which ultimately consists of being able to experience and test changes in the production process and products by experimenting in the virtual world which has infinitely lower costs compared to doing so in a real environment.] [2]

Summing up, the three main reasons for which augmented and virtual reality optimize manufacturing processes are:

1. Improves efficiency of manual assemblies: It offers the user a clear step-by-step instruction provided for manual assembly processes on production lines, as well as remote support to boost productivity and reduce possible errors.

2. Accelerates training: Facilitates the transmission of knowledge from experts to new employees through interactive 3D information.

3. Reduces costs: Provides a better clarity of manufacturing processes by integrating information and allowing quick sections for troubleshooting, also allows to anticipate potential problems before they happen.

[2] Industry 4.0 Virtual Reality and Augmented Reality, Source: www.nodocast.com

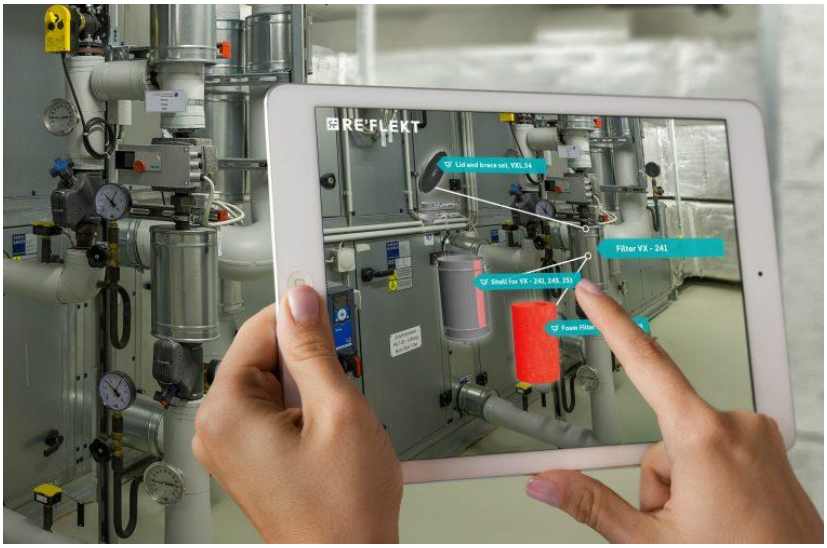


Figure 2, Augmented reality in a factory

3.2.3 The Cloud.

Cloud computing allows to store, modify, process data and run programs anywhere just by being connected to internet from an electronic device, is a way to get on-demand computing services. There is no need to invest on data storage structure, which saves companies plenty money and allows data to be used at any time and place. This great store of data called servers, have been used for many years, and today at least in all work office is found, as for example in emails.

Its economic benefit is based on economies of scale, by optimizing the use of existing servers around the world allows to make better use of its capacity and to offer services on demand. “una empresa promedio de 45 empleados puede ahorrar 67% de costos en TICs por migrar a la nube” [An average company of 45 employees can save 67% of ICT costs by migrating to the cloud] [3] assessed IMCO -The Mexican Institute for Competitiveness A.C.-.The savings in technology costs allow a greater opening of companies, since entrepreneurs should not invest in such equipment. In addition, the cloud contributes to the preservation of the environment by reducing global energy consumption and thus carbon emissions.

[3] IMCO, source: https://imco.org.mx/resultados/? cs=&t%5B%5D=investigacion&order_by=date_desc

The concept of cloud computing refers to almost all the services that a provider can offer over the internet regardless of its geographic location. It transforms the traditional manufacturing business. The flow of information between workers, suppliers, distributors and customers, involves the use of different tools, which increases the time needed to complete different tasks. Cloud manufacturing facilitates a more agile and real-time interaction between people involved in the chain value of the company.

3.2.4 Internet of Things – IoT.

It refers to the transformation of the relations between objects and people and even between objects themselves, connecting them globally, offering a more efficient service. This is achieved by empowering objects that were previously connected by a closed circuit, now do it globally via the internet and sharing data through the cloud.

To define it, could be analyzed dividing it into its two components:

- Internet: Allows computing equipment to be interconnected enable them to access to resources, services and websites anywhere in the world.

- Things: Physical objects or devices of daily life, such as a car, washing machine, cell phone. Integrating circuits, sensors and connectivity that allow them to collect and exchange data between themselves or through the internet.

These intelligent devices have the following functions:

- To monitor: Through the integration of several sensors people will be able to know what is happening around the intelligent device, for example identifying speed, temperature, among others.

- To control: From checking they would be able to take an action, or example to turn on/off a light, open or close a door.

- To optimize: From the monitoring and analysis of the information they have collected, they could know how to use the resources when required.

- To automize: Facilitating and reprogramming activities considered a routine.

3.2.5 Big Data.

The term big data refers to quantities of data with such a level of volume and complexity that cannot be processed by conventional software, since its beginnings the characteristics of big data have been defined around the denominated 3 Vs:

1. Volume of data.

2. Speed with which these are received, processed and the decisions made from them.

3. Diversity of sources from which the data comes.

Unlike conventional systems that used structured data sources, such as databases in a format prepared for processing, big data obtains data from numerous sources, including both structured data and unstructured, these data are processed, organized and stored, but instead of being loaded into a single source they are done in a distributed way, so large data can be divided and distributed among several processors, while structured data search and analysis is performed at a higher speed.

To address the analysis of all the information, big data uses algorithm-based logic and can employ different divisions of artificial intelligence, as well as predictive and prescriptive models, finally brings the value of the analyzed data in behaved patterns, purchase predictions, or identification of new business opportunities, among many others.

The ability to analyze data at the rate world is producing information, has made big data an indispensable medium for governments and companies, and its benefits are already being applied in multiple sectors, such as optimizing traffic management in cities by knowing the most common behavior of drivers, on marketing and sales, being able to predict beforehand what consumer’s tastes and needs are, and how they are evolving, in politics by publicizing citizen’s concerns and trying to predict the impact on public opinion of political decisions, or on science and health by allowing advances such as helping decoding DNA chains.

3.2.6 Additive Manufacturing and 3D printing.

The American Society for Testing and Materials (ASTM) defines it as “a process of joining materials to make objects from 3D models data, usually layer upon layer, as opposed to subtractive manufacturing methodologies” [4]

Prior to the implementation of 3D printing, other techniques were used to obtain an object such as subtraction, bending, smelting or molding materials, they were effective but expensive and produced a large amount of waste that polluted the environment.

In 1984 Chuck Hull invented stereolithography, patenting the first 3D printing method which allows solid objects to be made by printing consecutive thin layers of material. Years later, 3D injection printing is invented, allowing costs to be reduced.

In order to guide the printer, a 3D model of the object, obtained through design models or 3D scanner, is then sent to the printer, which overlays thin layers of adhering material to create the model. Its main features are:

• No waste produced.

• Faster prototyping.

• Low production costs.

Figure 3, 3D printer

[4] Additive Manufacturing, ASTM, source: https://www.astm.org/industry/additive-manufacturing-overview.html

3.2.7 Autonomous robots.

It is the usage of computer and electromechanical systems or elements to control machinery and industrial processes, minimizing human intervention in the most repetitive, dangerous or demanding tasks. Automated robots incorporate sensors and controllers that execute the orders of the devices by measuring variables such as temperature, position, pressure, etc; thanks to the implementation of the IoT which allows robots to operate smoothly and controlling the status of the process the whole time thanks to real-time data analysis.

In addition, after analyzing historical data and actions taken on problems presented in the past, allows machines to learn from it and take decisions before a problem occurs, thus avoiding accident risks, losing money and being able to carry out maintenance processes on their own at the right time. These collaborative robots use lower speed and forces, they have incorporated proximity and touch sensors, allow employees to work together with robots at the same space, without risk of injuries or accidents.

All the collected data is processed and displayed through Human Machine Interface - HMI- the old panels are now tables, laptops offering more services, being able to work in extreme conditions of humidity, temperature, dust, among others.

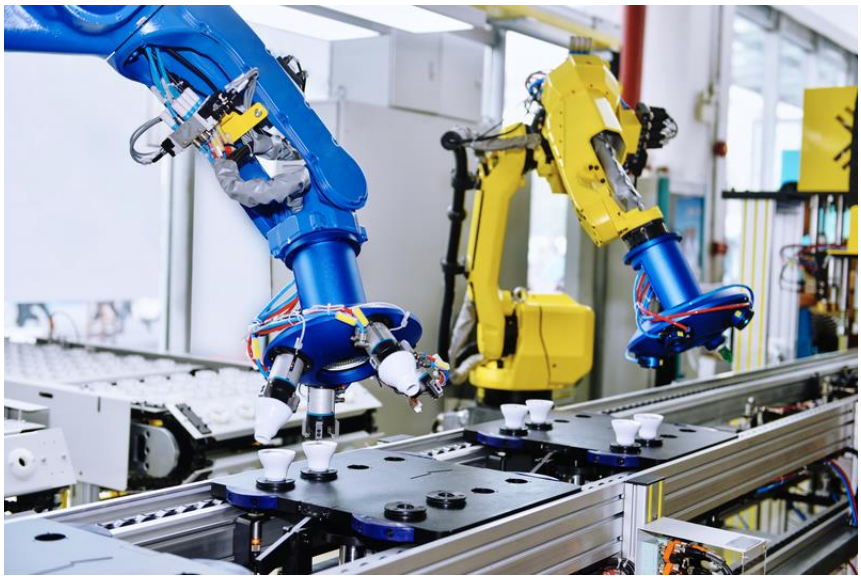


Figure 4, robotic arm in production line

Figure 5, logistics robot used in warehouses to control stock of products and transport small objects or messages.

3.2.8 Cybersecurity.

According to Garfinkel and Spafford which tells us that "a computer is secure if you can depend on it and its software to behave as you expect" [5]. Hence, when using a website is important to ensure that the personal information used on it will not be trackable or used by another person.

The following requirements are attributed when talking about security:

1. Confidentiality: Keeping information accessible only to users who wish to consult it.

2. Integrity: Ensuring consistency of information, guarantee that only authorized people can modify it and only by certain patterns that assure consistency.

3. Availability: Focus on the system being able to continue providing its services under any circumstances.

4. Authentication: Ability of the system to authenticate an user, to confirm the identity of the person who is using the services of the device.

5. Responsibility: The system is able to confirm if a certain entity or person has been the one who performed a certain action with any other entity of the system.

6. Auditability: Allows users to know which operations have been performed with a certain entity.

7. Privacy: Right of individuals to be able to decide what, when, and to whom private information is going to be share.

[5] Cyber security- Garfinkel and Spafford , source: http://www.albion.com/security/intro-4.html

3.3 Groundbreaking technologies.

3.3.1 Digital Twins.

"can be defined, fundamentally, as an evolving digital profile of the historical and current behavior of a physical object or process that helps to optimize business performance" (Parrot, 2017, p.3) it is a matter of digital processing which performs simulations and tests for production lines, it helps to reduce waste and downtime, allowing the creation of infinite copies of the digital product, making as much changes as required, and the best part of it, is that the whole process does not need to use real resources such as raw material, which reduces the expenses.

As an example, we have (ESMARTCITY.ES,2019) in Singapore. They project the city using real time data, but the main challenge of Digital Twin focuses on the lack of qualified staff to gather accurately the essential data needed to reproduce the idea in the most realistic way.

3.3.2 Servitization.

Model which offers additional services to the client in real time, "se refiere en su origen a la tendencia entre las empresas industriales a ir basando sus negocios de forma creciente en los servicios para así ganar competitividad" [it refers at its origin to the trend between the industrial companies to base its business increasingly in services gaining competitive advantage] (Kamp, 2016, p.77). For example, as it happens with printers, seller provide the machine, along with sensors indicating to the consumer the level of the toner , status of the cartridges, among others; with the purpose of being trustworthy keeping the good name of the seller company, it also eases the maintenance process by helping the client to prevent failures, identifying in advance the possible breakdowns.

2.2.3 Blockchain.

Is one of the most innovative technologies, specially known because it gave birth to the Bitcoin network, it has defined and materialized applications in many fields, obtaining a reliable assessment, all contributors must give permission before the system gets any modification. This technology along with artificial intelligence will allow machines to take autonomous decisions based in all possible scenarios.

3.4 Adoption of the Industry 4.0

3.4.1 Advantages

Is believed that the Industry 4.0 brought improvements in the timeline, production-line, trading which recognize the value of time, and reward its optimization.

Navarro y Sabalza (2016) postulate that among the advantages the Industry 4.0 offers "dar lugar a procesos más eficientes y con menores costes (con menores tiempos muertos, menor número de operaciones, menor consumo de materia primas y energía...)" [make way to more efficient processes with lower expenses (lower downtime, less operations and consuming a lower amount of raw materials and energy…)] (p.151)

It is recognizable that the markets are more discerning, and the Industry 4.0 challenges the traditional models by offering an approach of researching and developing a wider competitive advantage to meet the time requirements of the emerging conditions of the market, that each day is shifting from a centralized and meticulous production to a flexible and decentralized one.

Changes in consumerism trends force companies to adapt their production, stocking, and distribution strategies; inventories are being left behind due to the millionaire loses it could cause, obsolesce is the current destiny of the majority of products and services, these days consumers change their requirements and preferences almost weekly.

Therefore, technology allows to accelerate processes, optimize resources, and reduce expenses which at the end determine the prices that for the consumer and industry generate benefits.

3.4.2 Problematics

In the digital age it is becoming more likely that human unemployment starts becoming a standard, as machines will have the ability to do many tasks that people now do, workers will become less and less wanted, leading to an increase in the unemployment rate, wages will fall, causing people's well-being to decline, leading to social inequality.

Even though implementation of new technologies is an innovative approach to improve the development of tasks, could also have some disadvantages, for example, in the long run could reduce the demand of human skills in a factory. So instead of becoming a system that could replace the human roles in the industry, we should work along with it, developing capabilities and skills to take society to the optimal and balanced progress of the economy, aiming to improve the quality of life.

The market demands the renewal and adaptation of companies to the changing trends, preferences, needs and desires of the users; where the processes and procedures that allow the consumers to acquire reliable, high-quality and innovative products with timely deliveries, taking customers to new and incomparable sensations.

Hernández and López mention it as:

The use of Cyber-Physical Systems (CPS), Internet of Things (IoT), Big Data (BD), Cloud Manufacturing (CM), Augmented Reality (AR), Smart Factory (SF), and new business models that take into consideration the dynamic between the new technologies, workers, managers, suppliers and users.

3.4.3 Challenges.

Without any doubt, a turning point in the labor market emerged with each industrial revolution, because all careers are affected from it, and many activities are going to be replaced by new technologies, tools and/or machines. Hence, improving the worker's skills and capabilities is a huge challenge for enterprises, due to the lack of knowledge and interest in specialized sectors such as artificial intelligence, blockchain, data analysis, roboti, among others; thus, the big challenge for those companies willing to give the next step towards being part of the fourth generation of the industry is to develop a strategic plan based on a constant high skill training of its staff, aiming towards digital transformation of data and activities.

Certainly, nowadays to create and offer new goods and services, demands a high competitive and innovative mindset, where creating new necessities and consequently products or services to fulfill the new demand, adds more value to a company, standing out its business above the rest of competitors in the market.

3.5 Industry positioning: Overview

3.5.1 United States and Europe.

Although it is true, the United States represents one of the countries occupying one of the first places in the production of manufactures worldwide, it cannot be ignored that in the last decade between 2000 and 2009 the sector had a decrease of 25%; causing a loss that has benefited Asian countries mainly China. (Casalet, 2018, p.19).

This decrease is appreciable in activities relating to sectors like electronic machinery, machinery and equipment, a large part in motor vehicles and the development of rolled equipment. However, according to Casalet (2018) there are sectors that experienced significant growth, as is the case of the chemical and pharmaceutical industry.

Therefore, the United States government under the administration of the ex-president Obama sought to implement manufacturing strategies that would allow the loss to be recovered, the strategies deployed were:

Developing advanced manufacturing, understanding the way information, automation, computing, software, sensors and network operation, should be utilized, which made use of cutting-edge materials and emerging capabilities linked to physical sciences, biotechnology, nanotechnology, Chemistry and biology. (Casalet, 2018, p.19).

This strategy was led by the Implementation Office for the Advanced Manufacturing Programs, in collaboration with the industry and the academy, according to the PCAST, three goals were initially outlined:

1) Strengthen financial incentives to attract investment and retain firms by improving existing manufacturing.

2) Designing financial incentives to facilitate business investment in other states and expand firms within the territory.

3) Creating real support for SMEs to participate as suppliers of advanced manufacturing. PCAST (2011) cited by Casalet (2018, p.19-20).

For the United States, innovation depends heavily on the capacity of these companies; some of them do not possess sophisticated areas of research and development, and are located far from universities; The aim is to eliminate this gap in order to link enterprises with education and research, and in this way significant technological changes could be implemented among them.

Through the Federal Association Program for Manufacturing (MEP), USA seeks to go directly to the root of the problem described above in SMEs, and therefore, aim its efforts to provide technical assistance and thus contribute to the competitive development of US small and medium-sized enterprises (Casalet, 2018, p.21).

Several institutes of innovation, science and technology joined forces with the US government in order to be able to face the new revolution "Industry 4.0", was as well as according to Casalet (2018) in 2014 the initiative called "Manufacturing USA" was launched as:

The creation of an organizational structure of public-private support for the development of digitization in industry, the promotion of applied research and the design of new networks that facilitate information and competitiveness. (Casalet, 2018, p.21).

This initiative has been well received by the different actors among their government, business, educational centers, control agencies, among others, but a number of drawbacks on its implementation emerged, because there were great limitations on the inadequate qualification of the workforce, here we can highlight the importance of staff training and human skills, to be able to carry out activities involving a technological transformation within an organization.

On the other, hand there were great advances in legislation and was achieved at the end of 2016, some new private public support was integrated to the initiative seeking to expand the nation towards an advanced technology. Deloitte (2017); Manufacturing USA (2017) mentioned by Casalet (2018, p.25).

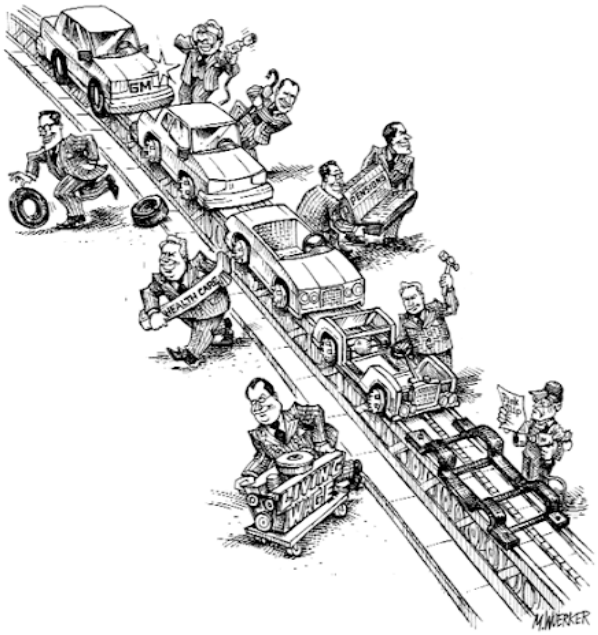
These organizations have a multidisciplinary vision that has allowed the USA to have an optimal scenario for companies to succeed in positioning themselves in advanced manufacturing making use of the technological revolution called "Industry 4.0".

On the other hand, the majority of countries belonging to Europe, have stood out for their technological advances, proposing to the world an urgent change in the operation of the industries, since it now involves not only digital tools but also the skills of professionals who are part of the organizations and later are responsible for managing intelligent operating systems and being at the forefront of technology.

The evolution of society has been so constant that requiring professionals with technological knowledge is vital for developed countries, software studies and the use of technologies is not a requirement for intra-company operation, but it is a necessity for every person and every professional to have these skills if they want to compete in today's demanding markets.

According with, Schroeder (2015). "Alemania, por el contrario, gracias a la modernización de su industria, ha pasado de ser el «enfermo de Europa» a convertirse en la economía europea más estable en la actualidad." [Germany, on the other hand, thanks to its modern industry, evolved from being the <sick from Europe> to become into the most stable economy] (p.4)

4.



CASES OF STUDY

4. Cases of study.

4.1 Case A.

4.1.1 Overview.

It is taken as an example one of the largest American companies, being a chemical company, focused on the processing and selling of chemicals, plastic materials, agricultural and other specialized products and services, aimed at combining the power of science, technology, innovation and human capital to constantly improve. This company offers a high range of products and services in some 175 countries and has more than 43,000 employees, reaching a turnover of 66 billion dollars per year. Bnamericas. (2019).

The Chief Operating Officer of the company, in 2018, said, that industry 4.0 is a fact, companies are facing a scenario full of technological advances, new challenges in terms of digitization, It is therefore important to make a paradigm shift, as the way in which company A produces and delivers solutions in a complex and competitive environment needs to be transformed immediately.

The company has focused mainly on robotic security, since 2012 they started using predictive models at the corporate level, these models allowed to estimate demand and performed more optimized operations, helping the company to analyze in real time its strategies for the supply of raw materials. At the same time they noticed that the daily operations of the company generated thousands and thousands of data that could become a high valuable idea; they foresaw failures in the machinery, and replace the machines before they fail or stop producing, all these benefits in the useful life of the assets can be extended, by significantly reducing operational costs and minimizing risks. These predictive methods result in the advance making of intelligent decisions, which generate a great benefit for both customers and the company, making the company guarantee focused on excellence and efficiency. Arrieta (2017) and Dow Mexico, (2018).

Company A was nominated in awards that recognize best practices in industrial innovation, new materials, solutions and 4.0 industry implementation to improve the

competitiveness and productiveness of the industrial factory, receiving the GMV Award for Best Entrepreneurship to meet the challenge of the 4.0 revolution in Industry in 2019; thus, recognizing the company's initiative in one of its plants in the field of robotics aimed for the safety. The jury valued the way in which this project managed to integrate human factor, preserve people's lives and contribute to the safety of their workers. Info PLC. (2019) (Spanish).

Figure 6 and 7,Equipment used for security tests, source: company A website. (2018).

4.1.2 Analysis.

For an enterprise as big as company A, in 2018 the fourth industrial revolution took it to be a world reference for its efficient and flexible production, it has been a company recognized with the internal prize "Best of the Best Cracker", it is because its strategy is based on 4 pillars: Safety of Workers and Facilities, Excellence of People, Operational Excellence, and the positive impact of Technology Centers of Innovation. (Company A website, 2018).

The last pillar has been fundamental for this company to be competitive in the world chemical market, thanks to their innovation and technology center they achieved the development of new products which led to a significantly increasing in sales. In 2019 they obtained 20.24% higher sales than their competitor 1, 40.11% more than the competitor 2, and 43.74% more than competitor 3, being the second leading company in the chemical industry market in the United States. (Seville, 2020).

For company A, their competitive advantage lies on "… an innovative operations strategy", since unlike its competence they implement several support technology platforms which provide the smart technology and real-time data needed to increase value generation and improve competitiveness through advanced robotics, artificial intelligence, smart sensors, cloud use, the Internet of things, analytics, smartphones and other mobile devices." [6]

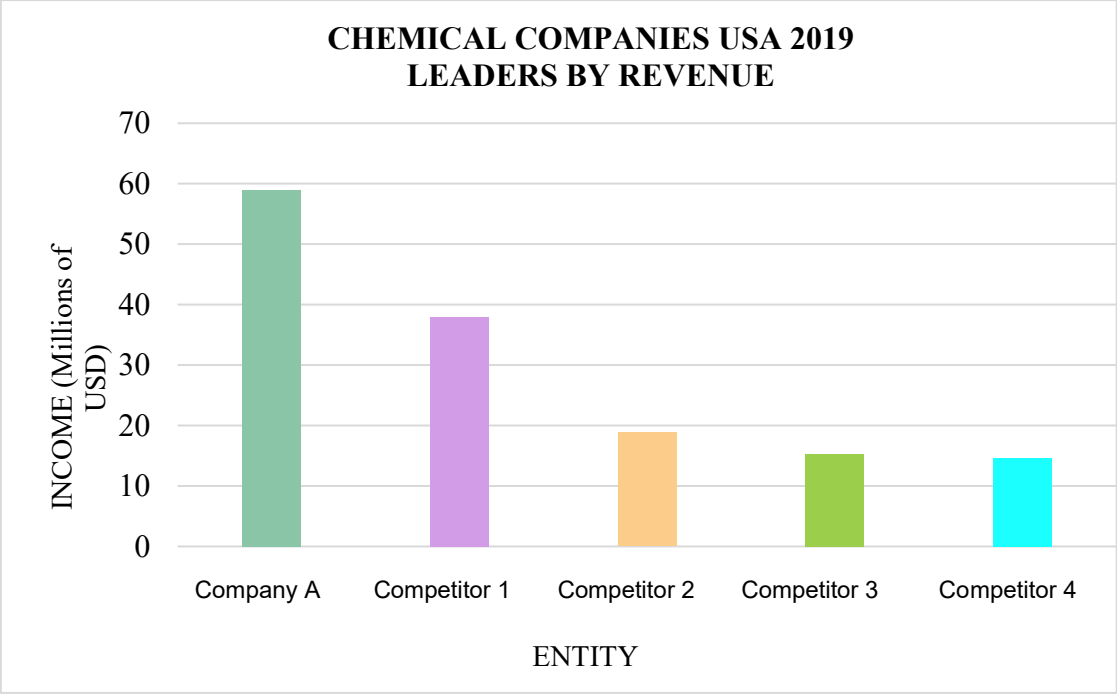


Table 2, developed using data from Public report Dow C. 2020

[6] Dow México. (2018). La manufactura 4.0 está transformando la manera de hacer negocios. Available at https://mx.dow.com/es-mx/noticias-y-medios/detail/la-manufactura-40-esta-transformando-la-manera-de-hacer-negocios-en-america-latina

4.2 Case B.

4.2.1 Overview.

Another of the most important American firms, was founded in 1937, initially manufactured machinery to work with land producing ploughs, later on, they start offering hydraulic power options, currently is a manufacturer of agricultural machinery, always managing high quality standards, also manufactures construction equipment, and maintenance; this company strives day by day to uphold the fundamental principles of the founder, which are based on Integrity, quality, commitment and innovation that they try to put on every product, service and opportunity they offer.

The company has introduced industry 4.0 to the farming market, taking advantage of the new technologies, currently these vehicles have incorporated meteorological sensors or crop tips, Duro (2017).

Company B is known as one of the leading companies in the 4.0 industry, in 2016 joined with the company IBM to develop the future's intelligent manufacturing, this is how a pilot test of cognitive maintenance is introduced in their production system, what they sought was the integration of cognitive maintenance, so if any manufacturing problems arise, the deep learning platform "watson" is introduced IBM comes into play. The methodology is as follows:

The worker takes a picture of his workspace, then artificial intelligence determines the possible causes of the system failure through an image recognition algorithm; only with a voice command to "Watson" in order to explain how it can be fixed, the system also has the ability to verify schedules and suggest the best time for maintenance. Tecnoplc (2016), in other words, after analyzing the performance of the system with many data bases, the software can use predictive maintenance to provide the customer warnings and suggestions regarding when the system should be checked.

In addition to that, it is important to highlight that the company bet on the acquisition and implementation of software for virtual manufacturing, which have the ability to quickly make manufacturing tests for the equipment in the production line, or analyzing processes the company have applied in the past or new proposals for current projects.

Analyzing the processes in anticipation allow to achieve:

• Higher quality and better designed parts and components.

• More efficient, secure and reliable processes.

• Investing less time at lower cost.

Thus, when new models or components of combine harvesters must be manufactured, a multi specialized group of designers, engineers, builders, among others, work together to simulate the manufacturing virtual process of combine harvesters. That is how both the design and the manufacture process of its components and the subsequent assembly of the machine are simulated in programs allowing to draw and replicate all types of movements in three dimensions.

This virtual manufacturing is achieved by using a 3D design software, created as a three-dimensional virtual world which works as if it was a real factory, allowing the production process to be more efficient, faster and cheaper. This technology eliminates the need for expensive product prototypes, manufacturing products with higher quality, lower amount of detects in designs by showing problems and bugs in real time. Artaban (2013) cited in Sahifa (2019).

The implementation of three-dimensional virtual world (3D) has become company B more competitive in the market, thanks to the fact that it was able to incorporate new technologies on its processes, opting for the virtualized production of their products. Without a doubt, it is a business model that focused on innovation and the technological

revolution 4.0, seeking new approaches and technologies to add more value to its production chain.

Figure 8 and 9,Source: Worldofmods (2017). Farming Simulator.

4.2.2 Analysis.

Company B managed to generate its competitive advantage in the market by becoming a "Smart Tech" company, providing accurate solutions, connecting machines, technology, people and intelligence, for greater efficiency and profitability. The high technology they use on their products is also built with their advanced systems for technical support, which radically changed the way issues are diagnosed and problem solved, positioning the company as a world leader in the American market.

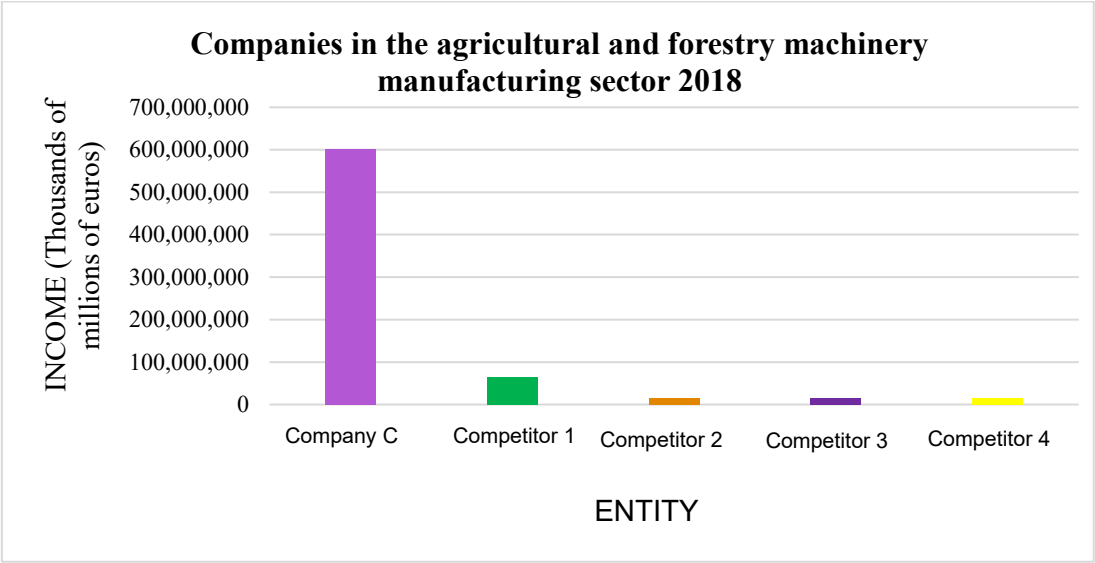


Table 3, realized with data from report D&B s.a.u. (s.m.e.), (2018).

A fundamental factor in this firm consists in managing to recognize the importance of technology for customers, always looking for the best solutions through artificial intelligence for their crops, -company B- focused on the use of GPS that allowed to accelerate the connectivity and optimization of machines. (Agroinformación, 2017).

Company B equipment -monitors and receivers- allowed a competitive advantage over competitors brands, by offering a wide variety of technological possibilities, precision levels and functionalities adapted to their agricultural operations needs; however, the use of 3D software has led company B to position itself as the second leading company in tractor production worldwide.

4.3 Case C.

4.3.1 Overview.

An Italian startup working in the Consumer Electronics Industry, well known for their smart writing robot which in words of the mind responsible behind the project CRA-Carlo Ratti Associati "… thanks to a special patented technology, can safely draw, cancel and re-draw new content an infinite number of times, allowing you to print a different image on your wall every day or even every few minutes. It can travel on every kind of vertical surface, from whiteboards to glass or plaster. Thus, any vertical surface can be transformed into a screen – a wonder wall where images, messages or feeds are projected." [7] in other words, a vertical plotter allowing customer to link their jobs, ideas or interests with art using a smart approach.

Launched during the summer of 2018, that through a crowdfunding worldwide campaign raising 1.6 million dollars to start production. Consequently, at the beginning of 2019 rewards for their 6.5 thousand backers began to be shipped from their factory, located in the capital city of Piedmont, Italy. Six months later, they started direct sales in US, Canada and Europe; raising up to now almost 2.5K purchases.

[7] Taken from https://carloratti.com/project/

Figure 10, Drawing smart robot of company C, source: company C website.

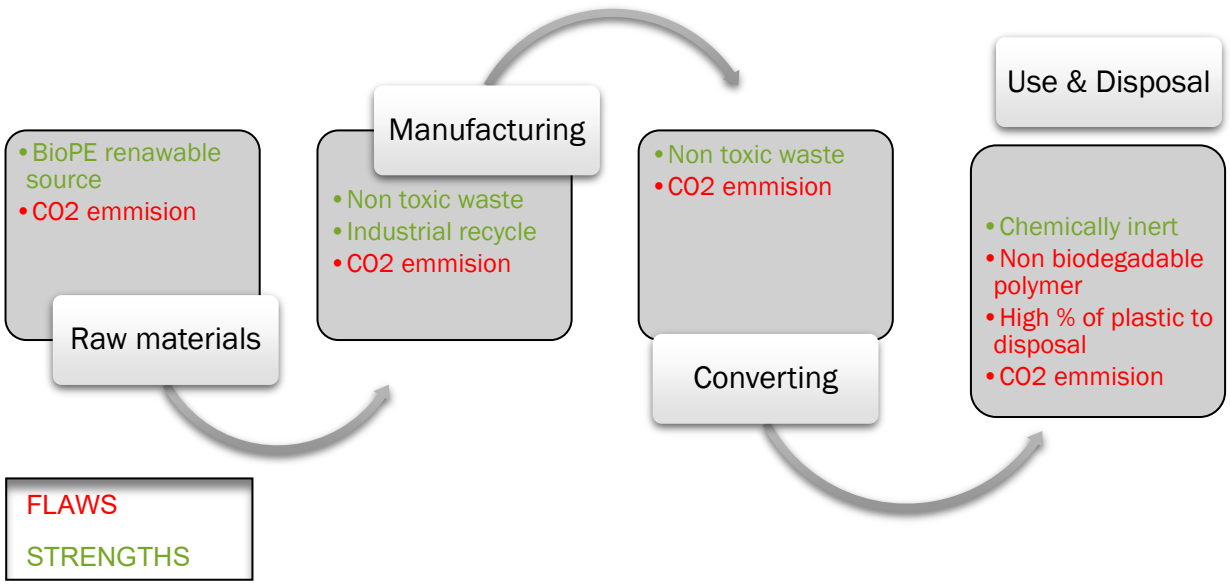
4.3.2 Analysis.

The whole team formed by almost 25 members, classified as a small enterprises has designed, produced, promoted, sold, shipped and assisted a product that due to the capability of being always connected to the web, the support team can internally run tests and updates to the software of the device, and in many cases also saving some time and money in sending back the product to the factory for checking and repairs, in a couple of minutes the team can get an internal analysis using the Industry 4.0 to understand if the system needs to be restarted, updated, among others.

The app maintains the device connected to the web, using the Internet of Things-IoT and using Cloud data analysis the team can evaluate performance data, to be used when taking re-engineering, marketing and production decisions.

Nevertheless, to what they are really aiming for is to take advantage of additive manufacturing, using 3D printing to give the first step in the transition of green manufacturing, reducing contamination and waste, replacing plastic for biodegradable materials to redesign their markers.

Lately they are researching new feasible Eco-Friendly technologies and approaches to re-think the way markers are manufactured and used, in order to reduce the quantity of plastic used. Their current situation qualifies as a linear plastic economy, working as follows:



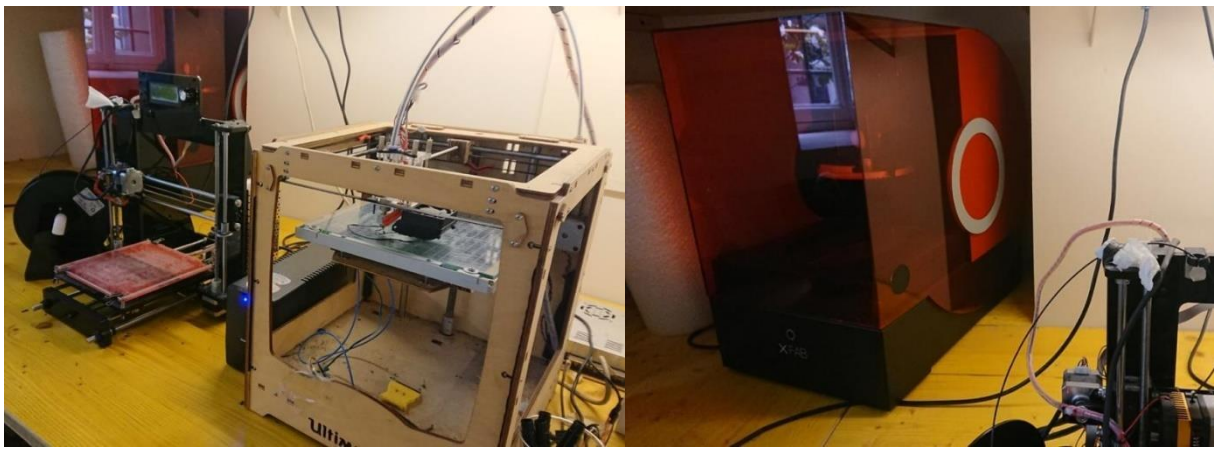


Figure 11 and 12, 3D printers Company C – Source: Company C Lab, Design, R&D Team

Figure 13, markers made of plastic – Source: Company C- website

Since the current material is not biodegradable, makes the markers to be disposable; therefore, it increases the amount of waste release into the environment, because the customer is not usually advised on how to recycle or re-use the product.

Among their recent proposals we find:

- ✓ Recycling economy: It creates an effective after-use for the plastic economy, by using secondhand plastics named Ecoallene, is a material obtained from the

simultaneous recovery of polyethylene and aluminum elements through the differentiated recycling.

Figure 14, ecoallene plastic material

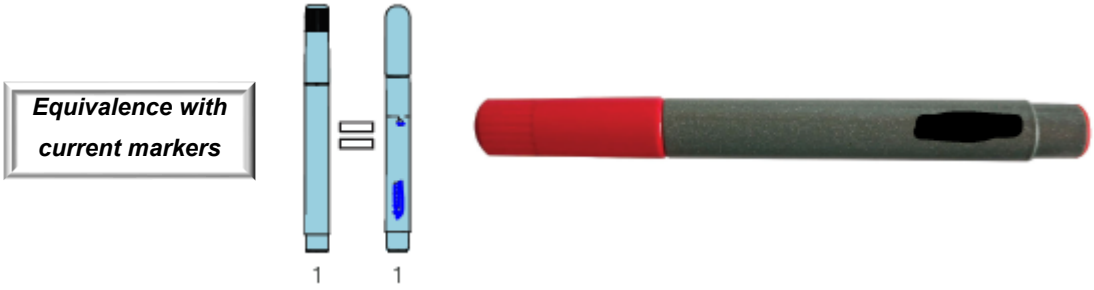


Figure 15 and 16, Comparison recyclable marker prototype Vs current marker system - Source: Company C, Design Team

- ✓ Renewable source: Decouple plastics from fossils feedstock, meaning the use of renewable materials, bio-based and biodegradable like PLA, PHA, MaterBi, etc.

  PLA, is a thermoplastic polymer derived from natural sugars, such as maize and sugar cane.

Figure 17, PLA material

Figure 18, 3D marker prototype - Source: Company C, Design Team

Figure 19, 3D marker prototype - Source: Company C, Design Team

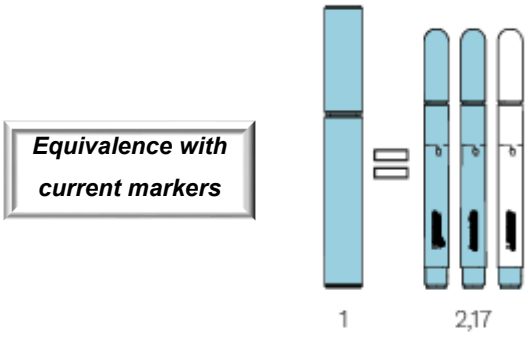


Figure 20, Comparison 3D marker prototype Vs current marker system - Source: Company C, Design Team

- ✓ Product reuse: It drastically reduces the leakage of plastics into natural, systems and other negative externalities. Leads to a shift from disposal product to an ink rechargeable system to reduce the amount of plastic used by their current markers.

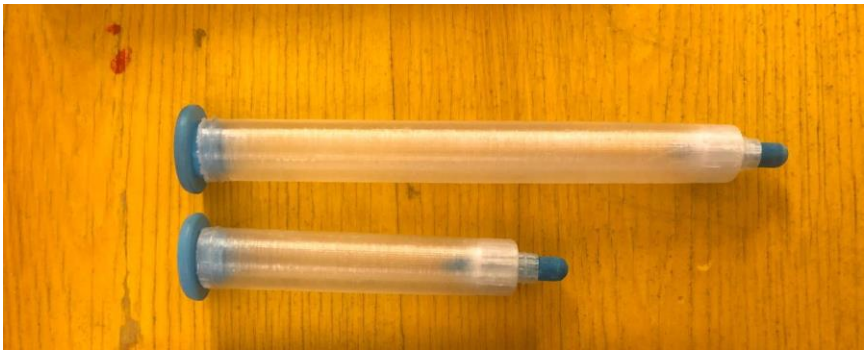


Figure 21, 3D marker prototype for an ink cartridge system - Source: Company C, Design Team

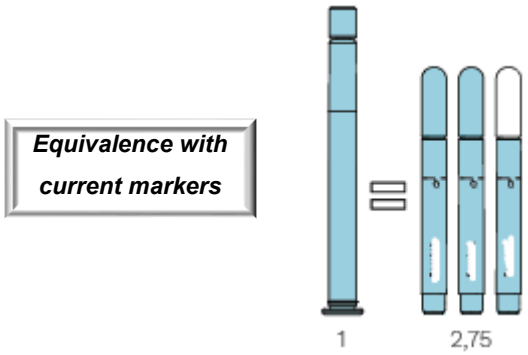


Figure 22, Comparison ink cartridge system Vs current marker system - Source: Company C, Design Team

Analyzing the data from the tests, the following conclusions are obtained:

	Current approach	Recycling economy	Renewable source	Product reuse
Strengths	- Cheap production - High variety of colors - Fast production	- 100% recycled material - Technically close to current model - Completive cost	- 100% biodegradable material - More durability of the marker - Improve customer experience	- Reduction of plastic - Higher product value - Disruptive innovation
Weaknesses	- Non biodegadable polymer - High % of plastic to disposal - CO2 emmision	- Limited colors - Experimental material - Difficult welding (for highlighter)	- Higher production cost - Limited colors-PHA - Experimental material	- Higher production cost - Fully product oriented
Variation of plastic	0%	0%	+31%	-44%

Equivalent number of current markers	1	1	2.17	2.75
Production time in hours	4	5	8	6

Table 4, data was obtained from Company C, Design Team

Although the production time increases when using biodegradable materials, if company D starts producing markers, they could:

- Taking advantage of equipment and labor hand
- To not depend in only one source of supply
- Reduce the risk of merchandise getting damaged while importing the products bought abroad
- Better quality control
- More flexibility to test new models and technologies

Model ---- Cost	Current Marker	Recycled marker	Renewable marker		Reusable marker	
			Quantity	Cost	Quantity	Cost
Fixed	0.00 €	0.00 €	100K	€90K (IT)-€45K(CH)	100K	€90K (IT)-€45K(CH)
			500K	€50K (IT)-€25K(CH)	500K	€50K (IT)-€25K(CH)
Per Unit	0.70 €	0.82 €	100K	€2.93 (IT)-€2.75(CH)	100K	€3.48 (IT)-€3.37(CH)
			500K	€1.46 (IT)-€1.38(CH)	500K	€1.74 (IT)-€1.68(CH)

Table 5, data was obtained from Company C, Design Team

In *Table 3* fixed and unit costs are reported for the current model and the three new proposals. For the current and recycled models, the fixed costs are 0.00 € because in these approaches the producer is a third-party partner who takes care of those expenses. On the other hand, for the renewable and reusable models, company D would oversee the whole production process, and as is shown in the table, costs decrease when increasing the production lot.
Even though at first sight could seem that the unit cost for *renewable* and *reusable* models doubles or triples the *current* and *recycled* unit cost, should be taken into account the total capacity of each model to be able to compare prices accurately, as discussed in *Table 2*, *renewable* and *reusable* models have an equivalency of 2.17 and 2.75 respectively in *current* markers; the expenses per unit will be:

Cost \ Model	Current Marker	Recycled marker	Renewable marker		Reusable marker	
Cost per unit with capacity of one current marker	0.70 €	0.82 €	100K	€1.35 (IT)-€1.26(CH)	100K	€1.01 (IT)-€0.898(CH)
			500K	€0.67 (IT)-€0.636(CH)	500K	€0.464 (IT)-€0.448(CH)

Table 6, realized by summing tables 4 and 5

Hence, from the economic point of view company D could if they decide to pursuit a vertical integration strategy by becoming producers of their own markers and starting to manufacture a larger quantity of markers. But the saving does not end there, by producing locally they avoid shipping expenses and customs fees and duties when importing the final products.

4.4 Case D.

4.4.1 Overview.

Company E, born as a Startup based in Turin, Italy, his founder Carlo Ratti, professor at the Massachusetts Institute of Technology and co-founder of company says "… is an example of how robotic technologies are changing the interaction between people and products, a topic we explored in depth. The system explores the new dynamics of creation and social consumption design, make, enjoy allowing users to design their own creations, while robotic arms transform these projects into reality".

The team with almost 40 members, nowadays classified as a small enterprise, firstly launched the project as an installation during the Google I/O forum in 2013. Equipped with two robotic arms capable of replicating all operations a skilled bartender usually does; like crushing ingredients in the mortar, slice the lemon, and of course to shake like a professional bartender. It also offers the possibility to communicate the robot in real time through an app the cocktail that the customer has always wanted, it can store up to 158 different non-alcoholic and alcoholic beverages, making possibilities rise up to 10^{100} combinations. They are trying to be seen as collaborators and a link between society and technology rather than just an equipment trying to replace bartender's job, in words of the developers "Instead of trying to replace a bartender with a robot, is a social experiment that looks at how people might embrace the new possibilities offered by digital manufacturing."[8]

With more than 3 Tons of weight, the bartender robot is serving drinks in more than 14 venues all over the world, achieving since 2014 more than 2.1 million of cocktails served. They have really exploited the interaction between man and machine "the social experiment allows consumers to learn from each other by sharing connections, recipes and photos on social networks. Moreover, -the robotic bar from company E- is able to monitor alcohol consumption and blood alcohol levels, thus boosting responsible drinking."[9]

[8] https://carloratti.com/projects/
[9] https://www.pentagram.com/work/makr-shakr-1/story

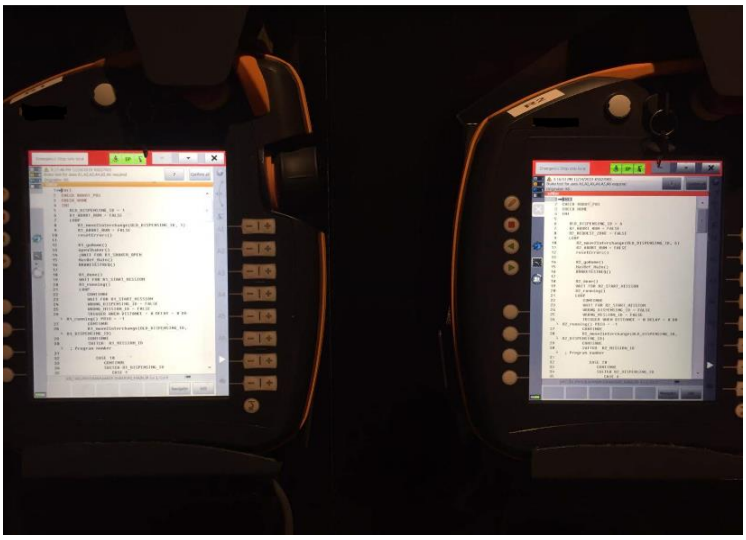
Figure 23, Exhibition in London, 2019 - Source: Company D social web.

4.4.2 Analysis.

Their strategy of factory management, takes all automated processes to analyze data through their software, giving you much more control and information data to analyze on how production and performance of their equipment is going; for example, the CNC (Computer Numerical Control) cutter allows to have a continuous control of the machine through a software package 4.0, that it serves to connect in network all the machines, seeing the workload, programmed maintenance, predictive maintenance then, since all data is stored in the cloud, they know what is going on, anticipating problems, managing all the activity cue; for example, if a very big order is received and one machine is not enough to meet the request, thanks to industry 4.0 and all tools and technologies such as cloud, IoT, etc the workload can be distributed automatically without wasting time talking to operators, workers, explaining what the plan to follow is.

Figure 24 – CNC Machine, Taken from the factory of company D

Thanks to the IoT, the robot's Control Pad with which the robotic arms are controlled, are always connected to the web, so the technical team can check the Control Pad of each robot wherever it is located to run tests.



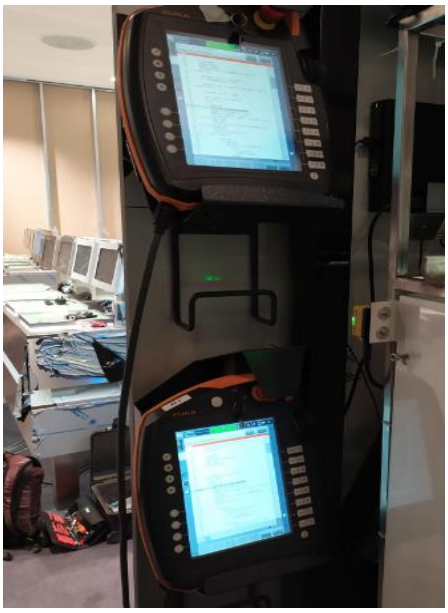


Figure 25, 26- Bar's smart tablets, Taken from the factory of company D

Thanks to industry 4.0, they have shifted from calling the customer, activate a video with the Control Pad in hand, giving all the directions to the customer to do the reset, in which they took hours to do it; now with the new automatic procedure the robot returns by himself, the program behind the procedure also allows to monitor in advance all the electronic problems, immediately understanding if there is a component to be replace, if so, team sends the replacement with anticipation, or on the other hand if the problem is physical, the team will send a technical team to prevent the machine to stop working.

Figure 27, robotic arm with shaker, Taken from the factory of company D

Maintenance in company E is one of the most important features, all process which can be done remotely, somehow exploiting the industry 4.0 represents a huge cost reduction by the company. The technical team has found many issues in the performance of the machine, then they have created routines that allows to activate a sequence of procedures, allowing to remotely check what is going on in the machine, which signals work and which do not, why does the robot executes X or Y process, and

at that point without even talking to the customer and without having to go there, they will know if the robot has any blocks that after a certain time of use due to bugs or sensor problems the robot gets blocked. Normally the specialist has to take with the robot's Control Pad to bring it to the zero position, it would be chaotic to do it manually in all the robots they have in the world, so the developer team has created a special routine called auto homing, the objective is to automatically make the robot arm go back to its initial position no matter the position or process the robot is, it will reset itself avoiding to hit or damage other pieces or people around it.

Figure 28, right robotic arm blocked when taking ice, Taken from the factory of company D

Figure 29, right robotic arm going back to homing, Taken from the factory of company D

Now, regarding the critical parts of the robot, there is the shaker, one of the most important pieces of the robot, but at the same time one of the most likely to suffer damage, thanks to the data received in real time, the team is able to understand some physical problems the engine is having or is about to suffer such as a broken or damaged wire, remotely they receive signals from the sensors while the system is performing its usual tasks and perceive if there are problems on the sensors devices, at that point, they know the wire has problems and proceed to send to the client a new one before the problem scales causing the device to stop operating.

Figure 30 and 31, Sensors and wires in the shaker, Taken from the factory of company D

By downloading the robot's daily task history, they can do analyses to create new procedures and anticipate the problems that happen more often and communicate them to the customer through warnings. If the robot needs maintenance or an action in situ. As mentioned before, analyzing the data history of the shaker they discovered some sensor response delays, realizing that the piston is starting to work badly, managing to alert the customer in advance and send the gear piece before the current one breaks.

Companies C and D have found in partnerships and coworking between each other a strategy to reduce direct and fix costs, which has led them to give the first step into joining the transition to the new era of industries. They have been sharing locations, the factory and in some cases letting functional areas help each other if needed. The tactic has led to save significant amount of money, with which they have been able to intend it for Research and Develop new updates and better process for their products, using of course the methodologies and technologies described above.

5.

CONCLUSIONS

5. Conclusions.

Throughout the document it has been shown the research made about the main concepts and characteristics of the Industry 4.0, allowing to understand the impacts brought by the usage of its pillar technologies. Afterward, two international companies have been analyzed, highlighting the technological tools they have used, and the competitive advantages they have acquired thanks to it. Finally, a deeper analysis into two small European startups which are trying to take its business to the next level using some of the new technologies the fourth industry era is now offering.

The technological revolution represents a great challenge for the organizations, due to the great and constant technological advances, is still necessary to hire workers with specific skills and knowledge, but they are difficult to obtain because of their low availability and high wage requirements. It also has caused several changes in the economy that have led organizations of all typology to apply strategies aiming to develop technological capabilities, managing to compete with competitors that have automated their processes, making their production systems intelligent, positioning their business in an optimal and promising scenario for the next decade. Due to the new requirement of automated processes in the industrial economy the small and medium enterprises might be at risk, despite the efforts of developed countries to strengthen this business sector, there has been a drop-out of SMEs, which slows down economic development in several sectors, especially in countries like Italy where a great percentage of businesses belong to this sector. It evidenced the fact that some industrial segments are managed by a small number of multinationals, creating a social gap, which every day is getting bigger.

Powerful new technological tools are in the hands of a few, therefore, it is important that the top government and enterprises directives get well prepare for the great expansion of the technological revolution to transform human society, as it is already beginning, very often digital tools are developed without thinking firstly on their wide impact on society. Industry 4.0 presents a research and development proposal that

tends companies to incorporate technological resources to meet customer requirements in time. Through process automation, work is done in the shortest possible time at very low costs, achieving greater productivity, sustainability and economic performance.

The first common characteristic found in the four cases is the usage of new technological tools and processes as a route to gain business competitiveness, however, for its implementation companies must incurred into high investments that even tough will be remunerated with an increasing on sales, not all SMEs have the equity to finance the equipment or the specialized staff needed to get into this transition, that is the main reason for which SMEs usually opt to use the classical approach, where processes and data are realized, managed and analyzed by their workers. Nevertheless, nowadays new approaches like partnerships and coworking have showed up for SMEs to explore new technologies like 3D printing in case C, or Cloud computing, automated robots and predictive maintenance in case D by sharing spaces and expenses in some of their business processes.

In addition, with the incorporation of new technologies as a whole, there is a cultural change of adaptation so that industries must create strategies to lead the fast and demanding markets, taking advantage of Big Data as the value of information is currently the most valuable asset, so they must also invest on its protection and privacy in order to avoid disorder.

SMEs faced the great challenge of how would they survive in the route of digitalization and the industrial revolution, in order to do so, the most important thing is to put the individual at the heart of this transformation, because is usually confused that digital transformation is just adding new technology to the company; but at the end, technology is implemented to work as bridges between each party of the entire business cycle, meaning: suppliers, distributors, workers and the final client.

Hence, instead of creating just value to the process by using new equipment and technologies, SMEs should also try to focused on establishing mutual value by selling their products as services, where the client may be as much involved as possible,

allowing him to interact during the whole process, as company D does. In the production face, customer can customize the bar according to his needs; after the sale, the team is still able to add value to the transaction by offering data analysis for sales (best seller cocktails, combinations preferred, which type of liquor is preferred the most, media of drinks and the average age of the customers, etc.).

Thus, what characteristics SMEs should have in order to continue subsisting? It is known even for them that is not possible to compete with big enterprises in terms of mass production, investments for R&D and in general most of the advantages a high demand and equity can bring. As an alternative, they need to create something unique and different for the environment, society and from their competitors; they need to provide something more than just a product or service, and that is an experience to each customer, a dynamic and constant one which motivates customer to keep being part of their community, because in the era of technology, there is not a better marketing tool as social network and reviews. There, a single bad comment might mean a decrease on the amount of people willing to try the product. The way customers qualify a product or service has changed, as well as the reason of purchasing it; social trends led by influencers and the power of word are today's marketing successful key.

What should SMEs seek to offer? This has to be done in the light of today's market trends; for example, people now identify more with organic products, so you have to think of new tools, so when a company delivers the product to the user, it should be under the green rules of the environment, for the reason that the consumer 4.0 does not want to waste natural resources, they want to be the protagonist in the purchase, as it was shown with company C, the whole team of R&D is searching to make the products go green, and not just motivated by reducing costs on materials, but also because some market analysis show a high percentage of the population wants to belong to a community, and with the climate change, all products somehow related to it are gaining value. Globalization drives to super connected commerce, which, thanks to the internet and social networks, is increasingly influential and the demand for the product depends on the popularity of it on the web and social media; hence, the

feedback and reviews of each consumer becomes a very powerful and influential advertising instrument. When a product or service is sold today, the company comes categorized or qualified on the basis of the experience commented by the consumer, which will be analyzed by potential new customers, leaving a little aside in itself the product and the company.

It is not accurate to conclude if the fourth industrial revolution is good or bad due to the high amount of changes is bringing with it; the truth is that those changes are already happening, and is worrying that most SMEs are not giving too much attention to it. Those fluctuations in the market come very fast without previous warning, forcing companies to adapt their strategies, to be pioneers in new technologies; specially when it comes to data, being nowadays one of the most valuable and protected assets in the market, every single data exchanged is monitored, controlled and registered.

The key to join the transition to the new technological era is of course implementing new technologies from Industry 4.0, but even more important, is to make the individual the heart of the whole process, along with selling a good product, under a good marketing, and through an excellent influence, that is how SMEs may gain competitive advantage in their market, making truly a difference.

Acknowledgments.

Being this master which allowed me to reach a dream that I had since I was a child, I would like to take this opportunity to express the gratitude and affection I feel for the people who have believed and have been there for me despite the obstacles in this time.

For me there is only one right way to start, it is to show gratitude to the people who thanks to their love and teachings have made me what I am, helping me to get where I am today; my parents, the couple who since the beginning have supported me in all my projects, dreams and adventures no matter how crazy they were; they have given me unconditional love despite all the stupid things and mistakes I have made in my life, they have never stopped believing in me.

This is especially for that person who came to bring color to my life, which is a synonymous of tenderness, happiness, my beautiful tiny sister, I want this to serve as proof that all your dreams, as crazy and difficult as they may seem, are fully achievable if you set your mind to them and strive to reach them. I want you to never forget that no matter what obstacles may separate us such as distance, you will always have in your brother a person who believes in you and will support you in all your dreams! I love you little sister!

Thank you to my family, particularly to my grandparents, for all the pampering, love and for the parenting role some of you have performed with love.

Especially thanks to that pair of special people life have gave me, who are my role model of grandparents and love, they are the connection I have between life and whatever is beyond; being here today achieving this dream was the promise I made to one of them. But even though they are unfortunately no longer around to see where I have arrived, I just hope that whatever is waiting for me after passing away is right next to them. Titi, although this dream has taken away my chance to be with you in your last days to say goodbye to you, I know you would not have allowed me to go back. That is why all this achievement is in your memory above anyone else, for having your memory and love always in my heart. Today more than ever I want to thank you, for your teachings and love, which is mainly what got me where I am.

Dani mi negra pecueca, Pily, Magoo, Andrew, Santi and Bullis, my closest friends from childhood and college with whom I have lived a thousand adventures, who have always been looking out for me, with whom daily speaking and joking make the distance become only a

confirmation that there are people who even though without sharing the same blood, the same bond of friendship is enough to call them family.

Of course, there can be no lack of those who in such a short time became already part of that family of another blood: my habibis Joe Albahad Mamad & Little Baby Vanussie, with whom we have shared trips, jokes, parties and laughs from the beginning.

Andy Yolanda! Dude, I am here mostly thanks to you and your backing, people as virtuous and sincere as you, there are very few! Actually, people close to you, your friends are very lucky, and it is an honor to be one of them.
Mi Vieja Luqui, who cheers up the house and any place with her dances and songs, after analyzing a couple of flashbacks I think I finally discovered the reason for our constant discussions and fights… After all, I think that is how most unconditional friendships start, don't you think?
Juanito! My perritou, thank you for all those laughs, parties, jokes and good times in these years, even if you are a traitor for going back to Colombia haha, I want you to know that I will always back you up!
Epaaa Checho! Dude it was so cool to met you, you know I Will back you up! You are a great human being, who gives awesome vibes to the house (except when you play vallenato haha).
Love y'all dudes!! I hope to continue sharing thousands of adventures and new dreams with you!

To all the people I have met in this time, my favorite group of caleñas, and from different parts of the world Italy, Spain Brazil and many others, which have brought out a thousand smiles on me making being away from home and this adventure worthwhile, I look forward to continue sharing more moments and adventures with you all.

To Professor Luigi Benfratello that on his courses and throughout this project, has always shown kindness and availability to guide me and resolve doubts.

Finally to - la vieja Dani- and the whole Scribit & Makr Shakr Team for their support and availability to develop this research.

Thank y'all !!

D.M

Siendo esta maestría lo que me permitió cumplir un sueño que tenía desde niño, quisiera aprovechar la ocasión para expresar el agradecimiento y cariño que siento por las personas que han creído y estado para mí a pesar de los obstáculos en este tiempo.

Para mí solo hay una manera correcta de empezar, es agradecer a las personas que gracias a su amor y enseñanzas han hecho de mi lo que soy, ayudándome a llegar donde estoy hoy en día; mis padres, las personas que desde el principio me han apoyado en todos mis proyectos, sueños y aventuras sin importar que tan locas eran; me han dado un amor incondicional a pesar de todas las estupideces y errores que he cometido en mi vida, ellos nunca han dejado de creer en mí.

Esto es especialmente para ese ser que llego a darle color a mi vida, que es sinónimo de ternura, felicidad, mi enana hermosa, quiero que esto sirva como prueba de que todos tus sueños, por más locos y difíciles que parezcan, son totalmente alcanzables si te los propones de corazón y te esfuerzas en llegar a ellos. ¡Quiero que nunca olvides que sin importar los obstáculos como la distancia, siempre vas a tener en tu hermano una persona que cree en ti y que te apoyará en todos tus sueños! Te amo enana.

Gracias a mi familia, en especial a mis abuelos, por todo todos los mimos, cariño y por el papel de padres que en algún momento realizaron con tanto cariño.

En especial, gracias a ese par de seres tan especiales que me dio la vida, que son mi modelo de abuelos y de amor, son esa conexión que tengo entre la vida y lo que sea que hay más allá; el estar aquí hoy culminando éste sueño fue la promesa que le hice a uno de ellos, pero aunque desafortunadamente ya no estén para ver a donde he llegado, solo espero que lo que sea que me espere al morir sea a su lado.
Titi, aunque este sueño me haya quitado la oportunidad de estar contigo en tus últimos días y despedirme de ti, sé que no me hubieras permitido volver. Es por eso que te lo dedico por encima de cualquier otra persona, por tu recuerdo y tu amor de abuela que siempre llevaré conmigo. Hoy más que nunca quiero agradecerte, por tus enseñanzas y amor que en gran parte es lo que me han hecho llegar a donde estoy.

Dani mi negra pecueca, Pily, Magoo, Andrew, Santi y Bullis, mis amigos más cercanos de la infancia y universidad con los que he vivido mil aventuras, que siempre han estado pendientes de mí, con los que a diario hablando y bromeando hacen que la distancia solo ratifique que hay personas que sin compartir la misma sangre, basta ese lazo de amistad para llamarlos familia.

Por supuesto no puede faltar aquellos que en tan poco tiempo entraron a formar parte de esa familia de otra sangre: mis habibis Joe Albahad Mamad & Little Baby Vanussie, con los que desde el principio hemos compartido viajes, fiestas y risas.

Andy Yolanda! Viejo en gran parte estoy acá gracias a usted y su apoyo, personas tan nobles y sinceras como usted, hay muy pocas! en verdad las personas cercanas a usted, sus amigos son muy afortunados, y es un honor ser uno de ellos.

Mi vieja Luqui, que alegra la casa y cualquier lugar con sus bailes y cantos, después de analizar un par de flashbacks creo que por fin descubrí la razón de nuestras constantes discusiones y peleas… después de todo creo que es así como comienzan casi todas las amistades incondicionales, no lo cree?

Juanito! Mi perritou, gracias por todas esas risas, rumbas y buenos momentos en estos años, ¡aunque sea un traidor por devolverse jajaja quiero que sepa que cuenta conmigo siempre!

Epaaa Checho! Viejo que chimba conocerlo, sabe que cuenta conmigo, es una gran persona y aporta una vibra muy cool a la casa! (bueno excepto cuando pone vallenato jajaja). *Los quiero mucho viejos y espero poder seguir compartiendo mil aventuras y nuevos sueños con ustedes!*

A todas las personas que he conocido en este tiempo, mi grupo de caleñas favoritas, y de diferentes partes del mundo Italia, España Brasil y muchas más, han sacado mil sonrisas en mi haciendo que el estar lejos de casa y esta aventura valgan la pena, espero seguir compartiendo muchos momentos y aventuras con todos ustedes.

Al profesor Luigi Benfratello que en sus clases y a lo largo de este proyecto, siempre mostro amabilidad y disponibilidad para guiarme y resolver dudas.

Por último a la vieja Dani y todo el Team Scribit & Makr Shakr por su apoyo y disponibilidad para desarrollar esta investigación.

¡Gracias a todos!

D.M

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Figure 2, Augmented reality in a factory - Source: https://www.machines4u.com.au/mag/augmented-reality-industry-4-0-great-gimmick-potential-industry-changer/

Figure 3, 3D printer – Source: https://cerasis.com/additive-manufacturing-and-3d-printing/

Figure 4, robotic arm in production line

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Figure 5, logistics robot used in warehouses to control stock of products and transport small objects or messages.

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Figure 12, ecoallene plastic material

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