New product development commercialisation of Industry 4.0 products: evidence from a B2B Italian SME

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Andrea Sabatini - Sara Bartoloni - Gian Luca Gregori

Abstract

Purpose of the paper: *The Industry 4.0 paradigm entails tremendous business opportunities. However, SMEs are struggling to effectively commercialize new products embedding Industry 4.0 technologies. Therefore, the study aims at exploring how SMEs manage the commercialization of Industry 4.0 new products to provide a thorough understanding of the main issues and barriers they face.*

Methodology*: The study adopts a single case study of an Italian SMEs. Data have been analyzed through an abductive approach. The novelty of the topic calls for an explorative study consistent with the methodologies adopted.*

Results*: The study finds several barriers and issues related to internal and external factors. Barriers and issues might be overcome if SMEs develop external partnerships to compensate their typical scarcity of resources. The firm faced the coronavirus pandemic, which highlighted further threats hidden into the commercialization process.*

Research limitations: *The study design is qualitative in nature, limiting the generalization of the findings. The internal perspective and the specific study contexts also offer new avenues for future. research.*

Practical implications: *The study provides several insights to support SMEs in their commercialization processes of new Industry 4.0 technological products. The study highlights the pivotal role of strategy and planning as well as marketing activities.*

Originality of the paper: *The study contributes to the new product commercialization and Industry 4.0 literature by unravelling potential issues and barriers that innovator SMEs might encounter when commercializing new products that fall into the Industry 4.0 paradigm. The article provides a novel perspective as the extant NPD literature focuses on start-ups or large corporations, while the Industry 4.0 literature has been neglecting the commercialization process.*

Key words: industry 4.0 product, commercialization, SME, new product development

1. Introduction

The recent technological development has unfolded new business opportunities. Megatrends such as digitization, internet of things, internet of services and cyber-physical systems boosted the creation of new industrial products and processes driven by real-time data interchange. All these technologies have been labelled as Industry 4.0, which are considered

the new main challenge in the current production system (Jabbour *et al.*, 2018). However, despite the growing importance in the academic and managerial literature, firms are struggling to effectively develop and commercialize new products embedding such technologies. This is even more challenging for SMEs. The main reasons hindering the development and commercialization of new products lie in the high investment levels, unclear costs and benefits, the newness of the solutions provided, and workforce issues (i.e. lack of adequate skills).

The study aims to explore and shed light on how SMEs are managing industry 4.0 new products commercialization. Despite commercializing new products is being pivotal in the product development journey, SMEs are still seldom researched by academics in this field (Pellikka and Lauronen, 2007; Nicholas *et al.*, 2011; Leithold *et al.*, 2015). Commercializing highly technological products is increasingly relevant as Industry 4.0 brought more complexities into manufacturing and development processes as well as into marketing and sales activities. Therefore, the study posits that embedding Industry 4.0 into new products might bring new challenges in the commercialization phase. As a matter of fact, in order to create marketable solutions, firms are asked to develop personalized products that can fit the buyers' manufacturing processes (Bollweg *et al.*, 2019; Porter and Van der Linde, 1995; Stone and Wakefield, 2000).

The study contributes to two established streams of research by providing evidence for SMEs: the new product development literature, more precisely the new product commercialization phase, and the Industry 4.0 literature. These two research areas are closely related and intertwined since they both deal with innovation processes.

To the best of our knowledge, no previous empirical studies have attempted to provide a clear and thorough understanding of the several issues and barriers which SMEs face in the New Product Development commercialization process while developing Industry 4.0 products. In addition, studies that deal with Industry 4.0 and studies that tackle the NPD and commercialization process present some gaps regarding SMEs. Firstly, the works that deal with driving forces and barriers of SMEs mostly concern the adoption and the implementation phase of Industry 4.0 projects (Moeuf *et al.*, 2019; Agostini and Nosella, 2020). Secondly, academics have usually invested efforts to uncover New Product Development commercialization dynamics on start-ups and large corporation, devoting less attention on incumbent SMEs (Carter and Jackson, 2019; Durst *et al.*, 2018, Cooper, 2008; Christensen, 2013; Chesbrough *et al.*, 2006). However, SMEs are still relevant actors of the world's economy (Durst *et al.*, 2018; Carter and Jackson, 2019), deserving more space in understanding innovation processes. Moreover, few researchers explored how this actor manages the new product launch and commercialization phase, although it is the most critical step of New Product Development (Durst *et al.*, 2018).

The remainder of the article is organized as follows. The following section outlines the background literature, presenting the gaps and the research questions. The third section describes the methodology, the data collection and data analysis; the fourth paragraph illustrates the case study, while the fifth discusses the findings followed by theoretical and managerial

implications. Finally, the seventh section outlines the conclusion of the study, together with limitations and further research directions.

2. Background literature

2.1 The New Product Development commercialization process

Academics and practitioners alike are still paying attention to innovation as it is pivotal for the creation of a competitive advantage (La Placa, 2014). This is even more true when considering the recent technological advancements brought by the Industry 4.0 paradigm. The commercialization of new products is strictly connected to the innovation process. The commercialization phase, and the launch of new products, is where most firms, especially SMEs, often fail to link their innovation programs with the buyers' and users' requirements and needs.

According to the new product development (hereafter NPD) literature, the innovation process can be conceived as a linear sequence of phases (Cooper, 2008), whereby the commercialization is the final step. The NPD process generally begins with the idea generation, followed by the further technical and technological development of the concepts, and ends when the developed product has been commercialized to create new wealth (Cooper, 2008; Aarikka-Stenroos and Sandberg, 2012; Medlin and Törnroos, 2015). For the development of technological products, the NPD process might follow four major steps (Crawford and Di Benedetto, 2008; Pellikka and Lauronen, 2007; Tsokas *et al.*, 2004):

1. Idea generation: the idea for an innovation arises, concepts about the final product are produced and analysed according to the information gathered from buyers and users.
2. Concept selection: the firm starts to develop more in detail the most promising ideas resulting from the previous stage. The product concept is defined by defining its main features.
3. Development: once products are selected, the firm proceeds into the designing and manufacturing phase. Product testing and refinement complete the development phase which ends with the marketable product.
4. Launch: the firm deploys all the commercialization activities that ultimately lead to the sale of the new product. In this phase, the firm is focused on managing and exploiting distribution and sales channels.

The NPD is also understood as a stage-gate process since the firm needs to reach specific results, that define the level of the gate, before stepping into the next stage. Otherwise, the process might stop due to unfeasibility. Consequently, each phase is crucial for the success of the entire process, even the last one. As a matter of fact, in order to be recognised as an innovation, any products need to be commercialized and adopted among users (Van de Ven, 1986). However, in the NPD literature the attention has been mainly focused on the exploration phase (Durst *et al.*, 2018) - the early stages of the process, such as the idea generation or the development phase - and far less attention has been dedicated to the exploitation phase - the process of

identifying the potential buyers (Aarikka-Stenroos and Sandberg, 2012). Previous studies have also highlighted that although these phases are often described separately, they tend to overlap making the nature of the entire innovation process very dynamic (Aarikka-Stenroos *et al.*, 2017), and rather complex as it can be difficult to separate marketing and innovation activities (Aarikka-Stenroos and Sandberg, 2012).

The study adopts the concept of commercialization of innovation and new product as the last step of NPD, the process of turning ideas into new products (Cooper 2008, Pellikka and Lauronen 2007). The study draws on the Schumpeterian old adagio (Schumpeter, 1934), which argues that achieving a successful commercialization process is crucial in transforming the invention into innovation. The new product commercialization starts from developing the product launch strategy and continues through establishing interactions with potential buyers and users until the product is fully adopted among the targeted users (Aarikka-Stenroos and Sandberg, 2012).

The commercialization process comprises three different activities: the development of the marketing strategy, useful to understand the business context and plan the launch of the new product; communicating the benefits of the new product and create the right awareness about it; and finally develop sales and mobilizing stakeholders toward the adoption of the new product (Aarikka-Stenroos and Lethimaki, 2014).

Regarding marketing activities, they intertwine and even overlap within the different phases of the innovation process. Marketing resources deployed by the firm in commercializing new products can include the product demonstration, advertising, communication and events, free trials or samples and distribution (Aarikka-Stenroos and Sandberg, 2012). Partners and other actors of the business network may have a crucial role in supporting these activities. For example, universities and municipalities can provide specific expertise that can generate trust toward key actors of the business network and thus facilitate the development of new business relationships (Aarikka-Stenroos and Sandberg, 2012). Other actors can be identified in distributors, public organization, regulators, and opinion leaders. These actors support the firm in creating opportunities, performing commercialization and facilitating the adoption of the innovation within the business network (Aarikka-Stenroos *et al.*, 2014). However, despite the pivotal role played by commercialization in the innovation process, most innovations fail right in this phase (Aarikka-Stenroos *et al.*, 2014). Usually, firms that are technology-oriented and focused on technology development face several issues in commercializing new products.

In addition, the commercialization process can be analyzed both from an innovator and an adopter perspective. While the adopter perspective is well developed, with a specific stream of research about adoption barriers and drivers (Aarikka-Stenroos *et al.*, 2014, Von Hippel, 1986), few studies actually focused on the innovator's commercialization process. Besides, the literature on the commercialization of innovations has mainly focused on startups and multinational enterprises (MNEs) (Carter and Jackson, 2019; Durst *et al.*, 2018, Cooper, 2008, 2019; Christensen, 2013; , Chersbrough *et al.*, 2006) while far less attention has been paid to the SMEs' technological

commercialization process (Carter and Jackson, 2019;Durst *et al.*, 2018, Leithold *et al.*, 2015; , Nicholas *et al.*, 2011; Pellikka and Lauronen, 2007). Yet, SMEs usually suffer from liabilities and resource constraints that negatively affect innovation management and commercialization activities. Factors such as resource scarcity, lack of personnel capabilities (Leithold *et al.*, 2015), liability of newness and smallness (Aldrich and Auster, 1986; Stinchcombe, 1965), an overall lack of planning (Das and Van de Ven, 2000) and the outsourcing of marketing activities (Pellikka and Lauronen, 2007) are widely acknowledged as strong influencing factors of SMEs' behaviours.

Furthermore, technological developments entailed in Industry 4.0 rise new challenges in the SMEs' NPD commercialization process; however, studies dealing with the issues and barriers of this complex phenomenon are still missing and more research is needed (Aarikka-Stenroos and Lethimäki, 2014).

2.2 Industry 4.0: definition, driving forces and barriers

Digital technology has completely changed the world of industry, determining what today is called the fourth industrial revolution, better known as the phenomenon of "Industry 4.0". The term "Industrie 4.0" first appeared in a German strategic initiative in 2011 as a part of its high-tech program, and it was defined in the work of Kagermann *et al.* (2013, p. 5) as "a new type of industrialization". This revolution comes with the introduction of the Internet of Things and Services into the manufacturing environment. The economic impact of this revolution has great potential, as it promises increased operational effectiveness as well as the development of entirely new business models, services, and products (Hermann *et al.*, 2016).

Currently, there is no consensus in the literature about the definition of Industry 4.0 (Piccarozzi *et al.*, 2019; Hoffman e Rusch, 2017) even if its implementation is at the centre of the academic and political interest. Starting from the cited "High-Tech Strategy 2020" promoted by Germany, which provided for the annual allocation of millions of euros for the development of highly innovative and cutting-edge technologies in the production field, many other governments have begun to promote different initiatives and actions at a national level to favour the adoption of Industry 4.0 technologies by firms (Liao *et al.*, 2017). Among them, the Advanced Manufacturing Partnership (AMP) promoted by the US government in 2011, the "Nouvelle France Industrielle" in 2013, the long-term framework presented by the UK government for its manufacturing sector called "The future of Manufacturing", and the "Piano Industria 4.0" designed for Italian companies investing in technological transformation.

One of the main difficulties in defining Industry 4.0 derives from the different labels (Industrial Internet, Internet of things, smart factories, Human-Machine-Cooperation, smart manufacturing) used to indicate the same phenomenon: the application of digital and interconnected technologies to the manufacturing sector. As Burrit and Christ (2016) claimed, Industry 4.0 is an umbrella term used to describe a group

of connected technological advances that provide a foundation for increased digitization of the business. Hermann *et al.* (2015) identify four components of Industry 4.0: Cyber-physical systems (CPS), Internet of Things (IoT), Internet of Services (IoS), and smart factory.

CPS are systems that integrate computation, networking, and physical processes (Bag *et al.*, 2018); they bring the physical and the virtual world together (Akanmu e Anumba, 2015, Hoffman e Rusch, 2017). In the manufacturing environment, CPS comprise smart machines, storage systems and production facilities able to autonomously exchange information, trigger actions and control each other independently (Kagermann *et al.*, 2013). Their application to the manufacturing process allows for a whole new degree of control, transparency, efficiency, and flexibility of production processes. The *Internet of Things* (IoT), or the Internet of Everything (Lee and Lee, 2015), was first described as the phenomenon of adding new technologies (RFID) to everyday objects (Ashton, 2009). Today the term has evolved in a much broader meaning, that includes a network of entities coupled to each other by any form of wireless sensors, actuators and mobile phones (Giusto *et al.*, 2010). They allow the objects to provide information about their environment, context, and location (Ng and Wakenshaw, 2017). According to this meaning, even physical objects can now become intelligent objects with which it is possible to dialogue thanks to the Internet (Haller *et al.*, 2008). Similar to IoT, the *Internet of Services* (IoS) allows service vendors to offer their services via the Internet and consequently add value to their offer. As a result of the application of IoT and IoS technologies in manufacturing, firms are shifting from offering products to offering integrated product-service bundles, a phenomenon that the literature calls "servitization". Finally, the combination of CPS, IoT, and IoS enables the smart factories. Smart Factory can be defined as a factory where CPS communicate over the IoT and IoS, assisting people and machines in the execution of their tasks (Hermann *et al.*, 2015). In smart factories, human beings, machines, and resources communicate with each other naturally (Kagermann *et al.*, 2013). By equipping manufacturing with sensors, actuators, and autonomous systems, Industry 4.0 will help factories in becoming more intelligent, flexible, and dynamic (Kamble *et al.*, 2018). Beyond these four components, different authors identified other technologies that can be considered under the umbrella term of Industry 4.0: cloud computing (Bag *et al.*, 2018), additive manufacturing, wearables, big data, augmented reality applications, wireless network (Xu *et al.*, 2017).

Within Industry 4.0, a further element of complexity is its interdisciplinarity, since it touches different fields such as engineering, computer technology, manufacturing, logistic, human resources, environmental science, consumer behaviour. As a consequence, as Piccarozzi *et al.* (2018, pp.16) pointed out in their literature review about Industry 4.0 in management studies, "*the first insight that appears clear […] is that Industry 4.0 is a cross-cutting theme of many disciplines that influence each other […] It is rare to find a research paper purely dedicated to the managerial and business aspects of Industry 4.0 because in every aspect the business aspect blend with those pertaining to technical engineering, ICT or sustainability*".

As a matter of fact, in the Industry 4.0's domain, the focus has mainly been on technology and engineering, rather than on "firm-specific" issues, such as strategy or implementation/adoption process management. Thus, it is not surprising that by researching the keyword "Industry 4.0" in the Scopus database, among the total number of papers founded (n. 11.087, August 2020), 9.414 are listed under the "engineering" and "computer science" category, while only 1.630 papers refer to the "business, management and accounting" category. Hence, the examination of organizational and management aspects of Industry 4.0 is still in its infancy (Horvàth and Szabò, 2019).

The majority of the articles in the management field are dealing with the driving forces and barriers that firms face when adopting and implementing Industry 4.0 services and products. For example, Müller *et al.* (2018) identified three different opportunities which serve as antecedents: strategic opportunities (new business models, new value offers for enhanced competitiveness), operational opportunities (increased efficiency, decreasing costs, higher quality, increased speed and flexibility, load balancing & stock reduction) and environment and people opportunities (reduction of monotonous work, age-appropriate workplaces, reduction of environmental impact). On the other hand, they found three main barriers: competitiveness and future viability (the existing business models are endangered, increase the loss of flexibility, standardization, and transparency), organizational and production fit (such as high implementation efforts regarding costs and standardization) and employee qualification and acceptance (employee fear and concerns, lack of expertise).

Along the same line, Horváth and Szabó (2019) acknowledge the existence of some aspects that can sometimes be drivers or barriers of digital transformation. For example, human resources' issues can be considered as a factor that fosters the adoption of Industry 4.0's new technologies and could increase labour shortages, reduce human work and allow firms to allocate them to higher value-added areas. On the other hand, the lack of appropriate competencies and skilled workforce and the longer learning time could make human resources (especially for SMEs) one of the main barriers to the implementation of Industry 4.0 projects. They also demonstrated that MNEs have higher driving forces and lower barriers than SMEs across nearly every aspect. SMEs suffer from the lack of financial resources that prevent them from investing in a new technology and from the management ability to identify the additional opportunities offered by digital transformation. In addition to the ones already cited - employment disruptions, high implementation cost, organizational and process change, need for enhanced skills - Kamble *et al.* (2018) identify many other barriers such as lack of management systems knowledge, lack of standards and reference architecture, lack of Internet coverage and IT facilities, security and privacy issues, seamless integration and compatibility issues and legal and contractual uncertainty.

As emerged from the literature review, studies dealing with driving forces and barriers of Industry 4.0 by either suppliers or manufacturing companies, concern the adoption and the implementation phase of

Industry 4.0 projects, while neglecting the commercialization phase of Industry 4.0 products and solutions. However, identifying the antecedents and barriers to the adoption of Industry 4.0 technologies by SMEs can be useful to understand the complexities faced by firms that want to develop and sell highly technological products that fall under the Industry 4.0 paradigm.

Following the research gaps emerged in the two reviewed streams of literature, the present work aims to unravel what are the significant challenges and issues faced by SMEs when commercializing new high technological products. Besides, since nowadays highly technological products can be considered part of the Industry 4.0 paradigm, the authors want to analyze if this paradigm can either boost or hinder the innovation commercialization process. The novelty and multi-faceted nature of the phenomenon under investigation call for a qualitative approach in order to provide an in-depth analysis of the elements that hinder SMEs' commercialization processes in the Industry 4.0 context. In sum, the study tries to answer the following research questions:

- *RQ1: What are the major issues and barriers that hinder SMEs' commercialization process of high technological products?*
- *RQ2: Does Industry 4.0 support or hinder the commercialization of new products?*

3. Methodology

The explorative nature of the study coupled with the limited extant literature about the topic of commercialization of new products and Industry 4.0 technology calls for the use of a qualitative methodology. Therefore, the study employs a single case study (Eisenhardt, 1989, Yin, 2014) as this approach allows to conduct an in-depth analysis of a complex phenomenon in its real-life context (Yin, 2014; Scapens, 2004). As a consequence, a single case study of an Italian small-sized company (here called "Alfa" for privacy issues) has been chosen for its revelatory potential as it offers a distinctive and extraordinary setting to explore the phenomenon under investigation and to gain insights that other organizations would not be able to provide (Coviello and Joseph, 2012; Siggelkow, 2007). The case firm has been purposefully selected as was known to have invested in developing and commercialising new products embedding Industry 4.0 technologies.

Semi-structured face-to-face interviews with five key informants (CEO, shareholder, salesman and external partners) have been conducted as the primary source of data (Corbin and Strauss, 2015, Yin, 2014, Eisenhardt and Graebner, 2007). The data collection began in February 2019, involving 6 interviews for a total of more than 4 hours of recorded audio (see Table 1). The interviews were conducted in Italian, audio-recorded and transcribed verbatim to be subsequently translated into English. The interview was based on open-ended questions within a semi-standardized protocol to ensure both a guidance and consistency in the interviewing style and an adequate level of freedom in answering. The protocol was based on the

literature about innovation, Industry 4.0 and NPD process and it changed over time as new issues and barriers emerged. Given the novelty of the topic, data have been analysed adopting an abductive approach consistent with the systematic combining described by Dubois and Gadde (2002). This approach is suitable for case studies that require cycling back and forward between theory and data as the study proceeds to produce new insights, develop new hypothesis and identify new patterns (Dubois and Gadde, 2002; O'Toole and McGrath, 2018). In addition, archival data (e.g. reports, advertising materials, online information) analysis was used to provide stronger evidence and triangulate the findings (Eisenhardt, 1989; Yin, 2014).

Then, data reduction and condensation procedures were used to remove non-relevant information. Finally, manual coding was performed to aggregate the data into categories that facilitated analysis (De Massis and Kotlar, 2014; Miles and Huberman, 1994).

Tab. 1: Data collection overview

n.	Role	Organisation	Date	Interview span
1	CEO + Shareholder	Alfa	05/10/2018	70 minutes
2	CEO	Alfa	30/10/2018	70 minutes
3	Engineering Professor	UNIVPM	26/11/2018	46 minutes
4	CEO	Alfa	27/11/2018	45 minutes
5	Engineering Professor	UNIVPM	6/12/2018	Email I4.0
6	CEO	Alfa	23/01/2019	60 minutes
7	CEO	Alfa	23/04/2020	30 minutes

Source: author's elaboration

4. Case description

The chosen company - Alfa - is a small business operating in Le Marche region which designs and sells products and consumables for industrial printing. One of the main activities of Alfa is the optimization of the printing process and the waste reduction generated by it. Thus, the firm has always paid the utmost attention to environmental issues by deploying different activities: guaranteeing the quality of all the raw materials they use, investing in renewable energies projects, producing and selling green labelling products and solutions (see Table 2).

Since 2003, the CEO has been working for the introduction of new products within its business network. His idea was to employ new Industry 4.0 technologies to develop a new category of smart printers able to reduce both the costs and the environmental impact of labelling solutions. In order to achieve this goal, the firm pursued different collaborations, particularly with universities. In the beginning, they occasionally collaborated with the University of Padova in order to develop the first prototype of a smarter printing machine. However, when the headquarter moved from Padova to Falconara in 2015, Alfa began to realize the importance of a continuous

relationship with a certified partner and started a new collaboration with the engineering department of the Università Politecnica delle Marche.

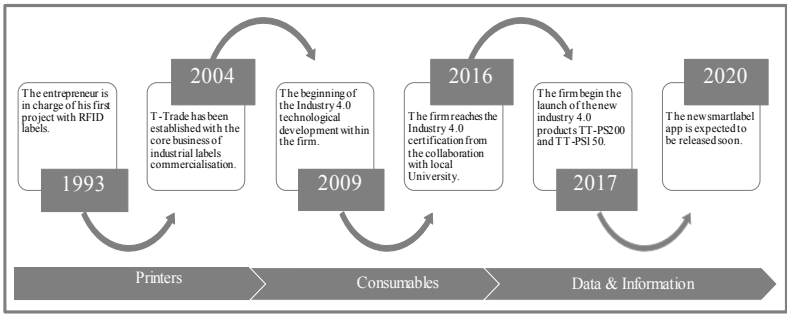
Tab. 2: Case profile information

	Alfa
Turnover (2019)	9 million €
Employee (2019)	31
Participates (2019)	5
Patent rights (2019)	280k €
Number of new products (2020)	5
Total Investments in new products and technologies	1,5 million € (in 5 years)
Markets	Italian mostly, 1 subsidiary in Dubai, 1 subsidiary in India
Customers segments	Food and Beverage, Healthcare, Fashion

Source: author's elaboration

As showed in Figure 1 (below), Alfa has experienced three periods where it has changed its core business. They begin with the commercialization of industrial printers, coming from the previous experience of the CEO in the USA. Then, in 10 years, they shifted to the commercialization of printing consumables, consistent with the growing demand for such products. Since 2004, fast-moving consumer goods and distribution companies have been the preferred customers. Nowadays, Alfa is struggling to begin a new wave, the third one, based on data and information, through the exploitation of Industry 4.0 technologies embedded in printers and labels.

Fig. 1: Alfa case overview



Source: author's elaboration

Alfa's efforts in terms of Industry 4.0 new product development result in the release of two different new products: TT-PA 15, a labelling solution with liner-less technology which allowed the complete avoidance of silicone paper and a 50% reduction of cellulose, and TT-PS 200, a printer which can both seal and label into one solution, resulting in a shorter packaging line and increased respect for the environment by using an adhesive tape as a support on which to write variable data instead of using the paper label.

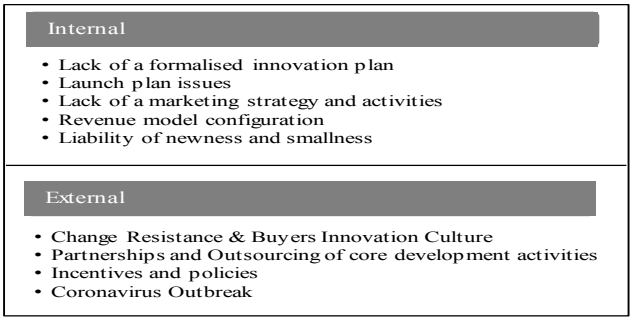
Besides, both products are interconnected and compliant with the Industry 4.0 criteria, as stated in the Italian Industry 4.0 plan.

After the launch in 2017, many issues started to stem while the commercialization was going on. In the last ten years, Alfa invested more than 1,5 million euro in innovation and the development of new technologies. However, these new products were still not creating the wealth expected but supported the firm in increasing the purchasing quote with each buyer. The new products sales are linked to their adoption by long-term customers that are already buying consumables products for printing. To date, no machine has been sold to new customers.

5. Findings

The single case study analysis reveals that a SME trying to commercialize Industry 4.0 new products faces several issues and barriers that can be either internal or external (see Figure 2).

Fig. 2: Summary of internal and external issues and barriers



Source: author's elaboration

The internal issues and obstacles are mainly related to innovation and NPD-process management. The first issue is the lack of a formalized plan to manage innovation. As a matter of fact, ALFA did not plan any development activities in advance and the linearity of the NPD process has been mostly disregarded in each phase, resulting in a disorganized and chaotic process. This lack will, in turn, lead to the emergence of other issues that will require significant efforts to be managed. The lack of a precise planning in innovation emerged during the interviews with the CEOs, who highlighted that some crucial aspects of the NPD process - such as the concept selection, the users' needs study, the prototype validation - have not been defined yet, even after two years from the release of the new products. Besides, the firm is still defining important elements - such as additional services attached to the product - that usually should be defined before the beginning of the product development process.

"*We have to overcome a strictly product-related logic and develop solutions where perhaps data becomes the real value. Industry 4.0 printer machines can lead us to that direction. They are constantly connected and*

capable of recording and communicating each type of data: level of paper consumption, production problems, operations required, and so on".

The lack of an innovation plan is linked to the lack of defining a standardized product portfolio.

"*We are trying to create standard machines otherwise we cannot develop our business network" as well as "Innovation cannot be constrained in a machine, but we should be compliant with customers' needs and regulations*".

The following three issues that emerged are more strictly related to the commercialization phase. First, the product launch not only lacked planning but was even disregarded. The analysis of the buyers' and users' involvement according the product characteristics - a critical activity for a successful launch - has been mostly ignored by the company. Second, another critical factor is the launch timing. They missed the right timing to launch the product mostly because no activities were developed to understand the buyers' requirements and prepare the launch. The CEO stated that:

"*When we tried to commercialize new products, time was needed both for us to understand the buyers' requirements and for the buyers to accept new products and/or technologies. Our biggest fault was to launch the product too early*".

Strictly related, the absence of any marketing and communication activities emerged as the third main issue hindering the commercialization of these new products. The sales team and the customer service are mainly internal, but there are different sale reps that are external brokers. Today, the firm has not yet appointed any salesperson specifically dedicated to the commercialization of the new machines and it lacks a marketing department or any marketing figure inside the organization as well. The communication effort has been limited to presenting the products during some important fair trade by delivering advertising flyers to explain the sustainability-related benefits of their machines.

"*I know our communication efforts are barely existent since nobody seems to perceive the added value of our machines*" (CEO).

The lack of an adequate revenue model represents the fourth internal issue. As the CEO pointed out: "I think we should develop a new revenue model such as rent or pay per use, or maybe even another different formula". In fact, Alfa's core business lies in the production of neutral and customized adhesive labels in huge amount to a variety of firms in different sectors (food, healthcare, FMCG). Consequently, the CEO still struggles to identify how to set-up the revenue model and the marketing activities related to the new products for getting the most out of the resources invested in the NPD process.

The fifth internal issue can be directly linked to the typical SMEs' lack of resources, thus determining the well-known issue of liability of newness and smallness. Firstly, the printer's innovativeness required to develop mixed competencies that integrate technical and marketing skills going beyond the expertise of a small manufacturing firm.

"*We are just a handful of people here that strives to accomplish too many different tasks. I have tons of innovative ideas, but then I have to deal with the reality of everyday life*" (CEO).

Secondly, Alfa is still new in the production of Industry 4.0 printers and is facing several difficulties in supporting the commercialization process of the new products. Alfa showed the barriers of a firm that has just tapped into a completely new business and it has not yet been perceived as reliable and trustworthy as other competitors that have been in the market for a longer time. Regarding these issues, the CEO underlined "If I were "X" [big player in the label industry] I would be able to be paid even for my R&D and customization activities related to the product".

Then, among the external issues and barriers to commercialization, the first is related to the buyers' change resistance and their innovation culture. As pointed out by the CEO:

"*We notice a high level of reluctance and resistance in buying new solutions, mostly since nobody wants to go against the production manager. […] In most companies, there are managing directors that stay in that firm for few years, and they often do not want to be remembered as the one who took the wrong decision. […] Innovation is interesting if it can be useful in that precise moment for the person in charge or in the position to recommend the adoption of your solution. Innovation should also support careers and political interest, inside a customer's company*".

Consequently, the buyers' hierarchic structure and their decision-making processes are strongly influencing their willingness to make a change towards the adoption of new technological products. In this case, the resistance seems to be linked to "career dynamics" issues, where the decision of introducing such new complex solutions in the buyer's production system requires courage and a strong confidence in the benefits of these technologies.

According to the innovation culture, the CEO pointed out that there are two different types of firms: the ones that genuinely believe in the Industry 4.0 opportunities and benefits, pursuing innovativeness and embracing new products; and the ones that look at innovation only if, as the CEO argued "*the price is lower than standard products*".

Additionally, buying firms should be aware of the potential of new solutions as the CEO suggested:

"*Our partner has to be aware that our technologies are going to change his company and its operations and organization… a partner that truly want to go ahead with this technology and believe in it*".

However, to embrace innovation and the related organizational and operational changes, the business network has to be ready to adopt a new technology compliant with the Industry 4.0 principles. Unfortunately, this seems a prerogative of large companies, as suggested by the CEO:

"*small firms still do not have the right structure to adopt this technology, and they do not want to pay a premium price for it" and "companies have not yet understood the real potential of our machines. It is difficult to tap into a market with new solutions, especially when there are such consolidated technologies as in the label's industry*".

The second external factor that has a strong influence in the commercialization of new products is related to the partnership developed, or needed, to exploit the innovation process. The case repeatedly outlines the central role of Universities and R&D centers in supporting the development

of new products. The University helps Alfa with a broad set of technologies capable of managing the machines' data in the cloud environment both for maintenance purposes and for a real-time assessment of their impact on sustainability. However, the benefits of this partnership go beyond the technological expertise of the University. The CEO emphasizes that this relationship should be further leveraged for certifying the Industry 4.0 features to customers and potential buyers. The case company reports "*the collaboration with the University gave us a much greater warranty towards our stakeholders. Being able to tell that our products are certified as Industry 4.0 and sustainable by such a recognized organization, protect us from any future doubts regarding noncompliance with the Industry 4.0 guidelines*" and "*this relationship might help our commercialization process by increasing the awareness in our potential buyers*".

The role of policymaker is the third external factor that seems to have a substantial impact on the buyers' decision to adopt Industry 4.0 new products. As the CEO pointed out "*several companies are willing to adopt such innovation only if there are policies that force them to be compliant with some standard or if they can benefit from some incentives to reduce the investments*". Consequently, the policy makers' intervention might occur in two ways: incentives to support the development and the adoption of new products and rules and legislation that make the transition to new technologies or new products mandatory.

The last external issue that is affecting the NPD and commercialization process of Alfa's Industry 4.0 products is related to the coronavirus outbreak. As pointed by the CEO: "*The pandemic had a negative effect on the new machines' sales. Companies seem to be scared of the situation and the uncertainty it brought; thus, they blocked all the investments, especially on new products. We lost more than 50% of the revenues coming from the sales of printers*".

6. Theoretical Discussion

The study contributes to the extant literature on NPD and Industry 4.0 by providing new evidence on the issues and barriers faced by SMEs when developing and commercializing new products embedding Industry 4.0 technology.

This far, studies have mostly investigated the NPD process of start-ups and larger corporations, leaving incumbent SMEs widely underexplored. Moreover, this article is one of the few attempts to adopt the innovator perspective rather than the innovation adopter perspective. Although there is a well-established literature investigating drivers and barriers in adopting Industry 4.0 technologies - and innovations in general (e.g. Müller *et al.*, 2018; Horváth and Szabó, 2019), very few studies have analysed how an incumbent SME innovator might commercialize new highly technological products.

In this regard, the case analysis outlines both internal and external issues that can hamper the commercialization process of new Industry 4.0 products, thus allowing a better understanding of what is still missing

when managing this process. The lack of a deliberated NPD and innovation plan as well as of any marketing activity and the presence of some typical liabilities of SMEs (i.e. liability of newness and smallness) emerged as main internal issues faced by the company.

The lack of a formalized plan for product innovation and technology development hinders the NPD stage-gate model that could support the commercialization of new products (see Cooper, 2019; Crawford and Di Benedetto, 2008). The literature on NPD specifically suggests developing a marketing plan before deploying the whole NPD process to adapt the product to the users' requirements and effectively market it (Saji and Mishra, 2013). The study findings mirror the "innovation inertia" that has been highlighted as one of the main challenges in the SMEs' innovation processes (see Carter and Jackson, 2019). This is consistent with the current literature emphasizing a "Marketing without Marketing" approach in Italian SMEs (see Varaldo, Dalli and Resciniti, 2006), whereby marketing is frequently underdeveloped and characterized by informal, reactive, and spontaneous techniques (Gilmore *et al.*, 2007), often inspired by the entrepreneur's intuition. SMEs' internal issues in managing marketing and new product commercialization activities often originate from the lack of a marketing department or even a person in charge of the whole process (Horváth and Szabó, 2019). Overall, the study findings provide additional evidence on how the lack of formal planning profoundly affects SMEs' behaviours.

Moreover, previous studies have identified liability of smallness and newness (see Aldrich and Auster, 1986; Stinchcombe, 1965) as the SMEs' issue. The study findings suggest that these barriers play a pivotal role in hampering the commercialization of Industry 4.0 products, mostly due to the complexities of such products which require dedicated knowledge and skills going beyond a small manufacturing firm's expertise.

The study shows how the buyer's change resistance and its attitude toward innovation challenge the commercialization of highly technological product like Industry 4.0 applications. Notably, the adopters' lack of knowledge and expertise about Industry 4.0 products which has been identified as one of the main adoption barriers (e.g. Müller *et al.*, 2018) represents a main issue for innovators' commercialization processes as well. These barriers are also tied to the hierarchy, and the career dynamics within large buyers, where the long decision-making process to introduce new devices and complex solutions requires long-term efforts from the supplier (see Thomas and Main, 2019). Interestingly, government incentives for acquiring and implementing Industry 4.0 products might help innovative SMEs in overcoming buyer-related barriers. As a matter of fact, although innovative products have the potential to provide tangible benefits and advantages, buyers are more eager to adopt new products when there are financial incentives to cover the purchasing and setting up costs, or when regulations demand to be compliant with certifications. Therefore, the study contributes to the Industry 4.0 literature by showing that this paradigm seems to mainly support the commercialization of highly technological products if the innovator can exploit and advertise the related incentives and policies.

Importantly, whilst the literature has emphasized the outsourcing of marketing and sales activities during NPD (Pellika and Lauronen, 2007), the study findings outline that a SME might benefit from the outsourcing of technological development activities to external actors (e.g. University). These partnerships have the potential to be extremely valuable in terms of warranty and authority towards stakeholders, thereby helping SMEs in overcoming commercialization issues.

Lastly, the study offers preliminary insights on the outbreak of the new coronavirus as an important external barrier for SMEs dealing with the commercialization of highly technological products. Such a global event entails tremendous consequences for SMEs by intensifying the main barriers already experienced by the companies, especially those related to the customer side.

7. Managerial Implications

The study allows to draw critical managerial implications able to support SMEs in their commercialization activities of Industry 4.0 devices. The technological innovation created by Industry 4.0 calls SMEs to adopt a new managerial approach.

The internal perspective of the study identifies the pivotal role of strategy and planning as the first step to manage commercialization. Particularly, innovation management and marketing activities are strictly intertwined and, as emerged in the study, the commercialization cannot exist without formalizing and planning both activities. Consequently, the strategy should also incorporate the firm's R&D vision and offer a guidance for the entire organization.

First, SMEs should create a cross-functional team headed by a team-manager who oversees the whole commercialization process and deals with eventual drawbacks or pitfalls. Concurrently, they should plan a marketing strategy without ignoring some important commercialization activities such as the accurate market analysis to identify the new potential buyers' profile and plan the launch. Regarding the first activity, SMEs usually find useful to start the commercialization of new products by approaching their existing customer portfolio and trying to sell their new products. This is also happened in ALFA, but then its lack of any marketing analysis prevents them to engage with the right buyers' profile. SMEs should develop a gradual activity to interact with further key users and key buyers consistent with the profile identified in the strategy.

In addition, once key actors have been identified, the launch should start by involving and convincing them to start using the new product. Thanks to the potential buyers' engagement, SMEs could also overcome the buyers' change resistance and innovation culture issues. In addition, firms might develop several types of communication strategies in order to demonstrate and try the effectiveness of the product. Providing free or controlled trials allows the firm to understand how to build-up the user experience thus creating confidence over the products.

Besides, in order to commercialize Industry 4.0 products and to help the buyer's willingness to change, SMEs should exploit the incentives

enacted by policymakers and governments in order to support the digital transformation of the business and entrepreneurial ecosystem. The commercialization process should leverage these policy measures and promote the incentives among the key potential buyers. In addition, in the investigated case, the partnership with the University seems to have a strategic role in certifying the Industry 4.0 features both for the potential users and for the government.

Lastly, we might draw early implications concerning the coronavirus' impact on Industry 4.0 products' commercialization. Firstly, reaching and engaging new customers appears to be increasingly problematic not only because of the social distance that limits sales meetings, but also because of the customers' motivation to buy. As a matter of fact, in turbulent times the business relationship may start for the wrong reasons, mostly for an isolated customer's need, thus might turning out to be a spot initiative, rather than backed with a strong purpose to establish a long-term relationship with a supplier. Secondly, managing the relationship through digital tools makes it difficult to discuss important issues such as investments in new products and new processes. In addition, since the introduction of highly technological solutions requires training activities in on how to correctly set and use the new products, as well as personalization activities to integrate the machines into the customer production lines, being able to physically meet the buyers appears to be mandatory for successfully commercialize Industry 4.0 products. Finally, the fear related to the uncertainty of the future economic situation brought by the pandemic is turning firms into being cautious and avoiding high and risky investments.

8. Limitations and future research

The study design is subject to several limitations, some of which offer interesting avenues for developing future research.

First, the study is explorative in nature, relying on a single case study, and accordingly, the findings cannot be generalized. However, the case study is considered a single context method (one case, one industry, one country) and it is increasingly and widely applied in different research fields (Dubois and Gadde, 2002).

Notably, the study identified several elements that hinder the commercialization of new high technological products in SMEs operating in the B2B context. Then, the study of other SMEs operating in different sectors and countries might lead to different results and show different paths, thus identifying other hindering factors to NPD commercialization process.

Furthermore, the study relies on interviews with some key informants inside the firm. Albeit following a strict methodological protocol that ensures the informants' reliability, allowed the authors to have only the internal perspective in analyzing the investigated phenomenon. Consequently, future developments of the study should gather additional insights into the customers' perspective in order to better triangulate the results and support the internal key informants' perceptions.

References

AARIKKA-STENROOS L., SANDBERG B. (2012), "From new-product development to commercialization through networks", *Journal of Business Research*, vol. 65, n. 2, pp. 198-206.

AARIKKA-STENROOS L., SANDBERG B., LEHTIMÄKI T. (2014), "Networks for the commercialization of innovations: A review of how divergent network actors contribute", *Industrial Marketing Management*, vol. 43, n. 3, pp. 365-381.

AARIKKA-STENROOS L., LEHTIMÄKI T. (2014), "Commercializing a radical innovation: Probing the way to the market", *Industrial Marketing Management*, vol. 43, n. 8, pp. 1372-1384.

AARIKKA-STENROOS L., JAAKKOLA E., HARRISON D., MÄKITALO-KEINONEN T. (2017), "How to manage innovation processes in extensive networks: A longitudinal study", *Industrial Marketing Management*, n. 67, pp. 88-105.

AGOSTINI L., NOSELLA A. (2019), "The adoption of Industry 4.0 technologies in SMEs: results of an international study", *Management Decision*, vol. 58, n. 4, pp. 625-643.

AKANMU A., ANUMBA C.J. (2015), "Cyber-physical systems integration of building information models and the physical construction", *Engineering, Construction and Architectural Management*, vol. 22, n. 5, pp. 516-535.

ALDRICH H., AUSTER E.R. (1986), "Even dwarfs started small: Liabilities of age and size and their strategic implications", *Research in Organizational Behavior,* vol. 8, pp. 165-198.

ASHTON K. (2009), "That 'internet of things' thing", *RFID Journal*, vol. 22, n. 7, pp. 97-114.

BAG S., TELUKDARIE A., PRETORIUS J.H.C., GUPTA S. (2018), "Industry 4.0 and supply chain sustainability: framework and future research directions", *Benchmarking: An International Journal*, Vol. ahead-of-print No. ahead-of-print.

BOLLWEG L., LACKES R., SIEPERMANN M., WEBER P. (2020), "Drivers and barriers of the digitalization of local owner operated retail outlets", *Journal of Small Business and Entrepreneurship*, vol. 32, n. 2, pp. 173-201.

BOUWMAN H., NIKOU S., DE REUVER M. (2019), "Digitalization, business models, and SMEs: How do business model innovation practices improve performance of digitalizing SMEs?", *Telecommunications Policy*, vol. 43 n. 9 pp. 101828.

BURRITT R., CHRIST K. (2016), "Industry 4.0 and environmental accounting: a new revolution?", *Asian Journal of Sustainability and Social Responsibility,* vol. 1, n. 1, pp. 23.

CARTER W., JACKSON G. (2018, July), "Clockspeed and Cooperation: Incumbent Motives to Participate in the Market for Ideas", *Academy of Management Proceedings,* vol. 2018, n. 1, p. 10340.

CHESBROUGH H., VANHAVERBEKE W., WEST J. (Eds.) (2006), *Open innovation: Researching a new paradigm*, Oxford University Press on Demand.

CHRISTENSEN C.M. (2013), "The innovator's dilemma: when new technologies cause great firms to fail", *Harvard Business Review Press*, Boston, Massachusetts.

COOPER R.G. (2008), "Perspective: The stage-gate® idea-to-launch process-update, what's new, and nexgen systems", *Journal of Product Innovation Management,* vol. 25, n. 3, pp. 213-232.

COOPER R.G. (2019), "The drivers of success in new-product development", *Industrial Marketing Management*, n. 76, pp. 36-47.

CORBIN J., STRAUSS A. (2015), *Basics of qualitative research,* Sage: Thousand Oaks, CA.

COVIELLO N.E., JOSEPH R.M. (2012), "Creating major innovations with buyers: Insights from small and young technology firms", *Journal of Marketing,* vol. 76, n. 6, pp. 87-104.

CRAWFORD C.M., DI BENEDETTO A. (2008), *New products management,* Tata McGraw-Hill Education, New York.

DAS S.S., VAN DE VEN A.H. (2000), "Competing with new product technologies: A process model of strategy", *Management Science*, vol. 46, n. 10, pp. 1300-1316.

DE MASSIS A., KOTLAR J. (2014), "The case study method in family business research: Guidelines for qualitative scholarship", *Journal of Family Business Strategy,* vol. 5, n. 1, pp. 15-29.

DE SOUSA JABBOUR A.B.L., JABBOUR C.J.C., FOROPON C., GODINHO FILHO M. (2018), "When titans meet-Can industry 4.0 revolutionise the environmentally-sustainable manufacturing wave? The role of critical success factors", *Technological Forecasting and Social Change*, vol. 132, pp. 18-25.

DUBOIS A., GADDE L.E. (2002), "Systematic combining: an abductive approach to case research", *Journal of Business Research*, vol. 55, n. 7, pp. 553-560.

DURST S., HINTEREGGER C., TEMEL S., YESILAY R.B. (2018), "Insights from the later stage of the new product development process: findings from Turkey", *European Journal of Innovation Management*, vol. 21, n. 3, pp. 456-477.

EISENHARDT K.M. (1989), "Building theories from case study research", *Academy of Management Review,* vol. 14, n. 4, pp. 532-550.

EISENHARDT K.M., GRAEBNER M.E. (2007), "Theory building from cases: Opportunities and challenges", *Academy of Management Journal,* vol. 50, n. 1, pp. 25-32.

GILMORE A., GALLAGHER D., HENRY S. (2007), "E-marketing and SMEs: operational lessons for the future", *European Business Review,* vol. 19, n. 3, pp. 234-247.

GIUSTO D., IERA A., MORABITO G., ATZORI L. (Eds.), (2010), *The internet of things: 20th Tyrrhenian workshop on digital communications*, Springer Science and Business Media, New York.

HALLER S., KARNOUSKOS S., SCHROTH C. (2008, September), *The internet of things in an enterprise context. In Future Internet Symposium* (pp. 14-28), Springer, Berlin, Heidelberg.

HERMANN M., PENTEK T., OTTO B. (2015), *Design principles for Industrie 4.0 scenarios: a literature review,* Technische Universität Dortmund, Dortmund.

HOFMANN E., RÜSCH M. (2017), "Industry 4.0 and the current status as well as future prospects on logistics", *Computers in Industry*, vol. 89, pp. 23-34.

HORVÁTH D., SZABÓ R.Z. (2019), "Driving forces and barriers of Industry 4.0: Do multinational and small and medium-sized companies have equal opportunities?", *Technological Forecasting and Social Change*, vol. 146, pp. 119-132.

KAGERMANN H., HELBIG J., HELLINGER A., WAHLSTER W. (2013), *Recommendations for implementing the strategic initiative INDUSTRIE 4.0: Securing the future of German manufacturing industry; final report of the Industrie 4.0 Working Group*, Forschungsunion

KAMBLE S.S., GUNASEKARAN A., GAWANKAR S.A. (2018), "Sustainable Industry 4.0 framework: A systematic literature review identifying the current trends and future perspectives", *Process Safety and Environmental Protection,* vol. 117, pp. 408-425.

LA PLACA P.J. (2014), "Innovation in business networks", Industrial Marketing Management, vol. 43, n. 3, pp. 359-360,

LEE I., LEE K. (2015), "The Internet of Things (IoT): Applications, investments, and challenges for enterprises", *Business Horizons*, vol. 58, n. 4, pp. 431-440.

LEITHOLD N., WOSCHKE T., HAASE H., KRATZER J. (2016), "Optimising NPD in SMEs: a best practice approach", *Benchmarking: An International Journal,* vol. 23 n. 1, pp. 262-284.

LEITHOLD N., HAASE H., LAUTENSCHLÄGER A. (2015), "Stage-Gate® for SMEs: a qualitative study in Germany", *European Journal of Innovation Management,* vol. 18, n. 2, pp. 130-149.

LIAO Y., DESCHAMPS F., LOURES E.D.F.R., RAMOS L.F.P. (2017), "Past, present and future of Industry 4.0-a systematic literature review and research agenda proposal", *International Journal of Production Research*, vol. 55, n. 12, pp. 3609-3629.

MEDLIN C.J., TÖRNROOS J.Å. (2015), "Exploring and exploiting network relationships to commercialize technology: A biofuel case", I*ndustrial Marketing Management*, n. 49, pp. 42-52.

MILES M.B., HUBERMAN A.M. (1994), *Qualitative data analysis: An expanded sourcebook*, sage.

MOEUF A., LAMOURI S., PELLERIN R., TAMAYO-GIRALDO S., TOBON-VALENCIA E., EBURDY R. (2019), "Identification of critical success factors, risks and opportunities of Industry 4.0 in SMEs", *International Journal of Production Research,* vol. 58, n. 5, pp. 1384-1400.

MÜLLER J.M., BULIGA O., VOIGT K.I. (2018), "Fortune favors the prepared: How SMEs approach business model innovations in Industry 4.0", *Technological Forecasting and Social Change*, n. 132 pp. 2-17.

NG I.C., WAKENSHAW S.Y. (2017), "The Internet-of-Things: Review and research directions", *International Journal of Research in Marketing,* vol. 34, n. 1, pp. 3-21.

NICHOLAS J., LEDWITH A., PERKS H. (2011), "New product development best practice in SME and large organisations: theory vs practice", *European Journal of Innovation Management,* vol. 14 n. 2 pp. 227-251.

O'TOOLE T., MCGRATH H. (2018), "Strategic patterns in the development of network capability in new ventures", *Industrial Marketing Management,* n. 70, pp. 128-140.

PELLIKKA J., LAURONEN J. (2007), "Fostering commercialisation of innovation in small high technology firms", *International Journal of Technoentrepreneurship,* vol. 1, n. 1, pp. 92-108.

PICCAROZZI M., AQUILANI B., GATTI C. (2018), "Industry 4.0 in management studies: A systematic literature review", *Sustainability*, vol. 10, n. 10, pp. 3821.

PORTER M.E., VAN DER LINDE C. (1995), "Toward a new conception of the environment-competitiveness relationship", *Journal of Economic Perspectives,* vol. 9, n. 4, pp. 97-118.

SAJI K.B., MISHRA S.S. (2013), "Investigating the role of firm resources and environmental variables in new product commercialization", *Journal of Product and Brand Management*, vol. 22, n. 1, pp. 18-29.

SCAPENS R.W. (2004), *Doing case study research. In The real life guide to accounting research* (pp. 257-279), Elsevier.

SCHUMPETER J.A. (1934), "The theory of economic development, translated by Redvers Opie", *Harvard: Economic Studies,* n. 46, pp. 1600-0404.

SIGGELKOW N. (2007), "Persuasion with case studies", *Academy of Management Journal*, vol. 50, n. 1, pp. 20-24.

STINCHCOMBE A.L. (1965), "Organizations and social structure", *Handbook of Organizations*, vol. 44, n. 2, pp. 142-193.

STONE G.W., WAKEFIELD K.L. (2000), "Eco-orientation: An extension of market orientation in an environmental context", *Journal of Marketing Theory and Practice,* vol. 8, n. 3, pp. 21-31.

THOMAS V.J., MAINE E. (2019), "Market entry strategies for electric vehicle start-ups in the automotive industry-Lessons from Tesla Motors", *Journal of Cleaner Production,* n. 235 pp. 653-663

TZOKAS N., HULTINK E.J., HART S. (2004), "Navigating the new product development process", *Industrial Marketing Management,* vol. 33, n. 7, pp. 619-626.

VAN DE VEN A.H. (1986), "Central problems in the management of innovation", *Management Science,* vol. 32, n. 5, pp. 590-607.

VARALDO R., DALLI D., RESCINITI R. (2006, January), "Marketing-non-marketing all'italiana: virtù, limiti e prospettive", in Collesei U., Andreani J., *Atti del Congresso internazionale Le tendenze del Marketing* (pp. 20-21), Venezia.

VON HIPPEL E. (1986), "Lead users: a source of novel product concepts", *Management Science*, vol. 32, n. 7, pp. 791-805.

XU L.D., XU E.L., LI L. (2018), "Industry 4.0: state of the art and future trends", *International Journal of Production Research,* vol. 56, n. 8, pp. 2941-2962.

YIN R.K. (2014), *Case study research and applications: Design and methods*, Sage publications, Thousand Oaks, CA.

Academic or professional position and contacts

Andrea Sabatini
Post-Doctoral Researcher of Management
University Politecnica delle Marche - Ancona - Italy
e-mail: a.sabatini@staff.univpm.it

Sara Bartoloni
Postdoctoral Research Fellow of Management
University Politecnica Marche - Ancona - Italy
e-mail: s.bartoloni@univpm.it

Gian Luca Gregori
Full Professor of Management
University Politecnica Marche - Ancona - Italy
e-mail: g.gregori@staff.univpm.it

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