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Automotive supply chain in the Canavese area

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1. Introduction

The automotive sector is experiencing turbulent times caused by changes in globalization, regulations and technological progress, the automotive sector is really important for the Italian economy (5.6% of Italian GDP), and is also a driving force for technological and organizational innovations for other manufacturing sectors (example: WCM).
In competitive sectors such as the automotive industry, continuous product and process innovation and business model innovation are needed to thrive and survive. At the same time, however, product innovation is closely linked to the whole enormous supply chain behind the automotive world, led by SMEs.
Industry 4.0 technologies are the main driver for process and product innovation. Studies that look at the level of diffusion of 4.0 technologies are limited. Furthermore, there are no studies that have analyzed in detail the strategic and organizational transformations required of the automotive sector companies.
The Canavese is a territory characterized by the presence of numerous SMEs that are part of the Automotive supply chain, which despite the turbulent period, are succeeding in growing and expanding abroad, beating the competition of other countries. Therefore, this research aims to understand what are the factors that motivate this growth, and whether they are linked to the adoption of new technologies, or organizational transformations linked to this evolution, or to the social context in which they are inserted.

This thesis aims to answer the following research questions:
- What is the level of diffusion of Industry 4.0 of SMEs in the Canavese area? Which technologies are used? for what purposes? Comparison with other Italian firms located elsewhere in Italy?
- As a result of this evolution, what organizational changes are required for SMEs, despite limited resources?
- What are the key success factors of the Canavese SMEs?

2.Canavese

2.1 The Canavese area

Canavese is a land in the North of Italy into Turin province. It is a part of Piedmont situated between Turin and the Aosta Valley, with the Grain Alps to the west and Lake Viverone and the first rice-fields of Vercelli province to the east; this is a quick description of a territory whose borders are not defined with absolute precision.
Anyone travelling in the Canavese would cover an area of about 2050 square km, divided between plains, hills, mountains, rivers, streams and lakes, forming a natural environment that earned the title of Green Canavese.
The name of this Piedmontese region is as uncertain as its borders: in A. Maselli's Guide to the Canavese, printed in Ivrea in 1904, he writes that "The Canavese does not currently have, a delimitation of its own. Neither history nor geography give it precis borders".
The town of Ivrea, home of the brilliant industrialist Camillo Olivetti, and whose beauty conquered the poet Giosuè Carducci. From Ivrea we can admire the Moraine Ridge, an incomparable and stunning wonder, a true, giant natural bastion about 20 Km long, a slope that is perfectly linear when seen from the distance and that descends gently from 1000 m above sea level at the village Andrate to 200 m at the lakesides town of Cavaglià, branching round Lake Viverone. It is the biggest moraine in all Europe, created in the Pleistocene era, an ice age hundreds of thousands of years ago. Although it looks from a distance like a straight line, when you travel along the Ridge you realise that in fact it is not so linear, but includes basins and valleys that contain the remains of peat bogs and some lakes including, at its end, Viverone.
At the foot of the Ridge runs the Dora Baltea river: it enters the Canavese from Carema , a land of top quality wines at the border with the Aosta Valley, and it flows towards the Po crosses a landscape of plains and rolling hills. Following the Dora, south of Ivrea and not far from the river, we meet another small mirror of water, surrounded by hills rich in fragrant Erbaluce vines; it is Lake Candia, full of pike and carp, from where, looking north, one can again see the Ridge but with one particular detail: the first thing to meet the eye is the castle of Masino which, perched on a high hill facing the Ridge, seems somehow to want to protect it.
We continue south following the Dora, which, after crossing the whole eastern part of the Canavese, empties into the Po near Crescentino.
At Chivasso and Brandizzo we discover that the Orco and Malone streams, because of the proximity of their junctions with the main river, enabled creation of the Confluence Special Nature Riserve, which became in 2000 a site of European Union Interest.
Further west, in the Turin district, the Po receives the waters of the Stura di Lanzo river, whose valley of the name serves for some distance as a border to part of the upper Canavese.
Following the big Orco stream backwards, with the separate Malone and Stura di Lanzo on our left, we climb into the Canavese of forges and hot-metal moulding in the towns of Rocca, Corio and Forno… In Cuorgnè one can go up into the Alpette astronomical

observatory or continue to Pont Canavese, where the Orco is joined by the Soana from the valley of the same name.
As one travels from there through the Locana Valley to Ceresole Reale. We have reached the Gran Paradiso National Park (the first Italian national park, dating from 1922) in the Graian Alps: it is amid these high peaks that the Orco, the watercourse that identifies the Canavese and is identified with it, rises: the entirety of its 90 km length runs through it, from its source to the Po.
One more look at the mountains of the Gran Paradiso, a true paradise for the eyes, then we turn to Cuorgnè, from where we climb to Castelnuovo Nigra to admire the crest that from Santa Elisabetta (Sacred Valley), passing via Mounts Quinzeina and Verzel, sketches against the sky the enchanting profile of a beautiful girl who sleeps: Sleeping Beauty, another gift of the mountains… visible from considerable distances away. From Castelnuovo Nigra we come down to Vistrorio in the Chiusella Valley. The Chiusella river stream comes from the foothills of Mount Marzo, further to the north, at the border with Aosta Valley, and flows into the Dora Baltea near Strambino.

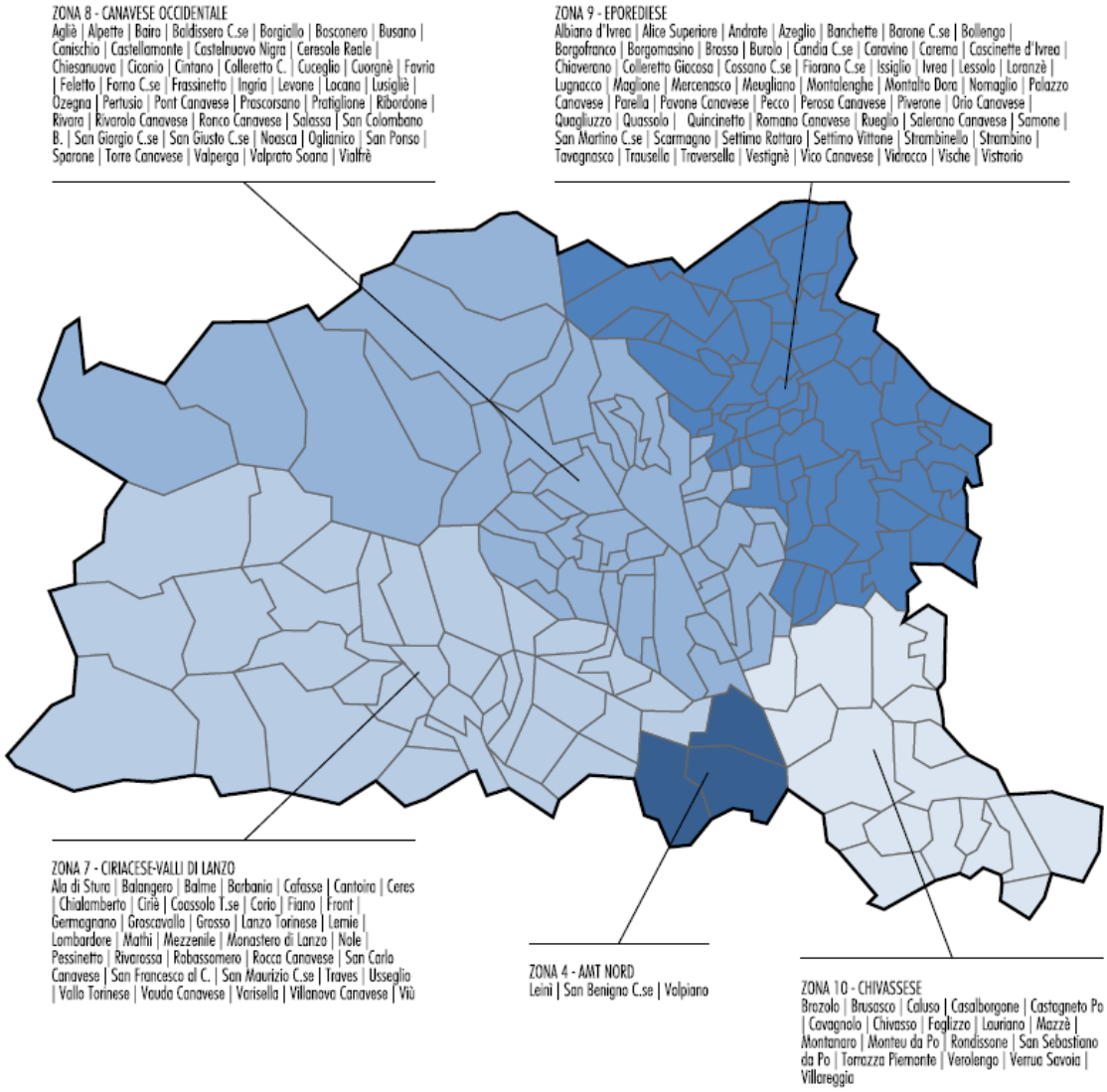

Figure 1: Canavese area

2.2 Canavese Industrial Union

Confindustria Canavese is the main representative organization of Canavese companies. It was founded in 1945 with the aim of promoting the progress of the territory by encouraging local businesses to carry out economic activities, acting as a spokesman for the needs and proposals of the local industrial sector in relation to institutions, political organizations and the economy and all the different components of society.
Today Confindustria Canavese represents over 300 productive realities, which operate in various sectors, from the more traditional ones: the electronic-information technology, the hot forging of steel and the precision mechanics, up to equally important areas for the development of the territory such as business services, scientific research and tourism.
Inside it there are specific bodies:
The Young Entrepreneurs Group, the Small industry Committee, the Metalworkers section, the ICT section, the Tourism section and the Canavese Business Consortium.

Figure 2: Canavese industrial union

2.3 The history of the Canavese industry

Starting from the 900 ' the industrial activities of the Canavese are uneven realities with different periods of activity depending on the success obtained by the various companies, the capacities of their owners and managers, the evolution of technologies and of the raw materials used, the characteristics of the products and market competition.
Industrial development allows great growth in the territory:
The textile industries, the mechanical industries, the steel hot forging industries in the upper Canavese and the ceramics in Castellamonte constitute the backbone of the Canavese along with the true industrial hub of the territory, the Olivetti.
Established in 1908 as "the first national typewriter factory", Olivetti stands out from the beginning for its attention to technology and innovation, care for design, international presence, sensitivity to the social aspects of work .These characters are impressed by the founder Camillo Olivetti and his son Adriano, who transforms the family business into a modern industrial group. Having conquered positions of world leadership in mechanical office products, in the 1950s Olivetti invests in electronic technology with important results. The disappearance of Adriano Olivetti (1960) and the weight of investments slow down the transition to electronics; but in 1978 the first worldwide electronic typewriter came out and in 1982 the first European professional PC, in these years, however, a slow decline begins for the company. In the 1980s, supported by a vast network of agreements and alliances, it accelerated development in information technology and systems. The progressive reduction in the profitability margins of the IT business and new telecommunications developments in the 1990s led Olivetti to shift its center of gravity towards this sector, first by creating Omnitel (1990) and Infostrada (1995) and then acquiring control of Telecom Italy (1999), with which it merged in 2003.
After the Olivetti's fall the Canavese managed, to undo and rebuild many pieces of its production system, in silence it quickly recovered the lost positions, to heal its wounds, more than to claim a past of great successes and innovative ideas; the history of Olivetti and most of the Canavese territory are in fact closely connected, difficult to revive.
The Canavese is therefore characterized by the presence of mostly small companies, which are lacking in system logics and partnership strategies able to guarantee the necessary resources to compete more strongly on the global market. The Canavese SME system is the result of the de-verticalization processes of the large enterprise: this allowed the system to be held up against the crisis of the large enterprise but caused a general weakness of the entrepreneurial fabric.
In general, therefore, the crisis of the late 90' and the disorientation generated by the end of Olivetti and the changes at Fiat and in the automotive market have pushed local institutions and companies to new solutions to these problems and to activate new forms of collaboration to guarantee a modernization of the territory. Gradually over time, therefore, the critical issues have been transformed into elements of strength, laying the foundations for a new development path.
The phenomena that have been observed are:

- The re-establishment of production chains with the failure of less efficient companies and with a corresponding reinforcement of the more solid and longer tradition;

- A framework of small and medium-sized enterprises capable of accommodating the workforce leaking from companies in crisis.

2.4 Canavese today

Today the Canavese represents a small nucleus of companies specialized in intelligent components and in the automotive supply chain, along with an IT sector no longer capable of exercise leadership but capable of giving life to some dynamic new entrepreneurial realities. On the other hand, reduced size of companies in a weak production system, the infrastructural deficits and the difficult generational turnover are the main obstacles on the road to an over all repositioning, also threatened by the lack of entrepreneurial dynamism and excessive dependence on power centers outside the territory as well as the reduced availability of young and qualified human resources.
Today there are medium-sized manufacturing companies specialized in the fields of mechatronics, hot forging, automotive and some niches of Made in Italy.
In the manufacturing sector there are two different profiles:

Innovative companies
Medium and medium-small businesses with growing international projection, positioned on quality segments, which have invested in advanced technologies, differentiating the sources of competitive advantage. Often leaders of specialized niches - but examples referable to this profile are also present in the small company and quality craftsmanship. Even in fields other than mechatronics and the industry of electronic components, starting from the transformations occurred in the hot forging pole of the Western Canavese, a small group of innovative companies has grown in terms of technology, organization and trade.. Companies with strong territorial roots, with family ownership that can also be transmitted to the new generations, specialized in product niches - which preside over thanks to a dynamic mix of design qualities and appropriate technological investments - and increasingly able to move in extra-local markets.
Moreover, in most cases, companies are experiencing an handover to the new entrepreneurial generation, almost always able to make more dynamic knowledge and attitudes open to the international dimension. These cases are part of the many SMEs that were able to promptly qualify the business model by acting on the leverage as an appropriate technology, on positioning in the production chain, on product innovation and turning to international markets, however, we must look at this situation in a right way . The Canavese companies included in this profile are overall too small, not particularly numerous and in more fragmented on the merchandise level, because they can’t autonomously drive the local economic system. Most likely the Canavese, in the absence of real industrial drivers or an innovative cluster that combines research, creation of industrial standards and applications, can’t exercise a real leadership in the future.

The castaways

As everywhere, in the territory prevails the profile of the castaways, the small manufacturing and construction industry whose survival seems uncertain today.
Many companies did not keep pace.

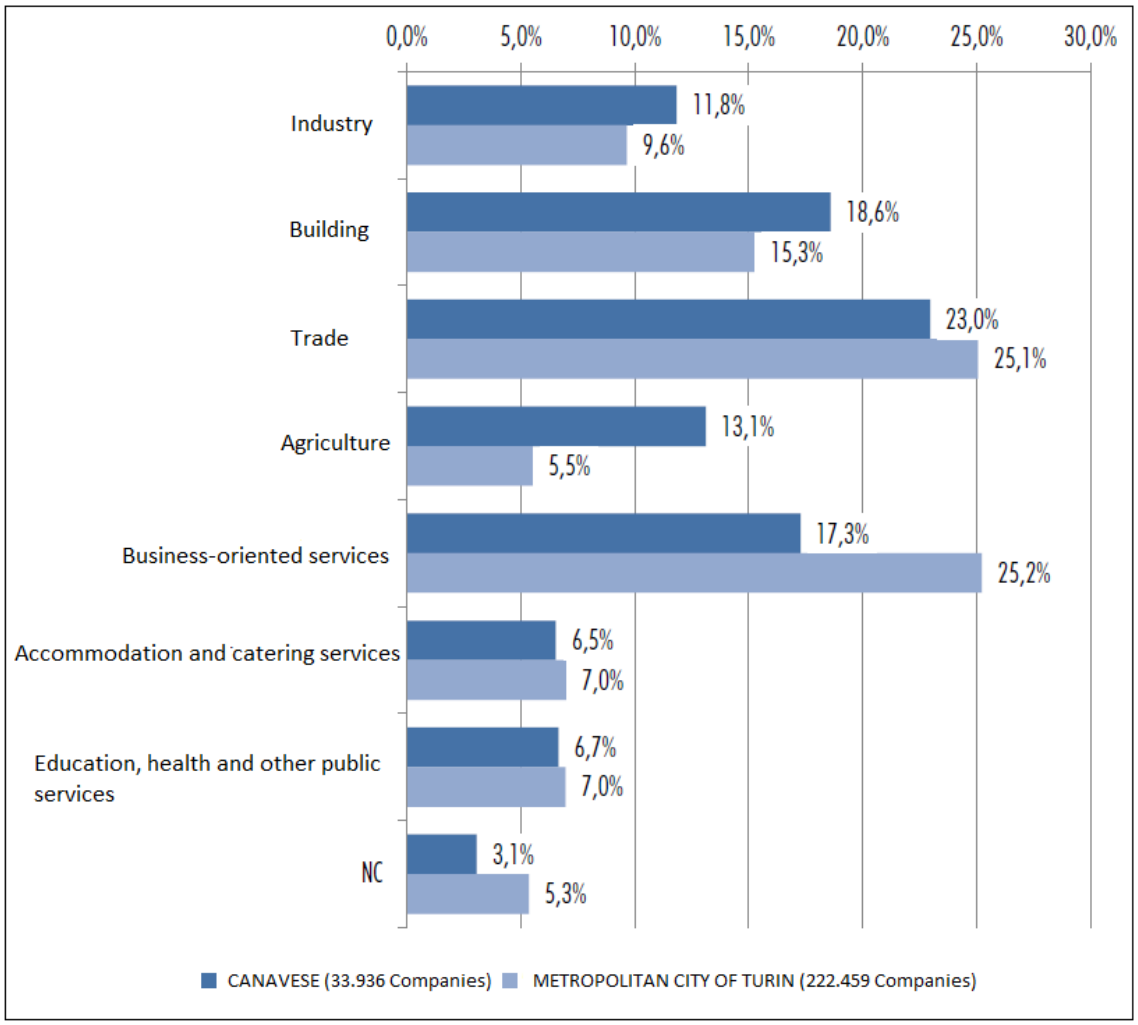

Figure 3: Registered companies of the Canavese area, 2017

2.5 Strengths and weaknesses

Strengths

- Work culture that has led to entrepreneurship in manufacturing highly specialized in mechanics, information technology and electronics;
- ten-year coexistence of classical economy represented from the hot forging companies of the upper Canavese area with the new economy characterized by a greater degree of innovation, such as information technology companies and of the electro-mechanics of the lower Canavese;
- presence of an environment suitable to the birth of new companies, to the experimentation of new technologies and innovative solutions in sectors – nano technologies, telecommunications, information technology, telematics, telecommunications - thanks to the presence of excellent research centers such as the Bioindustry Park Silvano Fumero, who is among the most successful cases among Piedmontese technology parks;
- activation of a process of economic growth that took place in a climate of strong social cohesion even in moments of great difficulty and radical change, as in the case of the crisis of the Olivetti system;
- presence of a virtuous legacy left by Olivetti that allowed the birth and permanence of niche market companies with cutting-edge technologies;
- presence of companies that have invested in advanced technologies, positioned on segments of quality and included in international circuits.

Weaknesses

- The economic system of the territory is characterized by a strong manufacturing presence with small businesses more easily exposed to risks that can be tested during an eventual economic crisis;
- Limited entrepreneurial drive;
- Difficulties for many companies in implementing marketing policies of products especially abroad;
- Lack of advanced services for companies: particularly difficult to fully integrate the manufacturing system with advanced services;
- Slow diffusion of innovative organizational and management models in small companies;
- Need to support investments and innovation;
- Need to better inform businesses about accessible innovative financial opportunities;
- Need to promote and support consortium forms and strategic alliances;
- Need to communicate the relationship between business and territory to consumers;
- The accumulated savings tend to remain locked up in savings rather than turning into capital for new business initiatives with consequent difficulty in transferring the business liquidity to the production system;

- Insufficient relations between companies and the Turin Polytechnic and the world of research and education.

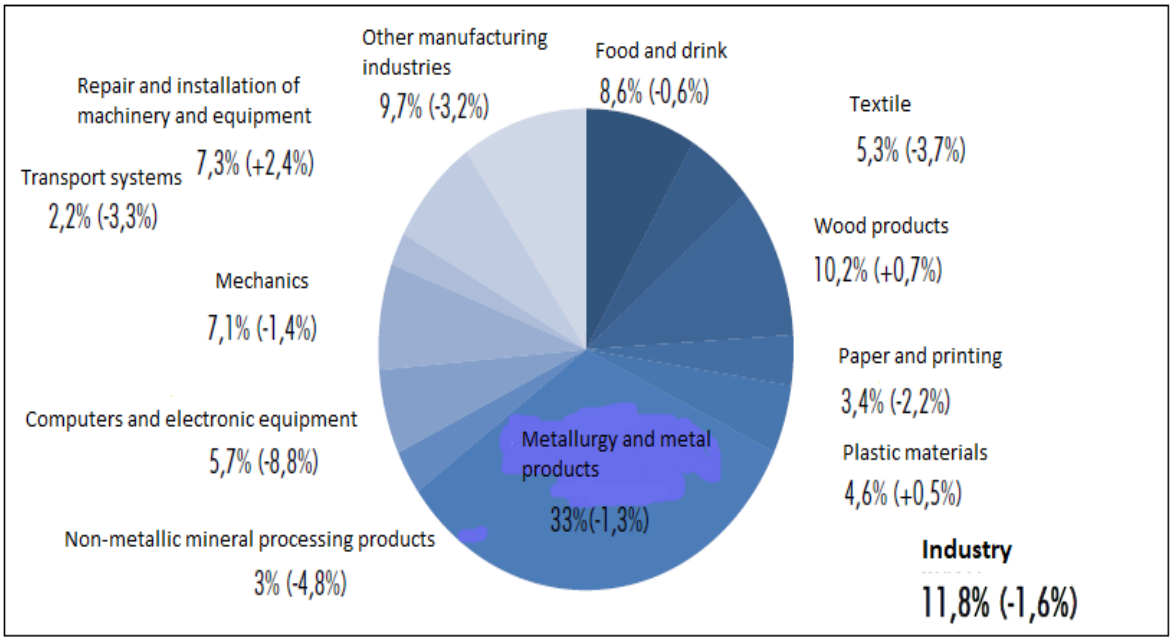

Figure 4: Manufacturing industry in the Canavese area

3. Industry 4.0

3.1 Theoretical background

The concept of Industry 4.0 has been conceptualized as the fourth industrial revolution that refers to how a bundle of partly related digital technologies will bring major disruptions to manufacturing industries enabling major business improvements in productivity and shaping current business models (Kagermann et al., 2013).
Indeed, the digital transformation ignited by Industry 4.0 pose significant challenges for established firms (Warner and Wäger, 2018) and in particular for manufacturing SMEs given their limited financial and managerial resources, low digitalization level (Müller et al., 2018a) and low attractiveness for IT talents. Still, there is little empirical research that investigates at a company level how to deal with these challenges or has given advices on how to develop the capabilities needed to adopt Industry 4.0 (Schneider, 2018).

Industry 4.0 is a widely accepted term originated in Germany in 2011 to refer to the Fourth Industrial Revolution.

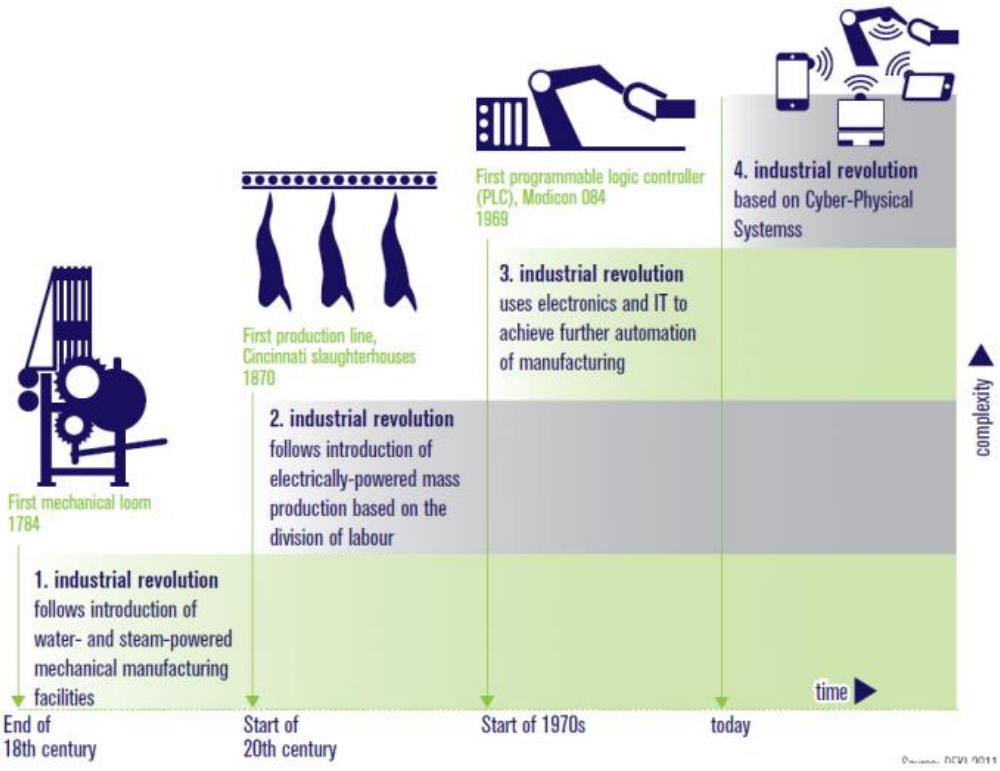

Figure 5: Industrial revolutions

The stages of industrial revolutions from the late eighteenth century up to the present can be traced to four events:

- The first industrial revolution: starting from the eighteenth century, characterized by the use of machines powered by mechanical energy and the introduction of steam for operation production facilities;
- The second industrial revolution: begun in the twentieth century, characterized by the advent of mass production and the birth of assembly lines that led to the use of oil, electricity and chemicals within production systems;
- The third industrial revolution: developed in the 70s of the 22nd century, characterized by the use of industrial robots, computers and IT technologies for the automation of production processes;
- The fourth industrial revolution, characterized by a high degree of automation and interconnection given by cyber-physical systems (CPS).

CPS are integrations of computations and physical processes with embedded computers and networks that monitor and control physical processes, usually with feedback loops where physical processes affect computations and vice versa (Wang, et al., 2015). Frequently CPS communicate over the Internet of Things, enabling further amount of Big Data related to physical systems available for analysis.

3.2 Enabling technologies

The fourth industrial revolution is commonly associated with a set of technologies, defined as enabling technologies: Internet of Things (IoT), Cloud Computing, Additive Manufacturing, Big Data Analytics, Advanced Robotics, Augmented Reality and Cybersecurity.
These technologies are already widespread among companies, but currently theirs application is still limited and sporadic, being mainly concentrated on industrial process control.
Therefore this trend towards the industry digitalisation is a phenomenon that already influenced the entrepreneurial universe, the industry 4.0 is just the summary behind this revolution that has been characterizing companies all over the world for years. Therefore, this revolution must not be interpreted just in terms of efficiency of production processes, but attention must be focused on the numerous e precious opportunities that arise from it. Among these we can mention: The optimization of resources, the development of new business models, the management of the product life cycle, the reduction of time-to-market and the possibility of knowing in real time the needs of consumers. All advantages arising from interconnection and integration of the entire ecosystem, thanks to the technologies listed above.

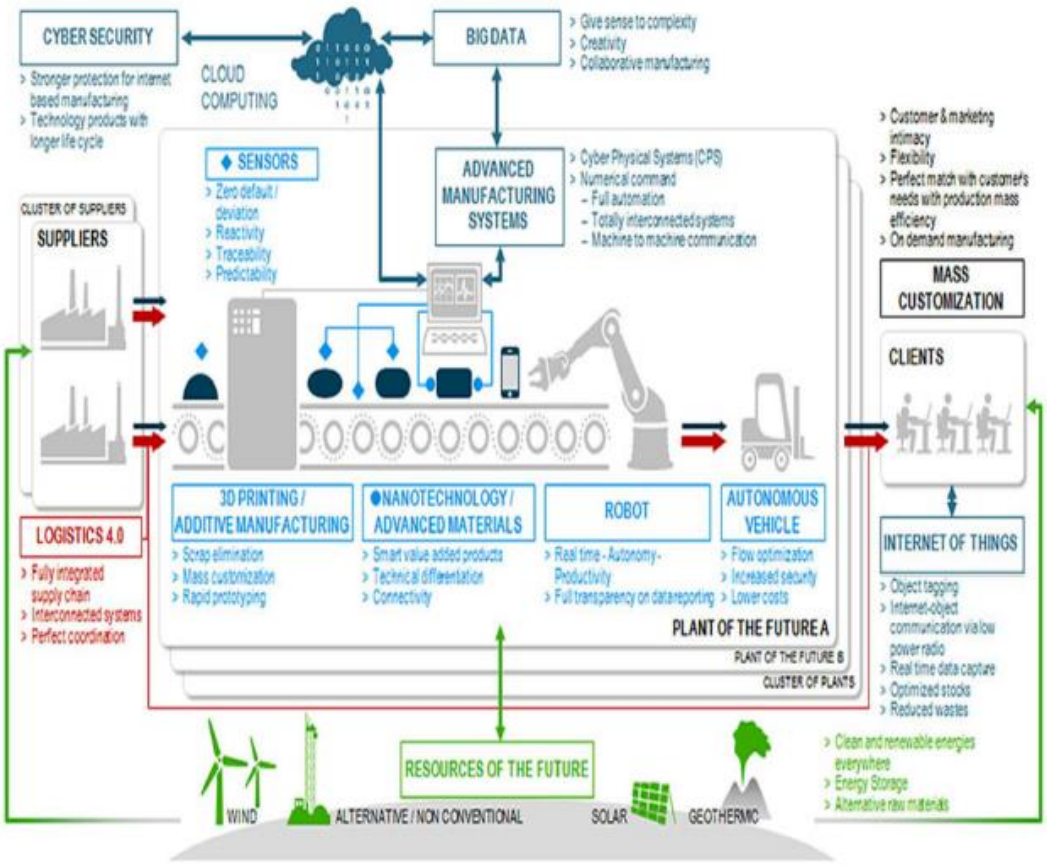

Figure 6: Ecosytem 4.0

Internet of things (IoT)

The internet of things is configured as a network of physical objects with special technologies incorporated that allow them to transmit data through an Internet network. Thanks to the application of appropriate sensors it is possible to digitize the object, making it capable of transmitting information in real time about its state or the surrounding environment, anywhere and at any time. In the manufacturing world, solutions of this type allow, for example, to intervene promptly in cases of malfunction.

Big data analytics

The elements that most characterize the fourth industrial revolution are undoubtedly the data; the digitization of the company causes the creation of a large amount of information, which must necessarily be collected and analyzed in order to become drivers for business decisions. Also in this case this technology allows to foresee malfunctions ex-ante and to monitor, control and eventually measure the performance of the production processes in real time. In a nutshell, the data represent the key concept of Industry 4.0 and their correct analysis is the fundamental prerequisite for being able to successfully implement the

digital transformation of the factory, as we will also see in the "Piano Nazionale Industria 4.0".
The present enabling technology, however, presents a criticality: as mentioned above, the enormous mass of data made available by the digitized company functions requires an accurate collection and analysis activity; without the infrastructure you risk finding yourself with a large amount of data in your hand without knowing how to exploit it.

Cloud computing

The Cloud is an IT infrastructure that allows the storage, retrieval and management of data from a shared platform between multiple users with the appropriate login credentials (Michele Rossi, Marco Lombardi, 2017). Therefore, through this technology it is possible to manage the enormous amount of data generated by the sensors characterizing the IoT described above. Cloud Computing is usually a service provided by third party according to the methods, times and costs decided by the users. The main criticality deriving from the adoption of a Cloud infrastructure concerns, without any doubt, data security: a possible data hacking can potentially cause enormous losses for the company.

Cybersecurity

The term Cybersecurity includes all the practices, technologies and procedures aimed to safeguard data security and defense against cyber attacks on servers, infrastructures and production systems (Michele Rossi, Marco Lombardi, 2017). As described by the following definition, IT security does not only concern the adoption of more or less advanced systems of antivirus and hacker protection, but also includes activities such as the identification of those that can be considered critical information, in order to to restrict access only to authorized persons and to take measures to prevent their hacking.

Additive manufacturing

From a technological point of view, three-dimensional printers do not constitute a recent innovation; however, their evolution over time has led to the possibility to produce any type of product with a reduction in waste and with a growing number of production materials. The opportunity to shape a physical object starting directly from a digital file, represents an enormous opportunity for the reduction of time-to-market, mass customization, and cost reduction of production and stocks.
The main advantage of this technology consists in the possibility of producing components with any geometric shape, avoiding having to produce numerous components to be assembled at a later time. On the other hand, however, it is a very expensive technology.

Advanced robotics

As in the case of three-dimensional printers, robots are now a widespread technology within companies, but advanced robotics refers to progress. This expression, in fact, refers to what are called CoBots (Collaborative Robots), designed with the aim of working closely with humans by sharing workplaces with them.
These machines are equipped with sensors that allow them to recognize the presence of any operators and to stop if a collision with one of these occurs, guaranteeing a continuous control of the surrounding environment, drastically reducing the probability of serious accidents.
We must say, however, that these robots require the intervention of a worker to be started, so it is necessary to train people to interface in the most appropriate way with these new technologies.
The ease of reprogramming these machines allows them to be placed in numerous work areas, giving flexibility to production processes.
The more the CoBots are integrated with other enabling technologies such as, for example, IoT, Big Data and Cloud Computing, the more it will be possible to implement the machine learning, that is the machine's ability to learn independently without the need to be constantly reprogrammed.

Augmented reality

Through the use of particular devices, defined as “wearable”, it is possible to view the real world enriched with real virtual objects that allow the operator to get hold of a mass of data way far than those it would have access without using these devices.
This allows you to drastically simplify operations very complex such as, for example, maintenance and repairs; in fact, the possibility of visualizing detailed intervention methods while carrying out a critical activity represents a huge opportunity made possible by the following technology.

3.3 Piano Nazionale Industria 4.0

The "Piano Nazionale 4.0 " is a plan formulated by the Ministry of Economic Development of the Italian Republic which consists on a set of economic measures and facilities aimed to stimulate the development of the industry 4.0 through private investments.
The objective of the plan is to promote investments for innovation and the competitiveness of businesses, especially those concerning SMEs.
The plan is an opportunity for all companies that want to catch the opportunities associated with the fourth industrial revolution. It provides for concrete measures based on some guidelines [1]:

- Operate in a logic of technological neutrality;
- Intervene with horizontal and not vertical or sectoral actions;
- Act on enabling factors;
- Orient existing tools to help the technological leap and productivity;
- Coordinate the main stakeholders without playing a leadership role.

The plan aims at the creation of enabling network infrastructures that can guarantee data security and protection, collaborate for the definition of international standards, innovative investments as regards research costs, growth of private investment in the development of enabling technologies.
The plan has also the goal of creating skills, stimulating research through training courses and spreading the knowledge and the potential of technologies for the company.
Among the main actions envisaged within the plan, which will benefit Italian companies to digitalize their production processes, there are:

- Hyper and super-amortization: incentives to companies that intend to invest in new capital goods, tangible and intangible assets functional to the digitalization of production processes; an over-valuation of 250% of investments is envisaged for hyper-amortization and a super-valuation of 130% of investments for super-amortization;
- Nuova Sabatini: investments to purchase or lease machinery, plants, equipment, hardware, software and digital technologies. A contribution to interest is expected from 2.75% to 3.5%;
- Guarantee Fund: favor access to finance through the granting of a government guarantee which replaces the real guarantees provided by companies equal to 80% of the loan;
- Innovation agreements: industrial research and experimental development projects aimed at the realization of new products, processes or services, through the development of one or more technologies identified in the EU;
- Innovative startups and SMEs: for these types of businesses, simplifications in administrative and bankruptcy matters and some tax breaks to facilitate their creation have been envisaged;

[1] https://www.mise.gov.it/index.php/it/per-i-media/notizie/2037096-piano-nazionale-impresa-4-0-i-risultati-del-2017-e-le-linee-guida-per-il-2018

- Patent Box: optional tax regime, with a reduction of Ires and Irap rates up to 50%, for income from intangible assets deriving from the use of software protected by copyright or industrial patents;
- Research and development tax credit: stimulates private R&D spending for process and product innovation and to ensure greater future company competitiveness;
- Technology transfer certification: regarding training, consultancy and technology transfer services to companies for when it concerns cloud, cyber security, big data analysis and internet of things.

3.4 SMEs and Industry 4.0

SMEs represent the backbone of many economies. In particular, in the European Union 99% of the companies are SMEs, hire between 50 and 70% of the full time equivalent of people employed and they produce over 50 % of the gross value added (Müller, et al., 2018). Therefore, SMEs require research that help them in dealing with this new industrial revolution. The academic research should not treat SMEs as small scales of their large counterparts and therefore using the same theoretical approaches in the context of Industry 4.0. Rather, it should study SMEs as a single unit of analysis considering the key challenges of these firms:

1. low digitalization levels: the third industrial revolution has been mostly incomplete in SMEs due to organizational and structural reasons (Buonanno, et al., 2005):
   It has been shown, that in most cases, the choice of SMEs not to adopt ERP systems is not caused by financial constraints, but by structural and organizational reasons. Large companies implement such systems for process integration management and data management, while SMEs are more influenced by exogenous factors or temporary opportunities in choosing to adopt an ERP;
2. limited financial resources (Lubatkin, et al., 2006) that limit their capacity to experiment with Industry 4.0:
   Larger companies have greater and more diversified resources, SMEs, having limited financial resources, must have the ability to reconfigure their resources and adapt them to priorities.
   Among SMEs, changes in business priorities will depend on their owners. In fact, family ownership is associated with the discretion to manage, assign, add or supply company resources.
   Generally, the widespread adoption and use of turnkey IT applications were much more motivated by limited resources (human, material and financial) than a genuine strategic intent (Pellettier, et al., 2019);
3. limited managerial resources with not formalized managerial practices and centralized decision making (Cagliano, et al., 2001):
   The traditional technical excellence or operational flexibility of SMEs are no longer sufficient to promise good performance. Instead, SMEs need ever more formalised practices to gain competitive success, so it's important the adoption of advanced management practices for SMEs.

Due to these challenges, SMEs risk to be drive out of the market by more advanced competitors (Müller et al. 2018), their products becoming commoditized, or they may be relegated to the role of OEM supplier, with system integrators or who manage the data platform in control (Porter and Heppelmann, 2014). Yet, a study already acknowledges that "the smaller SMEs are, the higher the risk that they will become victims instead of beneficiaries of this revolution" (Sommer et al. 2015; pp 1).

Therefore, the necessity to build the required capabilities to exploit digital technologies in products and/or in processes is even higher for SMEs. Literature suggests the necessity to provide an internal integration of competencies, centralization of (already available) expertise (Agarwal and Brem, 2015) as well as strategic partnerships with other firms, industry associations and trade unions well as collaborations with higher education institutions (Kagermann et al., 2013). Despite these exceptions, literature has not yet proposed the capabilities required by SMEs to use and implement digital technologies in products and/or processes.

3.5 The interplay between Industry 4.0 and work organization: The role of technological complexity

The aim is to understand how industry 4.0 affects work organization, both at the micro level, therefore on the operators, and at the macro level, therefore on the organizational structure, described in terms of centralization of the decision-making process.
There is wide evidence that technological changes often fail due to organizational misalignment, such as lack of employees' empowerment to exploit the new technologies (e.g. Kolodny et al., 1996).
The work organization, as previously anticipated, can be studied in two different levels: the micro-level and the macro-level.
By micro-level we mean a design of the work of the individual roles in terms of: job breadth (also called task variety), as the number of tasks that an individual job has to perform; job autonomy, as the autonomy that an individual has in deciding time and methods regarding core activities; cognitive demand, as presence of monitoring or problem-solving activities; and social interaction, as the exchange of information with other individuals (e.g. Wall et al., 1990). The macro-level instead, typically refers to the centralization of decision making power and hierarchical structure (Mintzberg, 1980).

With reference to industrial technologies 4.0 it is necessary to remember again that companies that implement stand-alone technologies 4.0, instead of technologies 4.0 integrated across the different phases of the manufacturing process, do not have significant improvements in performance (Cagliano and Spina, 2000), the reason is that specific characteristics of work at the micro and macro-level might depend on the level of technological complexity, defined as number of technologies 4.0 implemented and level of integration between the different technologies.

The results of previous research show the following relationships:

TYPES OF CONFIGURATIONS	TECHNICAL SYSTEM	SOCIAL SYSTEM					
		Job control and autonomy	Job breadth	Cognitive demand	Social interaction	Centralization of decision making power	Hierarchy
Configuration 1: Process-automated Factory	Low number of SM technologies, integration mainly at production phases level	Prescription of all work procedures	Work specialization (Limited number of activities for each job)	Manual job	Individual job; interaction mainly with the team leader that coordinates individual work	Centralization at plant management level	Vertical organization
Configuration 2: Partially integrated Factory	Low-Medium number of SM technologies implemented, integration mainly at production processes level	Prescription of work procedures; autonomy in work procedures related to to controlling	Multi-tasking: activities related to production and control of the machines	Both manual and cognitive job	Formal team working; intra-team interaction	Centralization at plant management level	Vertical organization, with bottom-up flows of information
Configuration 3: Fully integrated Factory	Medium-High number of SM technologies implemented, mainly integration between production processes and other departments	Autonomy in work procedures related to controlling and problem solving	Multi-tasking: activities related to production, control and information gathering	Mainly cognitive job (control/decision making; information gathering)	Formal team working; intra-team and inter-team interaction	Decentralization at the team level on goal setting and problem solving activities	Transition from vertical organization to flatter organization
Configuration 4: Smart Factory	High number of SM technologies implemented, full integration of operation processes	Autonomy in work procedures related to controlling; problem solving and working methods	Multi-tasking: activities related to production, control of the machines	Cognitive job (control/decision making information gathering, information analysis)	Formal team working; intra team, inter-team, and across hierarchy interaction	Decentralization at team and worker level on work organization	Flat organization

Figure 7:Research results (Cagliano, 2019)

Findings show that for low levels of SM (Smart Manufacturing) technological complexity, the associated social system is characterized by not-empowered operators that have limited job breadth and job autonomy, and do mainly manual work with limited exposure to monitoring, control and decision-making tasks. Instead, in presence of higher levels of SM technological complexity, operators are empowered through higher levels of job breadth and job autonomy, and the cognitive demand they experience increases (Cagliano, 2019).

SM technology applications can be successfully implemented only “on top” of a coherent re-organization at the macro-level, with organizational choices being antecedents for the successful implementation of complex integrated SM systems, the types of SM technologies implemented and their level of integration along manufacturing processes are key variables to include when studying the effects of SM on the role of the operator and the micro-level work organization (Cagliano, 2019).

4. Research method

To answer to research questions, the thesis combines quantitative and qualitative data. The quantitative part of the research is based on an ongoing research project called FAI Digital, which investigate similar topics of this thesis but with an international orientation.

The acronym FAI Digital derives from the Digital transformation the Italian automotive supply-chain (from the Italian: trasformazione Digitale della Filiera Automotive Italiana). Coordinated by Politecnico di Torino, Collegio Carlo Alberto and the Center of Automotive & Mobility Innovation of Università di Venezia, the goal of the research project is to develop an analysis on the changes in Italian digital manufacturing. In particular, the research aims to understand the impact of new production technologies (including the different applications of robotics and related technologies, IoT, etc.) on business organization, work and organization of industrial sectors. The research focus on the automotive sector due to the importance of this sector in the Italian economy. An analysis of the state of digital transformation underway in the Italian automotive supply chain offers opportunities for understanding the phenomenon both for the actors directly involved, for policy makers and for society in general. The project intends to collect the necessary data through the FAI-Digital questionnaire to be sent to the population of Italian companies in the automotive sector for its compilation.

The questionnaire developed in this research have been used to complement field interviews and to compare a sample of Canavese SMEs with a sample of Italian SMEs.

4.1 Research design and empirical setting

We have developed a three-step methodology that will be described in this section.

- Quantitative research: collect the necessary data through the FAI-Digital questionnaire (Appendix A).
  The questionnaire is divided into three sections aimed respectively at the Personnel Director, Production / Factory Manager and Sales Manager.
  Part 1 - Questionnaire on human resources management - addressed to Personnel Directors
  Part 2 - Questionnaire on plant / business management - addressed to Production / Plant Managers
  Part 3 - Questionnaire on the relationship with the main customer - addressed to the Sales Manager.

- Case study research, inductive methodology through an In-Depth interviews: A case study is an empirical research investigating a phenomenon within its real context (Denzin and Lincoln, 1994). It is a methodology particularly appropriate to cope with

situations where there are more variables of interest than data points and where new phenomena are inquired (Yin, 2014).
Case studies are recommended in exploratory research, as they provide rich data and allow the investigation of contemporary managerial challenges (Yin, 2014).
The case study protocol was not strictly followed during the interview, although we tried to obtain information on every topic in the protocol.

- Data connection: The aim is to create a logical link between the quantitative results of the questionnaire and the inductive results of the interview.

4.2 Data collection and analysis

The research was submitted to 5 Canavese companies that are part of the automotive supply chain.

Quantitative research:

We have only analysed a few questions from the questionnaire, and they have been divided into two broad categories, the goal was to separate the information regarding the technologies from those concerning organizational aspects.

Categories:

- Group of content related to the same variable that are coded differently
- Categories are mutually exclusive

- Technological aspects:

Category	*List of technologies*	*Question*	*Scale*	*Question*	*Scale*
Automation and advanced manufacturing	Robots	Q4c-II	Ratio	Q4-II	Ordinal
	Collaborative robotics	Q4d-II	Ratio	Q4-II	Ordinal
	Other equipment with programmable controls (not including CNC machine tools)	Q4i-II	Ratio	Q4-II	Ordinal
	Machine vision technologies for automatic inspection and robot guidance	Q4e-II	Ratio	Q4-II	Ordinal
Digital twin / Virtualization	Human-machine interfaces (augmented and virtual reality, tablets and wearables)	Q4l-II	Ratio	Q4-II	Ordinal
	Simulation and visualization of production processes	Q4o-II	Ratio	Q4-II	Ordinal
	Types of simulation software (generic - specific - both generic and specific)	Q3q-II	Ordinal		
Vertical integration and horizontal integration	Equipment embedded with sensors	Q4b-II	Ratio	Q4-II	Ordinal
	Automatic data collection and integration from sensor to ERP level	Q9-II	Ordinal	Q4-II	Ordinal
	ERP module for Manufacturing Execution System (MES)	Q23-II	Dummy		

	ERP module for inventory and logistic management	Q23-II	Dummy		
	ERP module for sales management	Q23-II	Dummy		
	ERP module fo human resources management	Q23-II	Dummy		
	ERP module for accounting	Q23-II	Dummy		
Traceability	Traceability for final products	Q4g-II	Ratio	Q4-II	Ordinal
	Traceability for raw materials	Q4f-II	Ratio	Q4-II	Ordinal

Table 1: Technological aspects

- Organizational aspects:

Category	*Question*	*Scale*	*Min*	*Max*	
Data-driven decision making	Q10-II	Ordinal	1	3	Data-driven decision making
	Q11a-II	Interval	1	5	Data are on silos [reverse]
	Q11b-II	Interval	1	5	Data for preventive maintenance
	Q13a-II	Interval	1	5	Rarely we use root cause data to improve the process
	Q13c-II	Interval	1	5	Increase of data analysis to improve the process
	Q13h-II	Interval	1	5	Production indicators are monitored to all the personell
Process optimization	Q13b-II	Interval	1	5	Preventive maintenances procedures
	Q13d-II	Interval	1	5	Increase of process engineers since 2015
	Q17-II	Ordinal	1	3	Value stream mapping
Empowerment of production workers	Q15a-II	Interval	1	5	Process improvements
	Q15b-II	Interval	1	5	Process improvements since 2015 (reverse)
	Q15c-II	Interval	1	5	Analytical skills reduction due to IT
	Q15d-II	Interval	1	5	stress
	Q20a-II	Interval	1	5	lean production (2015)
	Q20b-II	Interval	1	5	lean production (2018)
	Q21a-II	Dummy	0	1	Suggestions
	Q21b-II	Ratio			Average number per operator
	Q21c-II	Ordinal	1	3	Suggestion since 2015
	Q22-II	Ratio			Training in lean production/continous improvement (% of workers)
Job control and autonomy	Q18a-II	Interval	1	5	repair and autonomous maintenance
	Q18b-II	Interval	1	3	trend since 2015
	Q19a-II	Interval	1	5	Authorization to stop production line
	Q19b-II	Interval	1	3	trend since 2015
Job breadth	Q14-II	Dummy	0	1	Set-up
	Q14-II	Dummy	0	1	Coding machine
	Q14-II	Dummy	0	1	Diagnosis of quality problems
	Q14-II	Dummy	0	1	Material inspection

	Q14-II	Dummy	0	1	Quality data to improve processes
	Q14-II	Dummy	0	1	Meeting with customers to solve quality issues
	Q14-II	Dummy	0	1	Use of computer or tablet to input and monitor production data
	Q13g-II	Interval	1	5	job rotation
HR policies	Q6a-I	Interval	1	5	Long tenure workers
	Q6b-I	Interval	1	5	Consulting for professional development
	Q7a-I	Ordinal	1	4	Policies for workers dimsissal
Vertical integration of data management	Q12a-II	Dummy	0	1	Collaboration with system integrator
	Q12b-II	Ordinal	1	3	Level of customization
	Q12c-II	Ordinal	1	3	Relationship
	Q11c-II	Interval	1	5	Data sent to system integrators
	Q3a-I f	Interval	1	5	Request for IT competencies
Vertical integration of production activities	Q2-II	Dummy	0	1	Number of performed production processes
Collaborative relationship with customers	Q13e-II	Interval	1	5	Collaborative relationship

Table 2: Organizational aspects

Case study research, inductive methodology through an In-Depth interviews

The interviews have been codified:
Type of codes

- **"in vivo codes"** (Glaser & Strauss, 1967): codes are the wording that participants use in the interview
- **Constructed codes**:
  - Conceptual ideas
  - Academic theory terms

Example:

Code	Quotes
Product and production process traceability	We have only a few products that need to be traced, such as the handbrake lever and other safety features.

Data connection

The codes and quotes of the interview have been inserted into the categories created in the first step, in this way we tried to contextualize the quantitative results of the questionnaire with the inductive ones of the interview, the goal is to undertake organizational strategies and the choices in terms of technology behind those values.

4.3 Study cases

Case	Size	Growth	Product	Position in the value chain	Main production processes
Firm 1	Small (230 employees, 101 emplyees italian plant) 3 plants	20%	Metal components for braking system	Tier-2	Press forging, mechanical processing
Firm 2	Small (112 employees italian plant) 3 plants	5%	Engine brackets, various injection pump supports, exhaust gas manifolds, pulleys, bearing bushes, fan supports, oil sumps and engine blocks for small, medium and large displacement engines.	Tier-2	Mechanical processing and assembly
Firm 3	Small (80 employees) 1 plant	13%	Backlit keys and keyboards	Tier-2	Plastic injection moulding
Firm 4	Small (54 employees) 1 Plant	34%	Expanded Polypropylene (EPP) components and packaging	Tier-2	Plastic injection moulding
Firm 5	Small (250 employees, 70 employees italian plant) 3 Plants	50%	Electronic boards	Tier-2	Assembly

Table 3: Study cases

The five companies chosen for the case study are scattered around the Canavese area, they are all tiers-2 of the automotive supply chain, despite working in different manufacturing sectors, and having different dimensions.
These companies, like others in the Canavese area, show considerable growth, despite the turbulent period in the automotive sector. The goal, as previously mentioned, is to identify the key success factors behind this growth.
In the results section it will also be shown that these companies also present different levels of technological maturity.

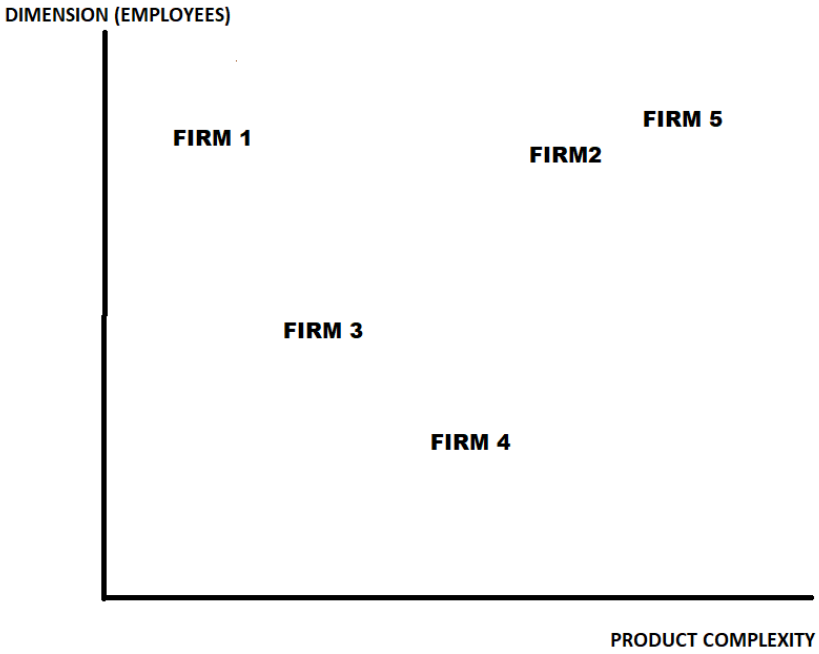

Figure 8: Study cases

RESULTS

5. Results

5.1 Technological aspects

AUTOMATION AND ADVANCED MANUFACTUIRNG

Category	Automation and advanced manufacturing								
Technology	Robots	Change of usage (2015-2018)	Collaborative robotics	Change of usage (2015-2018)	Other equipment with programmable controls (not including CNC machine tools)	Change of usage (2015-2018)	Machine vision technologies for automatic inspection and robot guidance	Change of usage (2015-2018)	Quotes
Firm 1	12	low growth (5-25%)	0	not used in 2015	10	wide growth (75-150%)	4	significant growth (26-75%)	"In recent years we have invested 4.5 million on 4.0 machines. We have modules designed for robotization, where one person operates two machines.We have added production complexity, with automated processing systems"
Firm 2	2	small change (+/- 5%)	0	low growth (5-25%)	5	small change (+/- 5%)	0	low growth (5-25%)	"We introduced a robot because the customer asked us for a very large order"
Firm 3	0	small change (+/- 5%)	1	low growth (5-25%)	0	not used in 2015	3	low growth (5-25%)	
Firm 4	1	small change (+/- 5%)	0	not used in 2015	2	not used in 2015	1	not used in 2015	"We have simple programming control systems"
Firm 5	0	not used in 2015	0	not used in 2015	0	significant growth (26-75%)	1	significant growth (26-75%)	

Table 4:Automation and advanced manufacturing

In general, the adoption of automation and advanced manufacturing technologies is not particularly growing, with the exception of equipment with programmable controls and machine vision technologies, growing in quality departments. The use of robots is essential when a large production capacity is required on certain products. The case studies analyzed show a Canavese where each company has specialized in a particular niche of a sector, therefore these companies mainly offer customized products on order, which

therefore do not require the use of robots. The robots were installed only in the event of specific customer requests, on particularly large orders.

"Before we produced 40000 pieces of that component, then the customer asked for 800,000 at half price, we accepted and consequently we automated the process." (Firm 4).

DIGITAL TWIN/VIRTUALIZATION

Category	Digital twin / Virtualization					
Technology	Human-machine interfaces (augmented and virtual reality, tablets and wearables)	Change of usage (2015-2018)	Simulation and visualization of production processes	Change of usage (2015-2018)	Types of simulation software (generic - specific - both generic and specific)	**Quotes**
Firm 1	30	wide growth (75-150%)	2	low growth (5-25%)	In use solutions not integrated with physical machinery (e.g. Excel, Arena, FlexSim etc.)	"On each machine we have inserted a tablet. The interface allows each operator to log in, and to enter all the information. If, for example, the machine stops, he inserts it and indicates the motivation and themaintenance, is a kind of digital card"
Firm 2	0	small change (+/-5%)	5	significant growth (26-75%)	In use solutions not integrated with physical machinery (e.g. Excel, Arena, FlexSim etc.)	
Firm 3	0	low growth (5-25%)	2	low growth (5-25%)	In use solutions that provide for the integration between the physical machine (s) and the modeling and / or simulation of its own behavior in the execution of the process	
Firm 4	5	wide growth (75-150%)	4	significant growth (26-75%)	In use solutions not integrated with physical machinery (e.g. Excel, Arena, FlexSim etc.)	
Firm 5	ND	low growth (5-25%)	10	Huge growth (>150%)	In use solutions that provide for the integration between the physical machine (s) and the modeling and / or simulation of its own behavior in the execution of the process	"It is a product that works on board the machine, they track production times and malfunctions of the machines."

Table 5: Digital twin/Virtualization

The process of digitalisation of machinery and connection with the management system remains a common goal for all the companies analyzed, two companies out of five have already begun to assemble human-machine interface systems, so that operators can

update machine information in real time, typing in case of malfunction, reasons of machine downtime and possible maintenance.

VERTICAL INTEGRATION AND HORIZONTAL INTEGRATION

Category	Vertical integration and horizontal integration							
Technology	Equipment embedded with sensors	Automatic data collection and integration from sensor to ERP level	ERP module for Manufacturing Execution System (MES)	ERP module for inventory and logistic management	ERP module for sales manageme nt	ERP module fo human resources management	ERP module for accounting	Quotes
Firm 1	80	Usually an operator detects the data, writes them on paper, and only later they are manually entered on a computer;Usually an operator detects the data and manually enters it on a terminal on the line / machine, from which the data is sent to a computer;Sensors on the machines transmit data to one of the various company information systems that manage the production activity (eg MRP) in a non-integrated way;	Production	Warehouse / Logistics	ND	HR	Accounting and management control	"Our next challenge is to connect production data to our management software, we need the data to go into our management system. To see the process parameters.All customers have a supplier portal, and we communicate our orders as well. There are few contacts with the establishments. "
Firm 2	10	Usually an operator detects the data, writes them on paper, and only later they are manually entered on a computer;	ND	Warehouse / Logistics	Sales	ND	Accounting and management control	"We still have to connect the machines on the network, and insert a human-machine interface on board the machine, to analyze the data, and connect with the office, to have access to data and everything else."
Firm 3	80	Usually an operator detects the data, writes them on paper, and only later they are manually entered on a computer;Usually an operator detects the data and manually enters it on a terminal on the line / machine, from which the data is sent to a computer;	Production	Warehouse / Logistics	ND	ND	Accounting and management control	"We are trying to digitalize production from presses, but now we are stopped, they are long processes, we need people who are dedicated to this, 24 hours a day; We are digitizing the order management"
Firm 4	90	Sensors on the machines transmit data to one of the various company information systems that manage the production activity (eg MRP) in a non-integrated way;	Production	Warehouse / Logistics	ND	ND	ND	
Firm 5	80	Sensors on the machines send data to a single integrated system (e.g. ERP) which manages data on production, human resources, accounting, sales;	Production	Warehouse / Logistics	Sales	ND	Accounting and management control	"Currently we have not yet received results as we have not yet finished the implementation, which lasted a year, it was a long journey and we had to adapt all the machines in the meantime;Now we are collecting data and very soon we will have a huge amount of data. Now we have foreseen the inclusion of a BI, a business intelligence because the data must also be analyzed in a more intuitive and efficient way possible "

Table 6: Vertical integration and horizontal integration

As mentioned in the theoretical background of Industry 4.0, all the advantages of this evolution arise from the interconnection and integration of the entire ecosystem, it is therefore necessary to digitize every business process.

Furthermore, in order to access government incentives such as those provided by the "Piano Nazionale Industria 4.0" it is necessary to obtain some requisites that are closely linked to the degree of interconnection.

TRACEABILITY

Category	Traceability			
Technology	Traceability for final products (%)	Change of usage (2015-2018)	Traceability for raw materials (%)	**Quotes**
Firm 1	80	wide growth (75-150%)	70	"On our products there is a code that allows you to know the entire production process: when I printed it, when I produced it and when I assembled it. From this code I get all the information on theproduct, dimensions, type of steel, molding lot, processing lot, quality control. "
Firm 2	20	low growth (5-25%)	20	
Firm 3	100	significant growth (26-75%)	90	
Firm 4	100	wide growth (75-150%)	100	"We have a code with a label applied to the packaging of tot pieces (according to the customer), there is a QR code that refers directly to the product code, to the lot and to those who packed it"
Firm 5	100	Huge growth (>150%)	90	"today we have batch tracking, with this system there will be traceability by product"

Table 7: Traceability

Traceability represents for some a guarantee on their product, for others an obligation dictated by the regulations, which make you civilly responsible for your product, in the event that it represents an element to be verified for the vehicle's safety.

Also in this case the digitalization of the production process represents an optimal solution.

Case 3:The company has recently started a process of manual traceability of a component, because the customer accused them of being guilty of a defectiveness on the final

component. In this case the presence of a digitized report of the production system, could have demonstrated the absence of defects on the component, without having to assign any manual task.

COMPARISON WITH QUESTIONNAIRE DATA

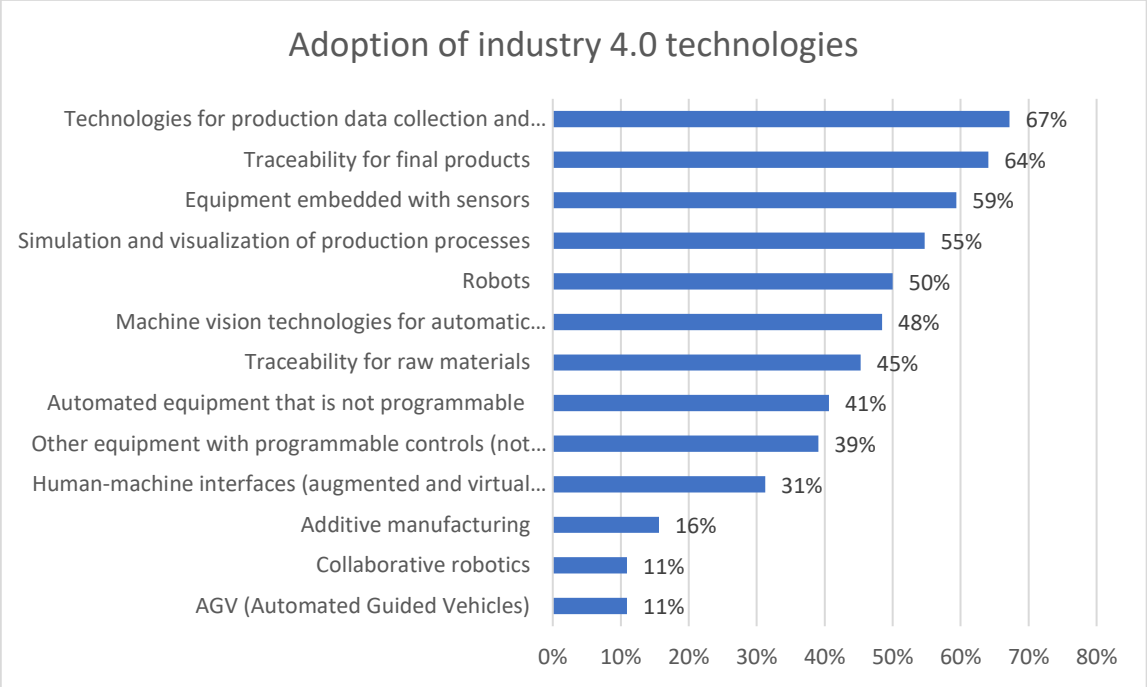

Table 8: Adoption of industry 4.0 technologies

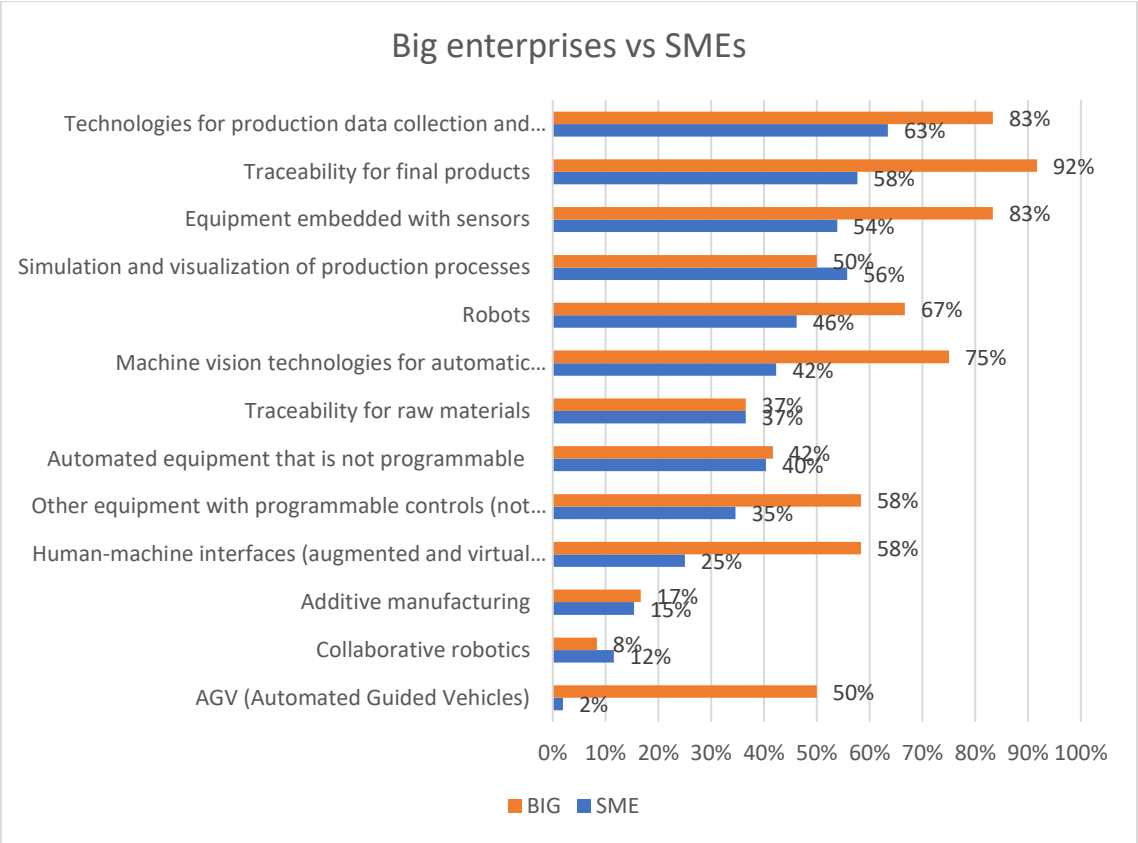

Table 9: Big enterprises vs SMEs

The data to which the tables above refer is a picture of the results obtained from the FAI digital research in the medium term. The samples refer to 74 companies, including those in the case study. SMEs are companies with fewer than 250 employees, large companies have more than 250 employees. The percentages refer to the number of companies compared to the number of those that have adopted at least one technology.

IoT of «machine» and «logistics / product», data analytics, simulation are the most adopted technologies, followed by Robot, machine vision, internal IoT, (non) programmable systems, human-machine interfaces. The use of additive manufacturing, collaborative robots, and AGVs is instead limited.

As we expected, large companies are more inclined to use technologies of this type, both thanks to the greater resources they have available, and to the greater need, due to a high complexity of business processes management.

6.2 Organizational aspects

DATA-DRIVEN DECISION MAKING

Category	Data-driven decision making						
Technology	Data-driven decision making	Data are on silos [reverse]	Data for preventive maintenance	Rarely we use root cause data to improve the process	Increase of data analysis to improve the process	Production indicators are monitored to all the personell	Quotes
Firm 1	We base decisions mainly on quantitative data analysis	2	5	1	5	5	"Our main goal in Industry 4.0 is to have a digitized data reporting, in order to learn how to manage the data, and to use them as drivers of corporate choices, to understand how much this costs me and what is the index of hours of processing. Our next challenge is to connect this data to our management software, we need the data we need to go into our management system. To see the process parameters."
Firm 2	We base decisions on a mix of intuition and data analysis, the quantitative analysis of data has a secondary role though	4	2	1 (very much in disagreement)	3	4	
Firm 3	We base decisions mainly on quantitative data analysis	5 (very much in agreement)	1 (very much in disagreement)	3	4	3	
Firm 4	We base decisions mainly on quantitative data analysis	4	2	3	4	2	"The data can be managed at various levels, the output data is verified by our production planner, who verifies that the cycle times are respected, updating the planned times and maintaining a data history for future planning."
Firm 5	We base decisions mainly on intuition or experience. Quantitative data analysis has a secondary role	3	2	3	5 (very much in agreement)	3	"Today we do data analysis, but the data we collect is not data that comes from the system integrator. Surely tomorrow we will be able to have much more precise data, something that today our system tracks, however, everything is left to the person who has to open the job"

Table 10: Data-driven decision making

As already anticipated in chapter 3, the data represent the key concept of Industry 4.0 and their correct analysis is the fundamental prerequisite for being able to successfully implement the digital transformation of the factory; the process of digitalisation of the company involves the production of a large amount of data, which must necessarily be collected and analyzed in order to become decisive for business decisions. The enormous amount of data made available by the company's digitalised functions requires careful collection and analysis; without the infrastructure you risk finding yourself with a large amount of data in hand without knowing how to exploit it.

PROCESS OPTIMIZATION

Category	Process optimization			
Technology	Preventive maintenances procedures	Increase of process engineers since 2015	Value stream mapping	Quotes
Firm 1	5	5	Yes, in a systematic or particularly structured way (on all operational processes that significantly affect our operating efficiency)	"The data on the percentage of waste is the last one we look at, what is important is the whole time lost in the entire process, and certainly using the WCM theory we started to examine the hours of work, realizing that there were too many hours lost, so we worked on it. We introduced the OEE parameter, we are at the beginning but we are starting to apply this theory, we are on an average of 65, to start talking about WCM we have to get to 85"
Firm 2	3	5 (very much in agreement)	Yes, but not in a systematic or particularly structured way (on a very limited number of operational processes)	"Last year as a WCM project we brought a SMED" "We have increased staff, before there were two engineers, now we are 4, it has doubled in less than a year." "The WCM was pushed by the customer, it was Marchionne who also extended it to the suppliers."
Firm 3	2	4	No	"We understood by ourselves that the implementation of 4.0 is necessary, because the times given by customers are always shorter"
Firm 4	2	Not applicable to this establishment	I don't know	"We must be very meticulous to save every tenth of a second possible, and this is what we try to teach to those who adjust the press. Now we are trying to insert a general monitoring at the cycle level, and not just a specific one for each machine"
Firm 5	5 (very much in agreement)	Not applicable to this establishment	Yes, but not in a systematic or particularly structured way (on a very limited number of operational processes)	"I can do so much on my times and my efficiency, and I do it because my competitors do it as well, I'm forced."

Table 11: Process optimization

The increase in production complexity that is characterizing the entire automotive sector inevitably has a strong impact on the entire supply chain, this translates into increasingly complex customer requests and very short delivery times, causing the need to introduce a greater number of process engineers.
Customer response times (time to market) determine your competitiveness in the market.

Also in this case the reactions of these SMEs are due to customer requests, such as the choice of Firm 1 and Firm 2 to implement the WCM system.

WORKERS

Category	Job breadth							
Technology	Set-up	Coding machine	Diagnosis of quality problems	Material inspection	Quality data to improve processes	Meeting with customers to solve quality issues	Use of computer or tablet to input and monitor production data	job rotation
Firm 1	Production workers (eg assembler, plant and equipment drivers, etc.)	Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);	Engineers and / or other graduates ";	Production workers (eg assembler, plant and equipment drivers, etc.)	Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);	Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);	Production workers (eg assembler, plant and equipment drivers, etc.)	5 (very much in agreement)
Firm 2	Production workers (eg assembler, plant and equipment drivers, etc.);Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);Engineers and / or other graduates ";	Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);Engineers and / or other graduates ";	Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);Engineers and / or other graduates ";	Production workers (eg assembler, plant and equipment drivers, etc.);Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);	Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);Engineers and / or other graduates ";	Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);	Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);Engineers and / or other graduates ";	3
Firm 3	Production workers (eg assembler, plant and equipment drivers, etc.);Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);	Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);Engineers and / or other graduates ";	Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);Engineers and / or other graduates ";	Production workers (eg assembler, plant and equipment drivers, etc.)	Engineers and / or other graduates ";	Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);	Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);Engineers and / or other graduates ";	2
Firm 4	Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);	Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);	Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);	Production workers (eg assembler, plant and equipment drivers, etc.)	Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);	Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);	Production workers (eg assembler, plant and equipment drivers, etc.)	5 (very much in agreement)
Firm 5	Production workers (eg assembler, plant and equipment drivers, etc.);Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);	Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);Engineers and / or other graduates ";	Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);Engineers and / or other graduates ";	Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);	Engineers and / or other graduates ";	ND	Production workers (eg assembler, plant and equipment drivers, etc.);Specialized specialized workers for whom a professional diploma or certification is required or specific work experience in the role (eg maintenance personnel, electricians, etc.);	3

Table 12: Job breadth

Category	Job control and autonomy			
Technology	repair and autonomous maintenance	trend since 2015	Authorization to stop production line	trend since 2015
Firm 1	2	3	5 (very much in agreement)	Much more encouraged
Firm 2	4	4	4	Equal
Firm 3	4	3	5 (very much in agreement)	Much more encouraged
Firm 4	2	3	5 (very much in agreement)	Much more encouraged
Firm 5	4	4	5 (very much in agreement)	Much more encouraged

Table 13: Job control and autonomy

Category	Empowerment of production workers										
Technology	Process improvements	Process improvements since 2015 (reverse)	Analytical skills reduction due to IT	stress	lean production (2015)	lean production (2018)	Suggestions	Average number per operator	Suggestion since 2015	Training in lean production/ continous improvement (% of workers)	Quotes
Firm 1	5	1	1	3	yes	yes	yes	3	Increased	90	"The organization of the workplace has changed a lot, always in the WCM chapter, so we did training, because before the operator could not even read the drawings, now there is the totem, there is the drawing, the core defects"
Firm 2	2	2	3	2	yes	No	yes	3	Increased	10	"We have been working on the WCM for some time: maintenance, warehouse ordering, personal suggestions. Acceptance is not easy for the worker who has worked here for 40 years, it is easier on young people."
Firm 3	5 (very much in agreement)	4	2	3	No	No	No	0	Equal (+/- 5%)	10	
Firm 4	5 (very much in agreement)	3	1 (very much in disagreement)	1 (very much in disagreement)	No	No	No	0	Equal (+/- 5%)	0	
Firm 5	5 (very much in agreement)	1 (very much in disagreement)	1 (very much in disagreement)	2	yes	No	No	0	Equal (+/- 5%)	5	"We do training, now every year we ask the department managers to do hours of training on new technologies"

Table 14: Empowerment of production workers

Category	HR policies			
Technology	Long tenure workers	Consulting for professional development	Policies for workers dimsissal	Quotes
Firm 1	5 (very much in agreement)	4	We have invested in automation / digitization which, however, have not caused changes in the number of employees	
Firm 2	5 (very much in agreement)	4	We have invested in automation / digitization which, however, have not caused changes in the number of employees	"The worker who has been here for 40 years is harder to get used to"
Firm 3	4	5 (very much in agreement)	We have invested in automation / digitization which, however, have not caused changes in the number of employees	
Firm 4	5 (very much in agreement)	5 (very much in agreement)	We have invested in automation / digitization which, however, have not caused changes in the number of employees	"60% of our employees have been with us for more than 25 years, 30% have been here for over 35 years"
Firm 5	5 (very much in agreement)	3	We have invested in automation / digitization which, however, have not caused changes in the number of employees	"We have the disadvantage of having staff with us for a lot of years and the more the staff is used to working in a certain way and the more difficult it is"

Table 15: HR policies

All the case studies show awareness of the main changes in work organization. Since these are family-run SMEs, they also show a strong connection with their staff, which results in very low staff turnover, so in these SMEs there are people who have been working there for more than 40 years, and it is with these that there are major problems in implementing these changes in work organization.

As shown in the first table, the skills required at work are always higher, demonstrating the growth of the medium skills required, mainly due to the increase in IT tools. The increase in job rotation programs is proof of this.

An increase in skills also translates into increased responsibility for the worker: more autonomy at work, repair and maintenance tasks, authorization to stop the line. The growth trends shown in the second and third table confirm these statements.

DATA MANAGEMENT

Category	Vertical integration of data management					
Technology	Collaboration with system integrator	Level of customization	Relationship	Data sent to system integrator	Request for IT competencies	Quotes
Firm 1	Si	We define the technical specifications and start the design phase, the system integrator completes the detailed project, develops the integration and creates the system	We typically have a continuous relationship with a system integrator that helps us improve the functioning of the automation.	ND	3 (they will be necessary and will not be easy or difficult to find them)	"We chose [the MES] based on experience, we have a Canavese solution.We then did a sort of Joint Venture to get a customized product for us "
Firm 2	Si	We define the technical specifications and start the design phase, the system integrator completes the detailed project, develops the integration and creates the system	There are few system integrators that we can refer to and we turn to them alternately	1 (very much in disagreement)	3 (they will be necessary and will not be easy or difficult to find them)	
Firm 3	Si	We use solutions proposed by the system integrator with limited degree of customization	We typically have a continuous relationship with a system integrator that helps us improve the functioning of the automation.	1 (very much in disagreement)	3 (they will be necessary and will not be easy or difficult to find them)	
Firm 4	No	ND	ND	1 (very much in disagreement)	These figures are not and will not be necessary in this establishment	"There is a local company that takes care of our IT, together we have created a system specifically for us"
Firm 5	No	ND	ND	1 (very much in disagreement)	3 (they will be necessary and will not be easy or difficult to find them)	"We have a special system for those who produce electronic boards"

Table 16: Vertical integration of data management

The table shows that, wherever possible, companies look for solutions in the area, developing customized IT products. This is a peculiarity that in the interviews came out on the whole supply chain of these companies, most of these companies, where possible, they choose local suppliers, contributing to the development of the territory.

VERTICAL INTEGRATION

Category	Vertical integration of production activities	
Technology	Number of performed productions processes	Quotes
Firm 1	Main process of the plant (> 30% of revenues or employees): - Molding processes - Production of molds - Tempering THF and laser -Assemby -Mechanical processing	"From the 80s our company began to offer mechanical processing on the product in addition to the molding process"
Firm 2	Main process of the plant (> 30% of revenues or employees): -Assemby -Mechanical processing Processes carried out in this establishment (but not the main ones): - Tooling production - Welding, balancing	"We have our own tooling production, nobody else does it"
Firm 3	Main process of the plant (> 30% of revenues or employees): - Molding processes - Plastic and rubber processing Processes carried out in this establishment (but not the main ones): - Production of molds -Mechanical processing -Assemby	"Since 2000 we have been managing a very large supply chain, we manage it because we have many suppliers that offer us services to give our customers a complete service. We are vertically integrated, from equipment design, to plastic material consultancy, to aesthetic finishes, and therefore we manage the entire production chain behind it. One component has many processing, painting, chrome, finishing, and they are all managed by our company, the customer no longer takes care of all these steps, there is a need for skills, so we have acquired them all"
Firm 4	Main process of the plant (> 30% of revenues or employees): - Molding processes - Plastic and rubber processing Processes carried out in this establishment (but not the main ones): - Production of molds -Mechanical processing -Assemby	"We produce our molds, it gives us a very fast time to market"
Firm 5	Main process of the plant (> 30% of revenues or employees): -Assemby Processes carried out in this establishment (but not the main ones): - Testing of electronic boards	"We also offer the possibility of testing the electronic boards here"

Table 17: Vertical integration of production activities

All the companies in the case study show a high degree of vertical integration, the interviews have highlighted how this is a strategic choice, to develop a greater number of skills, and to manage all the steps of the production process of its component, offering in this way a complete and reduced service to its customers.
Managing the entire production process reduces time and eliminates any communication defects, all factors that allow you to be more competitive, in a sector where a good time to market is essential.

ROLE OF CUSTOMERS IN NEW PRODUCTS DEVELOPMENT

Category	NPD capability	
Technology	Role in new product development	Quotes
Firm 1	the responsibility for product development was managed entirely by the customer;you have participated with the client in VA / VE (Value Analysis / Value Engineering) activities;	"it happens that the customer is developing a particular component and therefore making proposals, but in general we have specific skills."
Firm 2	you and the customer and have contributed equally to the design;you had all the responsibility in charge;you have collaborated with the customer in the specification of the component interfaces or in the design of components related to the product;	
Firm 3	product development responsibility was managed entirely by the customer;	"Since 2000 we have acquired the skills that before were all own by our client. If we were suddenly canceled, the customer would no longer know how to do it, it takes years, for example we have been working on painting for 19 years."
Firm 4	you and the customer and have contributed equally to the design;you have used the finite element method (FEM) or other simulations for this product;	
Firm 5	product development responsibility was managed entirely by the customer;most of the planning was carried out by the customer;	

Table 18: NPD capability

The increase in the degree of vertical integration of these SMEs often translates into greater responsibility in product development, in fact as these companies manage the entire production process of their components, the end customer consequently starts losing skills.

6.3 Summary of results

TECHNOLOGICAL ASPECTS

Category	*Results*
Automation and advanced manufacturing	- Robots are used when large production capacities are required by the customer; - The Canavese companies specialize in particular sector niches, therefore they mainly offer customized products and do not have a great need for automation systems; - The data are consistent with those of the other SMEs analyzed in the FAI DIGITAL research
Digital twin / Virtualization	- The process of digitalisation of machinery and connection with the management system remains a common goal for all the companies - Just two companies out of five have already begun to introduce human-machine interface systems - The data are consistent with those of the other SMEs analyzed in the FAI DIGITAL research
Vertical integration and horizontal integration of main business processes	- Sensors and human-machine interface systems have been introduced, but the data connection process between these and the ERP is not yet automatic, the interconnection is missing - ERP information systems are used for almost all the main business processes (less used in HR) - The data are consistent with those of the other SMEs analyzed in the FAI DIGITAL research
Traceability	- Traceability represents for some a guarantee on their product, for others an obligation dictated by the regulations, which make you civilly responsible for your product - Not in all cases traceability is automatic, the interconnection between machines and information system would guarantee an automatic traceability - The data are consistent with those of the other SMEs analyzed in the FAI DIGITAL research

Table 19: Results technological aspects

ORGANIZATIONAL ASPECTS

Category	*Results*
Data-driven decision making	- The data represent the key concept of Industry 4.0. the enormous amount of data made available by the company's digitalised functions requires careful collection and analysis - Companies show that they understood the importance of data management, despite a low degree of digitization, data have been already used as drivers for decisions making - Increase of data analysis to improve production processes and operational procedures
Process optimization	- Greater product complexity - The increase in production complexity that is characterizing the entire automotive sector inevitably has a strong impact on the entire supply chain, this translates into increasingly complex customer requests and very short delivery times, causing the need to introduce a greater number of process engineers.
Empowerment of production workers	- An increase in medium skills consequently requires continuous training courses for workers, the companies of the case seem to have perceived this need - Changing the organizational systems of work is much more difficult with the staff who have been in the company for years, it is difficult to change the mentality of those who have been always used to work with a specific method
Job control and autonomy	- An increase in skills also translates into increased responsibility for the worker: more autonomy at work, repair and maintenance tasks, authorization to stop the line
Job breadth	- Medium skills growth
HR policies	- Very low staff turnover - The process of automation / digitization does not cause a staff reduction, but only a change in the work method
Vertical integration of data management	- Search for customized IT solutions - Where possible, they choose local suppliers
Vertical integration of production activities	- High degree of vertical integration - Developing more skills - Management of the entire production process - Elimination of any communication defects - Better time to market
NPD capability	- Greater responsibility in product development

Table 20: Results organizational aspects

6. Results analysis

- What is the level of diffusion of Industry 4.0 of SMEs in the Canavese area? Which technologies are used? for what purposes? Comparison with other Italian firms located elsewhere in Italy?

The results of the questionnaires show a low level of technology diffusion, but in any case consistent with the other SMEs of the FAI Digital research.

The digitization of production and management processes is a transformation that requires numerous difficulties and very long times in SMEs, the impression is that they have already perceived the positive impacts that these technologies can have on the organization of work, despite the companies analyzed are still working / starting to integrate management systems with machines in order to obtain a digitalized data reporting, no one has yet figured out how to exploit it full potential, so as to make data analysis become the real driver for strategic decisions.

The only data that are slightly different from the database average are in the 'DATA DRIVEN DECISION MAKING', in fact in the five companies the decisions begin to be based on the quantitative analysis of the data. This is a revolution in SMEs, because decisions are often driven by the intuition and experience of the entrepreneur and workers. This passage represents a change of culture.

The enormous amount of data made available by the digitized company functions requires an accurate collection and analysis activity (Firm 5: "*this is a cultural change that must be made, it will take some time, we want to sensitize the management to work, we will also give specific objectives of efficiency to stimulate the change of mentality calibrated on each process, in order to sensitize the management , department heads, operators and the whole scale. It is clear that there is some time*") therefore it needs specific infrastructure and resources that a SME finds on average in a long time.

Where a precise technology has been introduced (robot, man-machine interface, sensors ...), the motivation has always been closely linked to particular customer requests (Firm 2: it has just two robots, introduced to follow a specific customer request, which consists of increasing production capacity), or to increase its competitiveness in terms of production (Firm 3: "*We understood for ourselves that the implementation of 4.0 is necessary, because the times given to us by customers are always shorter*").

Besides infrastructure and resources, other factors that limit the introduction of new technologies are mainly related to the staff, in fact the implementation of these systems requires time and qualification, and the problems of introducing qualified personnel will be later highlighted. Moreover, we analysed family-run companies, characterized by a very strong relationship with the staff, which causes a low staff turnover , so they encounter numerous problems in transmitting the change of work methodology imposed by new technologies to employees of a certain age, got used to working in the same way for 30-40 years.

The results found show that it is still too early to be able to make an impact assessment of 4.0 technologies on SMEs, some are at the beginning, those who are ahead have not yet learned how to manage data, consequently they cannot evaluate their impact.

While we have already answered the first question, it is now fundamental to frame the remaining results in order to answer the other questions:

- As a result of this evolution, what organizational changes are required for SMEs, despite limited resources?

- What are the key success factors of the Canavese SMEs?

Through a SWOT analysis we want to identify the internal and external factors that are favorable and unfavorable to achieving those objectives. With this method we can ask and answer questions to generate meaningful information for each category to make the tool useful and identify their competitive advantage.

To complete this analysis, and answer the research questions, we will use even other information collected during the interviews, which have not been included in the previous results.

STRENGHTS

- **Business model shaped on customer care**:
  With this statement we mean a way of organizing resources, internal or external to the company, to ensure that daily operations support the Customer Care strategies and the business objectives of the Company with continuity and balance
- **Vertical integration**:
  In all the cases analyzed, over the years the companies have become increasingly vertically integrated, adding product complexity and subtracting know-how from the customer (Firm 3 *"Since 2000 we have acquired the skills that before were all own by our client. If we were suddenly canceled, the customer would no longer know how to do it, it takes years, for example we have been working on painting for 19 years."*). Other advantages of this strategy, highlighted by entrepreneurs, are the reduction of time to market, and the elimination of any communication defects
- **Best practices from big firms:**
  (Firm 1: "*There are numerous examples of SMEs that over the years have succeeded in doubling / tripling the turnover, but going through this scheme: applying the methods of big firms in SMEs*"
  The feeling of the entrepreneurs is that their growth has been driven by big firms, to implement their methods they can hire personnel with experience in such companies, letting themselves be influenced by their way of working.
  It is also necessary to exploit the opportunities for growth that the customer offers you, such as the implementation of WCM method
- **Willingness to enter new markets:**
  The history of these Canavese SMEs is strongly linked to this ability, in fact they are companies that during their history, have been able to adapt to the various needs of market and customers (Firm 4 *"One day a customer told us that polystyrene had just been invented, so my father went to Germany to study the product, and then we bought the presses to process it")*

- **Specialization of a niche:**
  The Canavese is an example of a territory that has been able to found entire blocks of the automotive supply chain, creating an ecosystem in which each company has specialized in a particular sector, adding value to the final product offered, and creating a supply chain with a reduced time to market
- **Great influence of Olivetti's skills:**
  The companies that have been successful in the Canavese area have been heavily influenced by Olivetti
  directly: exploiting the skills of the Olivetti outgoing resources
  indirectly: exploiting a social structure based on work culture.

WEAKNESSES

- **Limited financial resources**
- **Low staff turnover:**
  As we already mentioned in these SMEs there are people who have been working there for more than 40 years, generally, young people have a better learning ability, therefore they manage to adapt quickly to new changes and they are potentially more stimulated by technological development projects
- **Struggle to hire qualified personnel:**
  The factors that influence this issue are mainly two:
  1. Less attractive than the big firm (Firm 3 *"But the young resources remain few time with us, they receive other proposals that they do not refuse, it is not a question of money, but of experience")*
  2. Location far from the big cities

  These two factors are even more influential when they try to hire young staff.

OPPORTUNITIES

- **Possible increase in bargaining power:**
  Arising from the continuous acquisition of know-how due to vertical integration (Firm 3 *"Since 2000 we have acquired the skills that before were all own by our client. If we were suddenly canceled, the customer would no longer know how to do it, it takes years, for example we have been working on painting for 19 years."*)
- **Contacts with universities and institutions:**
  Researches like these allow small and medium-sized enterprises to talk about themselves to institutions and universities, bringing out their problems and difficulties, and seeking common solutions (example: POLITO Recruiting day is already a solution to the problems of search for young qualified personnel, but SMEs must open up to these opportunities)

- **Generational change:**
  Take advantage of the generational change that is occurring in the companies analyzed to achieve the organizational changes required by digital evolution
- **Opportunities made available by new technologies:**
  Firm 5 has opened a small research center near the Polytechnic of Turin, to attract young engineers, solutions like this, thanks to technology, will always be easier to adopt, due to greater efficiency of remote working.

THREATS

- **Continuous technological progress:**
  The only solution to this problem is to offer constant training programs, so as to be able to follow technological progress
- **Risk diversification:**
  Looking at the trend of the automotive sector, it is still advisable to diversify your risk by opening up to new markets, or at least trying to diversify your customers as much as possible, avoiding that your business depends too much on a specific customer.

7. Conclusion

As already demonstrated, the analyzed Canavese SMEs present a degree of technological maturity absolutely consistent with the SMEs of other territories, it is therefore necessary to look more deeply into the organizational aspects of these cases in order to understand what are the success factors of the companies in this territory.
The jobs lost after the the Olivetti's fall were a huge amount compared to the limited size of the territory involved and this phenomenon could have led to an irreversible crisis. Instead, a transformation process was initiated by those who were already entrepreneurs and by a significant number of former managers and employees who, forced by events, created a large number of companies both in sectors of traditional specialization and in new sectors. These substantial changes have occurred over such a short period of time that they are not clearly perceived in their complexity.
The Canavese SME system is the result of the de-verticalization processes of the large enterprise: Indeed, the influence of Olivetti on these analyzed companies is heavy, despite its failure, whose reasons are still partly unknown, we are still talking about a Company, which was a precursor for the electronics and IT sector, and with the most innovative social structure for workers. All these skills have undoubtedly represented a valuable starting point for the development of these companies.
The work culture has led to entrepreneurship in manufacturing highly specialized in mechanics, inevitably, after the fall of Olivetti, Canavese's successful SMEs with a business deeply tied to them, were able to reshape their businesses by exploiting another big market on the territory, the automotive one, developed by Fiat.
Thus a new supply chain for the automotive sector was born, in a territory already structured to supply a big customer. This structure is the same that allowed these SMEs to grow continuously, integrating themselves vertically, and creating an increasingly complex and structured supply chain. The ability to develop into niches, and to create a complete supply chain, is the real key success factor of these companies.
In the end, the results shows a surprising match up with Cagliano et. al 2001 findings, SMEs operating within big supply chains can play an increasing role, only if they follow the standards and requirements set by the focal companies. The Canavese SMEs, always used to grow with their customers, are continuing to move in this direction, their growth is certainly driven by focal companies. In this context, the traditional technical excellence or operational flexibility of SMEs are no longer sufficient to promise good performance. Instead, SMEs need ever more formalised practices to gain competitive success. In this context, the strategy of applying advanced managerial methods of big firms to SMEs is certainly a winning strategy, also thanks to the influence it has on the whole territory.

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Ricerca sulla Trasformazione Digitale della Filiera Automotive Italiana (FAI digital)

OBIETTIVI DELLA RICERCA: Il progetto di ricerca intende sviluppare un'analisi dei processi di cambiamento della Filiera Automotive Italiana. In particolare, la ricerca mira a capire l'impatto delle tecnologie digitali (es. Big Data, Internet of Things, Robotica Collaborativa) sui processi di produzione sull'organizzazione d'impresa, sul lavoro e sulle relazioni inter-organizzative nella filiera automotive italiana. La ricerca prevede un questionario diviso in tre sezioni rivolte rispettivamente a Direttore del personale, Direttore di produzione/stabilimento e Responsabile commerciale.

Parte 1 - Questionario sulla gestione delle risorse umane – rivolto ai Direttori del Personale
Parte 2 - Questionario sulla gestione dello stabilimento/impresa – rivolto ai Direttori di produzione/stabilimento
Parte 3 – Questionario sulla relazione con il cliente principale – rivolto al Responsabile Commerciale

IL TEAM DI RICERCA
Università Ca' Foscari Venezia
Collegio Carlo Alberto
Politecnico di Torino

I DATI OTTENUTI VERRANNO GESTITI CON LA MASSIMA RISERVATEZZA E IN ACCORDO CON LE PRESCRIZIONI DI LEGGE. NON VERRA' RILASCIATA alcuna informazione DI DETTAGLIO che permetta di identificare gli intervistati o le relative imprese. I dati raccolti verranno utilizzati per solo finalità scientifiche.

IL SUO RISCONTRO È MOLTO IMPORTANTE PER NOI. Se possiamo assisterla in qualsiasi modo o se ha commenti o domande relative alla ricerca può scriverci a faidigital@polito.it, indicando un numero di telefono di recapito. In seguito alla sua e-mail verrà ricontatto telefonicamente da un membro del team di ricerca.

RESTITUZIONE DEI RISULTATI. Qualora decidesse di prendere parte a questa ricerca, provvederemo ad inviarvi un rapporto di benchmarking di posizionamento della vostra impresa basato sui risultati della ricerca non appena saranno disponibili. All'inizio di ogni sezione può indicare una e-mail presso quale ricevere tale rapporto. Riceverà, inoltre, una copia del questionario in formato pdf una volta registrate le risposte.

Parte 1. Gestione delle risorse umane

La presente sezione del questionario è rivolta principalmente al Responsabile delle risorse umane o ad una persona da lui/lei delegata

Nome e cognome del rispondente _____
Indirizzo e-mail (presso cui ricevere copia del questionario compilato e rapporto di benchmarking):
_____
Ruolo in azienda: _____
Nome dell'Impresa/stabilimento:_____

Sezione A: Caratteristiche della forza lavoro

1a. Approssimativamente, quanti addetti di questo stabilimento ricadono nelle seguenti categorie? (Valori medi per il 2018)

	Addetti a tempo indeterminato	Addetti a tempo determinato o temporanei
a. **Addetti diretti alla produzione** (es. addetti all'assemblaggio manuale)		
b. **Conduttori di impianti e macchinari**		
c. **Addetti indiretti alla produzione** (manutenzione, logistica, magazzino, specialisti di qualità)		
d. **Addetti amministrativi, di vendita e di supporto alle attività produttive** (IT di fabbrica, contabilità industriale e di fabbrica, responsabili tecnici dei clienti etc.)		
e. **Altri addetti di stabilimento**		
f. Totale addetti (a+b+c+d+e)		

1b. Approssimativamente quanti addetti in questo stabilimento ricadono nelle seguenti categorie? (Valori medi per il 2018)

	A tempo indeterminato	A tempo determinato o temporanei	Stagionali (somministrazione, ex interinali)
a. **Lavoratori non qualificati (es. assemblatori, etc.)** CCNL metalmeccanico o CCNL equivalente inferiore a 3^ livello			
b. **Lavoratori qualificati/specializzati** per cui è richiesto un diploma professionale o certificazione o esperienza di lavoro specifica nel ruolo (es. manutentori, elettricisti, etc.) CCNL metalmeccanico tra 4^ e 6^ livello			
c. **Ingegneri e/o altri laureati per attività di produzione** (CCNL metalmeccanico superiore a 6^livello)			
d. Totale (a+b+c)			

1c*. Qual è l'età media degli addetti nello stabilimento? _____ [età media, in riferimento al 2018]

1d*. Approssimativamente, qual è la percentuale di:

- Donne _____%
- Uomini _____%

2. Qual è stato nel 2018 il numero medio di ore di formazione per dipendente? Non deve essere inclusa la formazione obbligatoria per legge

____ ore

3a*. Da qui ai prossimi quattro anni, quanto sarà difficile trovare le seguenti specifiche figure professionali per questo stabilimento?

	Queste figure **non** sono e non saranno necessarie in questo stabilimento	**1** (saranno necessarie e sarà **molto facile** trovarle)	**2** (saranno necessarie e sarà **facile** trovarle)	**3** (saranno necessarie e non sarà **né facile né difficile** trovarle)	**4** (saranno necessarie e sarà **difficile** trovarle)	**5** (saranno necessarie e sarà **molto difficile** trovarle)
a. supervisor di produzione	○	○	○	○	○	○
b. team leader di produzione	○	○	○	○	○	○
c. addetti alla programmazione della produzione	○	○	○	○	○	○
d. addetti alla gestione della manutenzione	○	○	○	○	○	○
e. addetti alla gestione della qualità	○	○	○	○	○	○
f. tecnici informatici	○	○	○	○	○	○
g. sviluppatori software/web	○	○	○	○	○	○
h. esperti di analisi dati	○	○	○	○	○	○
i. programmatori robot	○	○	○	○	○	○
l. programmatori CNC	○	○	○	○	○	○
m. programmatori PLC	○	○	○	○	○	○
n. tecnici commerciali (vendite),	○	○	○	○	○	○
o. addetti agli acquisti	○	○	○	○	○	○
p. addetti alla contabilità e al controllo di gestione	○	○	○	○	○	○

Altro (indicare eventuali altre figure professionali chiave che potrebbe essere difficile trovare, specificando tra parentesi un numero da 1 a 5 relativo al grado di difficoltà)

_____
_____
_____

3b*. Quale titolo di studio ha prevalentemente chi svolge le seguenti mansioni:

	Non applicabile (figura non presente in stabilimento)	Scuola media inferiore	Diploma (istituti tecnici o licei)	Laurea Triennale	Laurea Magistrale
a. supervisor di produzione	○	○	○	○	○
b. team leader di produzione	○	○	○	○	○
c. addetti alla programmazione della produzione	○	○	○	○	○
d. addetti alla gestione della manutenzione, addetti alla gestione della qualità	○	○	○	○	○
e. tecnici informatici, sviluppatori software/web	○	○	○	○	○
f. programmatori robot, programmatori CNC, programmatori PLC	○	○	○	○	○
g. tecnici commerciali (vendite), addetti agli acquisti	○	○	○	○	○
h. addetti alla contabilità e al controllo di gestione	○	○	○	○	○

3c*. Si prega esprimere il vostro grado di accordo o disaccordo con la seguente affermazione:
"Quando vengano assunte da noi in azienda, le seguenti figure hanno già un grado di formazione sufficiente per svolgere le attività richieste"

	Non applicabile (figura non presente in stabilimento)	**1** (molto in disac-cordo)	**2** (abbastan-za in disac-cordo)	**3** Né d'accor-do né in disaccordo	**4** (abbastanza d'accordo)	**5** (molto d'ac-cordo)
a. supervisor di produzione	○	○	○	○	○	○
b. team leader di produzione	○	○	○	○	○	○
c. addetti alla programmazione della produzione	○	○	○	○	○	○
d. addetti alla gestione della manutenzione, addetti alla gestione della qualità	○	○	○	○	○	○
e. tecnici informatici, sviluppatori software/web	○	○	○	○	○	○
f. programmatori robot, programmatori CNC, programmatori PLC	○	○	○	○	○	○
g. tecnici commerciali (vendite), addetti agli acquisti	○	○	○	○	○	○

h. addetti alla contabilità e al controllo di gestione	○	○	○	○	○	○

3d*. Relativamente alle figure di cui alla domanda precedente: in seguito all'assunzione, svolgete ulteriore formazione per sviluppare, integrare e/o aggiornare le loro competenze?
(è ammessa la risposta multipla):

- ☐ Sì, interna (es. corsi e workshop organizzati dalle risorse umane e/o dai responsabili di reparto)
- ☐ Sì, esterna, utilizzando scuole di formazione, società di consulenza, e altri fornitori specializzati di formazione
- ☐ Sì, esterna, presso clienti
- ☐ Fino ad oggi no, ma è nei piani accrescere la formazione per tali figure
- ☐ No, non è prevista né oggi, né tendenzialmente in futuro
- ☐ Non applicabile, in quanto le figure elencate nella domanda precedente non sono previste in azienda

Sezione B: Retribuzione

4a. Qual è la RAL media in questo stabilimento (non includendo bonus, premi individuali o di gruppo, e benefit) delle seguenti categorie di addetti?

	RAL media
a. **Addetti diretti alla produzione** (es. addetti all'assemblaggio manuale)	
b. **Conduttori di impianti e macchinari**	
c. **Addetti indiretti alla produzione** (magazzino, manutenzione, magazzino e logistica, etc.)	

4b. Qual è la RAL media in questo stabilimento (non includendo bonus, premi individuali o di gruppo, e benefit) delle seguenti categorie di addetti?

	€/ora
a. **Lavoratori non qualificati (es. assemblatori, etc.)** CCNL metalmeccanica o CCNL equivalente inferiore a 3^ livello	
b. **Lavoratori qualificati/specializzati** per cui è richiesto un diploma professionale o certificazione o esperienza di lavoro specifica nel ruolo (es. manutentori, elettricisti, etc.) CCNL metalmeccanico tra 4^ e 6^ livello	
c. **Ingegneri e/o altri laureati per attività di produzione** CCNL metalmeccanico superiore a 6^livello	

5a. Nel 2018 qual è stata approssimativamente la <u>percentuale</u> di salario variabile rispetto alla RAL? (si escludano benefit assegnati in base al livello di inquadramento dei lavoratori)
___%

5b*. Si indichi se l'azienda utilizza le seguenti forme di retribuzione variabile (è ammessa la risposta multipla):

- ☐ Incentivi collegati a obiettivi <u>aziendali</u> di redditività
- ☐ Incentivi collegati a obiettivi <u>aziendali</u> di produttività
- ☐ Incentivi collegati a obiettivi di team/gruppo di lavoro
- ☐ Incentivi collegati ad un sistema formalizzato di valutazione della prestazione o delle competenze dei singoli <u>individui</u>
- ☐ Nessuno dei precedenti

Sezione D: Politiche aziendali

6. Si prega di indicare il grado di accordo o disaccordo con le seguenti affermazioni.
(1= Molto in disaccordo; 5= Molto d'accordo)

	1 (molto in disaccordo)	**2**	**3**	**4**	**5** (molto d'accordo)
a. Preferiamo assumere lavoratori che desiderino rimanere nella nostra azienda con una prospettiva di lungo periodo.	○	○	○	○	○
b. Spesso forniamo supporto individuale ai nostri dipendenti per lo sviluppo professionale nella nostra azienda.	○	○	○	○	○

7a*. Per addetti divenuti in esubero in seguito ad investimenti nell'automazione o nella digitalizzazione dei processi produttivi, quali azioni sono previste?

- ☐ Non applicabile, gli investimenti in automazione/digitalizzazione sono stati nulli o del tutto marginali
- ☐ Abbiamo investito in automazione/digitalizzazione che però non hanno provocato variazioni nel numero di addetti
- ☐ Abbiamo attivato piani di prepensionamento
- ☐ Gli addetti sono stati ricollocati in altri ruoli in azienda in seguito ad un programma di formazione
- ☐ Gli addetti sono stati ricollocati in un'altra azienda attivando fondi di solidarietà

7b*. Quali dei seguenti strumenti sono stati tradizionalmente utilizzati per gestire situazioni di crisi aziendali?

- ☐ Nessuno strumento, in quanto non ci sono state crisi aziendali
- ☐ L'attivazione di Cassa Integrazione Guadagni Straordinaria
- ☐ Piani di esubero
- ☐ Altri strumenti (es. piani di solidarietà, corsi di formazione), specificare _____

8a. Qual è il turnover (tasso di ricambio dei dipendenti) medio annuo in questo stabilimento?
____ %

8b. Rispetto al 2015, il tasso di turnover è cambiato?

Molto diminuito	Diminuito	Rimasto praticamente invariato	Aumentato	Molto aumentato
○	○	○	○	○

9a. Esistono rappresentanze sindacali nell'impresa/stabilimento?

- ○ Si
- ○ No

9b*. Se si, qual è approssimativamente la <u>percentuale</u> di lavoratori iscritti a un sindacato?
____ %

Fine della parte relativa alla gestione delle risorse umane
Grazie per aver compilato questa parte relativa alla gestione delle risorse umane. Se desidera andare alla sezione relativa alla gestione dello stabilimento clicchi qui. Se desidera andare alla sezione relativa alla relazione con il cliente principale clicchi qui.

Parte 2. Gestione dello stabilimento

La presente sezione del questionario è rivolta principalmente al Responsabile di produzione o al direttore di stabilimento o ad una persona da lui/lei delegata

Nome e cognome del rispondente _____
Indirizzo e-mail (presso cui ricevere copia del questionario compilato e rapporto di benchmarking):
_____
Ruolo in azienda: _____
Nome dell'Impresa/stabilimento:_____

Sezione A: Introduzione allo stabilimento

1. Quale è stato il trend nei volumi di produzione (unità di prodotto realizzate) negli ultimi 3 anni?

Molto diminuito	Diminuito	Rimasto invariato	Aumentato	Molto aumentato
○	○	○	○	○

2. Tra i seguenti processi di produzione, quali sono realizzati in questo stabilimento?
(È ammessa la risposta multipla)

	Processo principale dello stabilimento (>30% dei ricavi o degli occupati)	Processo realizzato in questo stabilimento (ma non principale)
a. Stampaggio	☐	☐
b. Produzione di stampi	☐	☐
c. Trasformazione di plastica e gomma	☐	☐
d. Lavorazione meccanica (es. tornitura, fresatura)	☐	☐
e. Assemblaggio	☐	☐
f. Altri processi chiave realizzati nello stabilimento (si prega di specificare): _____ _____	☐	☐

3. Quali sono le sfide più importanti che affrontate generalmente in questo stabilimento?
(Indicare fino a 3 sfide che lo stabilimento si trova ad affrontare)

- ☐ Trovare lavoratori con le competenze di cui abbiamo bisogno
- ☐ Adeguare processi e prodotti alle diverse regolamentazioni di settore (es. standard su emissioni dei motori, sostenibilità ambientale dei processi produttivi, normative sulla sicurezza etc.)
- ☐ Avere un elevato grado di coinvolgimento e motivazione dei lavoratori
- ☐ Introdurre tecnologie avanzate di produzione
- ☐ Convincere chi prende decisioni di carattere operativo a farlo basandosi sui dati e non solo su esperienza ed intuito
- ☐ Accedere a risorse finanziare sufficienti per tutti gli investimenti necessari per la competitività dell'azienda
- ☐ Costruire relazioni mutualmente utili e durature con i nostri clienti diretti
- ☐ Costruire relazioni mutualmente utili e durature con i nostri fornitori *
- ☐ Migliorare costantemente i livelli di efficienza operativa *
- ☐ Tenere sotto controllo i livelli qualitativi / difettosità dei prodotti *

Altro (Si prega di specificare):
_____
_____

Sezione B: Adozione delle tecnologie

4. Per le seguenti tecnologie utilizzate nel vostro stabilimento indicate il numero di unità in esercizio? (Risposte con approssimazione sono accettabili, inserire 0 se tecnologia non in uso)

	adozione		Livelli di adozione e utilizzo		Non saprei quantificare
	No	Sì			
a. **Impianti automatizzati non programmabili** (impianti che eseguono operazioni che non possono essere modificate e.g. termo-pressa per stampaggio)	☐	☐	_____	# impianti/attrezzature non programmabili	☐
b. **Macchine dotate di sensori** finalizzati al monitoraggio continuo di condizioni di lavoro e dei parametri di processo	☐	☐	_____	% di macchine dotate di sensori	☐
c. **Robot** (Macchina a controllo automatico, riprogrammabile e multiuso. Per esempio: una cella di saldatura con 4 braccia robotiche conta come 4 robot)	☐	☐	_____	# braccia	☐
d. **Tra tutti i robot che utilizzate, quanti di questi sono robot collaborativi (cobots)?** (Si intendono cobots i robot in grado di lavorare fianco a fianco con un operatore umano grazie ad elevata capacità di interazione e di adattamento al contesto)	☐	☐	_____	# braccia	☐
e. **Tecnologie di machine vision** (tecnologia che permette al computer di ispezionare immagini impiegate nella metrologia e nelle altre attività di controllo della qualità di processo)	☐	☐	_____	# telecamere	☐
f. **Monitoraggio automatico di flussi di materiali e semilavorati** (codici a barre, RFID, codici QR, etc. per tracciare il movimento di materiali nello stabilimento e nei magazzini).	☐	☐	_____	% di materiali e semilavorati monitorati	☐
g*. **Tracciabilità di prodotti finiti con clienti e fornitori** (codici a barre, RFID, codici QR, etc. per tracciare il movimento di prodotti fuori dallo stabilimento per esigenze di filiera).	☐	☐	_____	% di prodotti finiti monitorati	☐
h. **Sistemi di trasporto di logistica AGV (Veicoli a guida automatica)** (Sistema di trasporto capace di funzionare in maniera autonomo senza persone alla guida)	☐	☐	_____	# AGV	☐
i. **Altri macchinari ed attrezzature dotati di controlli programmabili** escluse le macchine a controllo numerico computerizzato):	☐	☐	_____	# impianti/attrezzature programmabili	☐
l*.**Tecnologie di interfaccia uomo-macchina (visori e sistemi per la realtà aumentata, display touch, wearables)**	☐	☐	_____	# visori, wearables, display touch	☐
m*. **Tecnologie di manifattura additiva (stampa 3d)**	☐	☐	_____	# codici prodotto/componente fabbricati con manifattura additiva	☐
n*. **Soluzioni per la raccolta e l'analisi dei dati di produzione**:	☐	☐	_____	# di persone che utilizzano software generici e specifici di data analytics	☐
o*. **Soluzioni per la simulazione e la visualizzazione dei processi produttivi**:	☐	☐	_____	# di persone che utilizzano software generici o specifici di simulazione	☐

3p*. Quali delle seguenti soluzioni per la raccolta e l'analisi dei dati di produzione utilizzate?

- ○ Non in uso
- ○ In uso con software generici (e.g. Excel, Access)
- ○ In uso con software specifici per il data analytics (e.g. SAP Hana, Microsoft IoT suite etc.)
- ○ Sia software generici che specifici

3q*. Per le soluzioni per la simulazione e la visualizzazione dei processi produttivi indicare la tipologia di software utilizzato:

- ○ Non in uso
- ○ In uso soluzioni non integrate con i macchinari fisici (e.g. Excel, Arena, FlexSim etc.)
- ○ In uso soluzioni che prevedono l'integrazione tra macchina/e fisica/e con la modellizzazione e/o la simulazione del proprio comportamento nello svolgimento del processo

4. Com'è cambiato, dal 2015 a oggi, l'uso delle seguenti tecnologie per la vostra attività?

	Non in uso nel 2015	**Ridotto l'uso**	**Scarso cambia-mento** (+/- 5%)	**Bassa crescita** (5-25%)	**Crescita significativa** (26-75%)	**Ampia crescita** (75-150%)	**Enorme crescita** (>150%)	**SCALA**
a. Impianti automatizzati non programmabili	○	○	○	○	○	○	○	# impianti/ attrezzature non programmabili
b. Sensori finalizzati al monitoraggio continuo di condizioni di lavoro e dei parametri di processo	○	○	○	○	○	○	○	% di macchine dotate di sensori
c. Robot	○	○	○	○	○	○	○	# braccia
d. Robot collaborativi	○	○	○	○	○	○	○	# braccia
e. Tecnologie di machine vision	○	○	○	○	○	○	○	# telecamere
f. Monitoraggio automatico dei materiali e semilavorati	○	○	○	○	○	○	○	% di materiali e semilavorati monitorati
g*. Tracciabilità di prodotti finiti	○	○	○	○	○	○	○	% di prodotti finiti tracciati
h. AGVs	○	○	○	○	○	○	○	# AGV
i. Altre apparecchiature con controlli programmabili (escluse MCN)	○	○	○	○	○	○	○	# impianti/attrezzature programmabili
l*. Tecnologie di interfaccia uomo-macchina	○	○	○	○	○	○	○	# visori di AR/VR, display touch, wearables
m*. Manifattura additiva (MA)	○	○	○	○	○	○	○	# di prodotti eseguiti con MA
n*. Raccolta e analisi dei dati di produzione	○	○	○	○	○	○	○	# di persone da cui viene svolta analisi dati
o*. Simulazione e visualizzazione dei processi produttivi	○	○	○	○	○	○	○	# di persone da cui viene svolta simulazione

5a. Con quale frequenza viene modificato il software dei macchinari di produzione a seguito di cambiamento nelle esigenze di produzione?

- ○ Non applicabile (nessuna macchina o attrezzatura computerizzata)
- ○ Settimanalmente o più spesso
- ○ Mensilmente
- ○ Annualmente o meno spesso

5b. Talvolta per i nostri robot utilizziamo programmazione gestuale (per dimostrazione) invece che per codice:

- ○ Sì
- ○ No
- ○ Non applicabile, in quanto non usiamo robot

Sezione C: Robot

Si prega di passare alla prossima sezione se NON avete robot

6. In quale anno avete iniziato a usare robot per la prima volta? _____

7. Numero di robot industriali acquistati nel 2018 per questo stabilimento (si prega di contare ogni *braccio* acquistato, per una cella di saldatura con 4 braccia, scrivere "4"): _____[braccia]

8a. Che impatti hanno avuto i vostri investimenti in robot sui seguenti aspetti? (2015-2018)

	Significativo peggioramento	Piccolo peggioramento	Nessun impatto	Piccolo miglioramento	Significativo miglioramento
a. Conformità di prodotto	○	○	○	○	○
b. Abilità nel creare nuovi prodotti o servizi	○	○	○	○	○
c. Capacità di documentare, analizzare ed eliminare problemi (e.g. di processo, difettosità nei prodotti etc.)	○	○	○	○	○
d. Capacità di affrontare la mancanza di competenze	○	○	○	○	○
e. Capacità di entrare in nuovi mercati	○	○	○	○	○
f. Capacità di passare rapidamente da un processo di lavorazione all'altro (es. da fresatura a tornitura)	○	○	○	○	○
g. Sicurezza sul lavoro ed ergonomia	○	○	○	○	○

8b. In seguito agli investimenti in robot e altre tecnologie di automazione avanzata effettuati dal 2015 a oggi, qual è stato l'effetto su:

	Significativa diminuzione (del 10% o più)	**Piccola diminuzione** (5 - 10%)	**Nessun cambiamento** (+/- 5%)	**Piccolo aumento** (5 -10%)	**Aumento significativo** (del 10% o più)	**Non so**
a. costi di manodopera diretta per unità di prodotto	○	○	○	○	○	○
b. costo pieno industriale unitario	○	○	○	○	○	○
c*. valore della capacità produttiva massima teorica	○	○	○	○	○	○

Sezione D: Raccolta e utilizzo di dati

9. Come sono raccolti i dati sulle attività di produzione (qualità di prodotto, tempi, costi e volumi di produzione, etc.) in questo stabilimento? (è ammessa la risposa multipla)

- ☐ Non raccogliamo mai dati relativi alla produzione
- ☐ Di solito raccogliamo i dati solo su carta
- ☐ Di solito un operatore rileva i dati, li scrive su carta, e solo in un secondo momento vengono inseriti manualmente su un computer
- ☐ Di solito un operatore rileva i dati e li inserisce manualmente su un terminale presente a bordo linea/macchina, da cui i dati vengono inviati a un computer
- ☐ Impieghiamo soprattutto sensori che non trasmettono dati ai sistemi informativi aziendali (vengono utilizzati solo dalla macchina stessa ed elaborati a livello di singola postazione)
- ☐ Sensori sulle macchine trasmettono dati a uno dei diversi sistemi informativi aziendali che gestiscono in modo non integrato la sola attività di produzione (es. MRP)
- ☐ Sensori sulle macchine inviano dati a un unico sistema integrato (e.g. ERP) che gestisce dati su produzione, risorse umane, contabilità, vendite
- ☐ Altro, si prega di specificare: _____

10. Come sono utilizzati i dati in questo stabilimento? (è ammessa la risposta multipla)

- ☐ Basiamo le decisioni prevalentemente sull'intuizione o sull'esperienza. L'analisi quantitativa di dati ha un ruolo secondario.
- ☐ Basiamo le decisioni su un mix di intuizione e analisi dati, ma l'analisi quantitativa di dati ha un ruolo secondario.
- ☐ Basiamo le decisioni prevalentemente sull'analisi quantitativa dei dati.

11. Si prega di indicare quanto si è d'accordo o in disaccordo con le seguenti affermazioni.
(1= fortemente in disaccordo; 5= fortemente d'accordo)

	1 (molto in disaccordo)	**2**	**3**	**4**	**5** (molto d'accordo)	Non applicabile a questo stabilimento
I dati rimangono in "silos": è difficile collegare dati gestiti da diversi sistemi e/o funzioni aziendali.	○	○	○	○	○	○
Usiamo abitualmente i dati che abbiamo memorizzato per prevedere guasti o malfunzionamenti di un macchinario	○	○	○	○	○	○
Inviamo regolarmente i dati delle operazioni al di fuori della nostra azienda a fornitori di impianti e macchinari o a integratori di sistemi informativi.	○	○	○	○	○	○

12a. Questo stabilimento si è avvalso della collaborazione di una o più imprese specializzate nell'automazione dei processi produttivi (system integrator) ?

- ○ Si
- ○ No

12b. Se si, indicate il ruolo prevalentemente svolto dal system integrator per quanto riguarda la progettazione ed implementazione dei nostri robot e sistemi di automazione?

- ○ Noi definiamo le specifiche tecniche e avviamo la fase di progettazione, il system integrator completa il progetto di dettaglio, sviluppa l'integrazione e realizza il sistema
- ○ Noi definiamo i nostri bisogni di massima, il system integrator definisce i requisiti, completa il progetto di dettaglio, sviluppa l'integrazione e realizza il sistema
- ○ Utilizziamo soluzioni proposta dal system integrator con limitato grado di personalizzazione

12c. Se si, quali delle seguenti affermazioni meglio identifica la vostra relazione con il system integrator?

- ○ Per ogni progetto di automazione scegliamo il system integrator che riteniamo più adatto
- ○ Esistono pochi system integrator a cui possiamo fare riferimento e alternativamente ci rivolgiamo a loro
- ○ Abbiamo tipicamente una relazione continua con un system integrator che ci aiuta a migliorare il funzionamento dell'automazione.

Sezione F: Pratiche manageriali

13. Si prega di indicare quanto si è d'accordo o in disaccordo con le seguenti affermazioni.
(1= fortemente in disaccordo; 5= fortemente d'accordo)

	1 (molto in disaccordo)	**2**	**3**	**4**	**5** (molto d'accordo)	Non applicabile a questo stabilimento
a. Raramente utilizziamo dati storici di produzione relativi alle cause dei difetti e non conformità per modificare i nostri processi produttivi.	○	○	○	○	○	○
b. Tendiamo a seguire sempre i piani periodici di manutenzione preventiva.	○	○	○	○	○	○
c. Rispetto al 2015, dedichiamo più tempo all'analisi formale dei dati per capire come migliorare i nostri processi produttivi e le procedure operative.	○	○	○	○	○	○
d. Dal 2015, abbiamo aumentato il numero di ingegneri di processo in questo stabilimento.	○	○	○	○	○	○
e. Abbiamo una relazione collaborativa con i nostri clienti per quanto riguarda attività di miglioramento continuo (di qualità ed efficienza)	○	○	○	○	○	○
f*. Abbiamo una relazione collaborativa con i nostri fornitori per quanto riguarda attività di miglioramento continuo (di qualità ed efficienza)	○	○	○	○	○	○
g*. Una quota rilevante dei nostri addetti alla produzione ha svolto/svolge programmi di *job rotation*	○	○	○	○	○	○
h*. L'andamento degli indicatori di produzione sono costantemente monitorati e comunicati, sia formalmente che informalmente, a tutto il personale	○	○	○	○	○	○

14. Quali attività eseguono regolarmente i seguenti gruppi di dipendenti (almeno una volta alla settimana)? (è ammessa la risposta multipla)

	Lavoratori addetti alla produzione (es. assemblatore, conduttori di impianti e attrezzature etc.)	**Lavoratori qualificati/ specializzati per cui è richiesto un diploma professionale o certificazione o esperienza di lavoro specifica nel ruolo** (es. manutentori, elettricisti, etc.)	**Ingegneri e/o altri laureati**
a. Attrezzare i macchinari e i centri di lavorazione	☐	☐	☐
b. Modificare i codici di programmazione su macchinari e attrezzature computerizzate	☐	☐	☐
c. Partecipare alla diagnosi dei problemi di macchinari e attrezzature	☐	☐	☐
d. Ispezionare semilavorati	☐	☐	☐
e. Utilizzare i dati di qualità per proporre miglioramenti di processi e procedure di lavoro	☐	☐	☐
f. Incontrare il personale di imprese clienti per risolvere problemi di qualità	☐	☐	☐
g. Usare un computer o un tablet per registrare, analizzare e monitorare dati di produzione	☐	☐	☐

15. Si prega di indicare quanto si è d'accordo o in disaccordo con le seguenti affermazioni.

	1 (molto in disaccordo)	**2**	**3**	**4**	**5** (molto d'accordo)
a. Ogni anno ci aspettiamo che i nostri addetti di produzione apportino sostanziali miglioramenti nelle loro procedure operative.	○	○	○	○	○
b. Rispetto al 2015, abbiamo ridotto le nostre aspettative che i nostri lavoratori di produzione apportino sostanziali miglioramenti nelle loro procedure operative	○	○	○	○	○
c. Abbiamo riscontrato che l'uso di strumenti informatici in fabbrica riduce la necessità per i lavoratori di produzione di avere capacità analitiche per la risoluzione di problemi	○	○	○	○	○
d. i lavoratori impegnati nella produzione percepiscono un forte stress sul lavoro	○	○	○	○	○

16. Per quale percentuale del vostro materiale acquistato (in termini di unità) non si esegue nessuna ispezione alla ricezione delle consegne dai fornitori?

- ○ 0 – 15%
- ○ 16 – 50%
- ○ 51 – 75%
- ○ 76 – 100%

17. Lo stabilimento ha condotto una mappatura grafica di alcuni processi al fine di comprendere le attività operative che apportano valore aggiunto e quelle che non ne apportano ("value stream mapping")?

- ○ No – Non è applicabile al nostro business
- ○ No
- ○ Si, ma non in modo sistematico o particolarmente strutturato (es. su un numero molto limitato di processi operativi)
- ○ Si, in modo sistematico o particolarmente strutturato (su tutti i processi operativi che incidono in modo significativo sulla nostra efficienza operativa)
- ○ Non so

Sezione G: Organizzazione del lavoro

18a. Si prega di indicare il grado di accordo o disaccordo con la seguente affermazione:
" Agli operai di produzione (es. assemblatori e conduttori di impianti e macchinari) si richiede regolarmente di eseguire semplici riparazioni e operazioni di manutenzione autonoma".

1 (molto in disaccordo)	**2**	**3**	**4**	**5** (molto d'accordo)
○	○	○	○	○

18b. Rispetto al 2015, tali richieste sono diminuite, aumentate o rimaste le stesse?

1 (molto in disaccordo)	**2**	**3**	**4**	**5** (molto d'accordo)
○	○	○	○	○

19a. Si prega di indicare il grado di accordo o disaccordo con la seguente affermazione:
"In caso di problemi di qualità, gli operai di produzione hanno l'autorizzazione di interrompere la produzione per evitare che si realizzino prodotti difettosi "

1 (molto in disaccordo)	**2**	**3**	**4**	**5** (molto d'accordo)
○	○	○	○	○

19b. Rispetto al 2015, quanto frequentemente gli operai di produzione sono incoraggiati/autorizzati ad interrompere la produzione in caso di problemi di qualità?

molto meno incoraggiati	Meno incoraggiati	Incoraggiati allo stesso modo	Più incoraggiati	Molto più Incoraggiati
○	○	○	○	○

20a. Avete programmi formali di *lean production* quali circoli della qualità o settimane kaizen che avvengono in team, al di fuori delle normali attività di produzione e con il coinvolgimento degli operai di produzione ? Rispondere facendo riferimento al 2018 e al 2015

	Sì	No
a. 2018	○	○
b. 2015	○	○

20b. Approssimativamente qual è la <u>percentuale</u> di operai di produzione che hanno partecipato a riunioni dei suddetti gruppi negli ultimi sei mesi?
_____ %

21a. Avete un programma formale di raccolta di suggerimenti legato ai programmi di lean production da parte degli operai di produzione?

- ○ No
- ○ Si

21b. Se si, indicate il numero medio di suggerimenti raccolti nel 2018 per addetto alla produzione
_____[numero suggerimenti]

21c. In confronto al 2015, come è variato il numero di suggerimenti per operaio di Produzione ?

- ○ Diminuito
- ○ Rimasto le stesso (+/- 5%)
- ○ Aumentato

22.Indicativamente, a partire dal 2015 quale <u>percentuale</u> di addetti in questo stabilimento ha svolto attività formali di formazione su metodologie di lean production/miglioramento continuo?
_____ %

Sezione H: Gestione dell'informazione

23. Se nel vostro stabilimento vengono usati sistemi informativi del tipo *enterprise resource planning* (ERP), quali moduli sono utilizzati? (è ammessa la risposta multipla)

- ☐ Nel nostro stabilimento non vengono usati sistemi operativi del tipo ERP
- ☐ Vendite
- ☐ Magazzino / logistica
- ☐ Produzione
- ☐ Risorse umane
- ☐ Contabilità e controllo di gestione

24. Si prega di indicare quanto è d'accordo o in disaccordo con la seguente affermazione: "Poiché i nostri sistemi IT sono inadeguati o troppo difficili da usare, spesso li "aggiriamo" con soluzioni temporanee alternative di tipo informale."

1 (molto in disaccordo)	**2**	**3**	**4**	**5** (molto d'accordo)
○	○	○	○	○

Fine della parte relativa alla gestione dello stabilimento
Grazie per aver compilato questa sezione sulla gestione dello stabilimento. Se desidera andare alla sezione relativa alla relazione con il cliente principale, clicchi qui. Se desidera andare alla sezione relativa alla gestione delle risorse umane clicchi qui.

Parte 3. Relazione con il cliente principale

"La presente sezione del questionario è rivolta principalmente al Responsabile commerciale o ad una persona da lui/lei delegata"

Nome e cognome del rispondente _____
Indirizzo e-mail (presso cui ricevere copia del questionario compilato e rapporto di benchmarking):
_____
Ruolo in azienda: _____
Nome dell'Impresa/stabilimento:_____

Sezione A: Cliente e prodotto principale

Di seguito, si prega di descrivere brevemente la vostra famiglia di prodotto più venduta in ambito automotive in termini di fatturato. SI PREGA DI RISPONDERE ALLE PROSSIME SEZIONI FACENDO RIFERIMENTO A QUESTA FAMIGLIA DI PRODOTTO E AL RELATIVO CLIENTE.

1a. Famiglia di prodotto in ambito automotive / Nome del componente:

_____

1b. Si indichi la casa automobilistica principale a cui è destinato questo prodotto

_____

1c. Nome del modello o della piattaforma di auto/veicolo in cui questo prodotto è utilizzato principalmente:

_____

2. Quale è la distanza media che separa il vostro stabilimento dal cliente principale?
_____[km]

3a. Che durata ha il vostro contratto di fornitura con il vostro cliente per questa famiglia di prodotto (in anni)?

- ○ Anni: _____
- ○ Nessun contratto di lungo periodo

3b*. Siete l'unica impresa a fornire questa famiglia di prodotto?

- ○ Si
- ○ No

3c. Per quanti <u>anni</u> ritenete altamente probabile che per questa famiglia di prodotto continuerete a ricevere ordini di acquisto da parte di questo cliente?
_____[numero di anni]

4. Supponete di avere un'idea che vi consenta di ridurre i costi del prodotto, che però richiederebbe al vostro cliente di apportare una modifica alle sue procedure di progettazione e/o di produzione. Come ritenete reagirebbe il vostro cliente? (è ammessa la risposta multipla)

- ☐ Il cliente di solito sollecita fortemente questo tipo di suggerimenti.
- ☐ Il cliente spesso adotta questo tipo di suggerimenti.
- ☐ Il cliente implementerebbe il nostro suggerimento richiedendo un abbassamento del prezzo che lascerebbe quasi invariati i nostri margini di redditività sulla commessa.
- ☐ Il cliente implementerebbe il nostro suggerimento richiedendo un abbassamento del prezzo che comunque permetterebbe un aumento nei nostri margini di redditività sulla commessa
- ☐ Il cliente non accetta di buon grado suggerimenti che implicano modifiche nelle sue procedure.
- ☐ Non so come reagirebbe il cliente
- ☐ È improbabile che la nostra impresa faccia questo tipo di suggerimenti.

5. Nel caso in cui uno dei vostri concorrenti diretti offrisse al vostro cliente un <u>prezzo inferiore</u> per un prodotto di prestazioni simili al vostro, come reagirebbe il vostro cliente?
(E' ammessa la risposta multipla)

a. Passerebbe a fornirsi da questo concorrente cercando di interrompere il contratto con noi nel caso in cui non fossimo capaci di pareggiare il prezzo.	☐
b. Passerebbe a fornirsi da questo concorrente alla fine del contratto.	☐
c. Ci spingerebbe a ridurre il prezzo senza fornirci particolare supporto	☐
d. Ci aiuterebbe a "pareggiare" il prezzo offerto da questo concorrente fornendoci supporto attraverso dei programmi di efficientamento	☐
e. Ridurrebbe gli ordinativi da noi.	☐
f. Non saprei.	☐
g. Altro (Si prega di specificare):	☐

6. Si prega di indicare il grado di accordo o disaccordo con le seguenti affermazioni:

	1 (molto in disaccordo)	**2**	**3**	**4**	**5** (molto d'accordo)
a. Abbiamo la sensazione che il nostro cliente spesso utilizzi le informazioni che condividiamo con lui più come strumento di controllo piuttosto che per aiutarci a risolvere i problemi di qualità e/o di efficienza operativa	○	○	○	○	○
b. Il nostro cliente è sinceramente interessato ad ascoltare i nostri riscontri su come si sta comportando nella relazione con noi	○	○	○	○	○
c. Vi sono state spesso situazioni di significativo disaccordo con il cliente	○	○	○	○	○

7. Si prega di selezionare il numero che meglio descrive la sua convinzione che il vostro cliente vi tratterà in modo corretto (es. su tempi di pagamento, tempistiche degli ordini, collaborazione nella gestione dei problemi, controlli di qualità sui nostri prodotti).

1 (Non possiamo contare sul fatto che il cliente ci tratti in modo corretto)	**2**	**3**	**4**	**5** (il cliente ci tratta sempre in modo corretto)
○	○	○	○	○

8a. Immaginate di smettere di ricevere ordini per questo prodotto da questo cliente. <u>Con quale</u>

facilità potreste riassegnare/riconvertire le seguenti risorse dedicate a questo cliente ad altri clienti?

	1 (Sarebbe di fatto impossibile)	**2**	**3**	**4**	**5** (Sarebbe molto facile)
Impianti	○	○	○	○	○
Attrezzature (es. stampi)	○	○	○	○	○
Formazione dei nostri operai e tecnici su processi di lavorazione	○	○	○	○	○
Progettazione del prodotto	○	○	○	○	○

Sezione B: Ingegnerizzazione del prodotto e IT

9. Si indichi quale descrizione si adatta meglio al ruolo dello stabilimento nello sviluppo di questo prodotto. (E' ammessa la risposta multipla. Il termine "prodotto" si riferisce al vostro prodotto specificato alla domanda n. 1)

- ☐ la responsabilità dello sviluppo prodotto è stata gestita interamente dal cliente
- ☐ La maggior parte della progettazione è stata svolta dal cliente
- ☐ voi e il cliente e avete contribuito equamente alla progettazione
- ☐ avete svolto voi la maggior parte della progettazione
- ☐ avete avuto voi in carico tutta la responsabilità
- ☐ avete collaborato con il cliente nella specifica delle interfacce del componente o nella progettazione di componenti relativi al prodotto
- ☐ avete utilizzato il metodo degli elementi finiti (FEM) o altre simulazioni per questo prodotto
- ☐ avete partecipato con il cliente ad attività di VA/VE (Value Analysis/Value Engineering)
- ☐ Altro (si prega di specificare): _____

Sezione C: Informazioni di contesto del prodotto

10. Si prega di indicare l'intervallo di prezzo medio unitario della principale famiglia di prodotto per il 2018.

< 1€	1-10€	11-50€	51-100€	101-1000€	>1001€
○	○	○	○	○	○

11. In riferimento al vostro costo di produzione industriale unitario, qual è stato il suo tasso di variazione percentuale negli ultimi 3 anni?

Diminuzione di oltre il 10%	Diminuzione tra il 3 e il 10%	Sostanziale stabilità (+/- 3%)	Aumento tra il 3 e il 10%	Aumento superiore al 10 %	Non saprei

○ ○ ○ ○ ○ ○

12. Sulla base della sua esperienza, quante altre imprese potrebbero oggi offrire lo stesso prodotto senza dover effettuare significativi investimenti per le seguenti risorse?

	Numero imprese
Impianti	
Attrezzature (es. stampi)	
Formazione dei nostri operai e tecnici su processi di lavorazione	
Progettazione del prodotto	

13*. Indicate quali tecnologie sono contenute oggi nel vostro prodotto, specificando quali sono state inserite negli ultimi cinque anni

Tipo tecnologia	Presente oggi	Inserita negli ultimi 5 anni
Meccanica	☐	☐
Elettrica	☐	☐
Elettronica	☐	☐
Software	☐	☐
Oleodinamica/pneumatica	☐	☐
Altro (specificare):	☐	☐

14*. Indicate il numero totale di componenti nei vostri prodotti (facendo riferimento all'ultimo livello della distinta base)_____

Fine della parte relativa alla relazione con il cliente principale

Grazie per aver compilato questa parte alla relazione con il cliente principale. Se desidera andare alla sezione relativa alla gestione dello stabilimento clicchi qui. Se desidera andare alla sezione relativa alla gestione delle risorse umane clicchi qui.