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The 4th Industrial Revolution:
Business Models and Evidence From the Field

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ABSTRACT

The objective of this article is to analyze the impact of Industry 4.0 on business models considering technological change as a driver of strategic innovation. The research aims to provide the key to interpreting a process of innovation that, starting from the technological transformation, translates it into a broader change of business models. A structured literature review has been developed analyzing 144 sources divided into scientific papers, reports from consultancy firms and institutional reports. This method identified the importance given by the literature to the technologies and their impact on the building blocks of the business model. The research has led to the identification of 12 business models that can represent a framework to interpret the Industry 4.0 phenomenon strategically. A questionnaire analysis of a sample of 111 companies based in Italy allowed us to compare the results of theoretical research with the perceptions of Italian entrepreneurs.

KEYWORDS

Building Blocks, Business Models, Industry 4.0, Innovation, Italian Entrepreneurs, Strategy, Structured Literature Review, Technological Change

1. INTRODUCTION

The concepts of "Innovation" and "Strategy" have become the fundamental themes of two rich areas of study in the nineties (Schlegelmilch et al., 2003). The literature focused on strategy defines the way to compete within a specific market sector and outlines the field of action of the organization through the choices needed to achieve a long-term or overall aim. On the other hand, the literature on innovation has focused its attention on the level of product and process innovation (Schlegelmilch et al., 2003). Therefore, while the literature on strategy focuses on the overall aims of the organization, the concept of innovation, until the mid-nineties, was never used at the enterprise level. The different focus of innovation and strategy are stimulating, especially considering the intrinsic nature of the term innovation. Indeed, innovation represents the ability to think and to practice new or better ways of doing things, and thus represents an exceptional mechanism, capable of unleashing the creative spirit. Innovation can be the trigger for opening the mind to possibilities that were previously unknown, leading to progress in areas essential for human development. Therefore, innovation leads to very demanding challenges but also extraordinary opportunities for companies pushing traditional approaches focused on product and process under a great pressure to expand their horizons (Porter, 1996). Because of the need to create a more comprehensive approach on innovation, from the nineties,

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the concepts of innovation and strategy have started to become more linked, thanks to the introduction of the concept of strategic innovation (Schlegelmilch et al., 2003). Strategic innovation consists in the development of a new concept (and therefore a model) of business, namely: new products or services, presented or combined in a new way, to create a radically new experience for clients, involving them also at an emotional level. Strategic innovation can also arise from the reconfiguration of the sector's value chain to change the rules of the game - exploiting, for example, the possibilities offered by new technologies to reach the final customer directly to enhance the distinctive competencies of the company (Buaron, 1981).

From that point on the literature agreed that strategic innovation goes beyond the simple adjustment of the current business strategy. Indeed, strategic innovation requires extensive changes both at the level of the structure and at the level of business processes. Therefore, it becomes necessary especially for companies anchored to "traditional" business models (BM) that are resistant to strategic change (Spender, 1989). The phenomenon of the new industrial revolution (Industry 4.0) has contributed to enhancing the complexity of the topic.

Given the new technological challenges and the impact on innovation provided by Industry 4.0, this study employs a structured literature review (SLR) approach according to Massaro et al. (2018) to understand how Industry 4.0 is changing companies' BM providing new opportunities and challenges. The analysis refers to 144 selected documents such as journal papers, books, reports, to understand the impact of Industry 4.0's technologies on BM. A questionnaire analysis of a sample of 111 companies based in Italy has been carried on to double check the results of theoretical research with the perceptions of Italian entrepreneurs.

The paper is novel since it starts from a literature review of recent and various sources to verify the impact of new technologies on BM. The results allow identifying which BM seem to be the more successful, and which technologies seem to have the power to influence the current BM. The results of the survey allow verifying what appears to be the state of the art for Italian entrepreneurs.

The paper is structured as follow. The first paragraph explains the literature review, and it is followed by the research methodology. Results and conclusions end the paper.

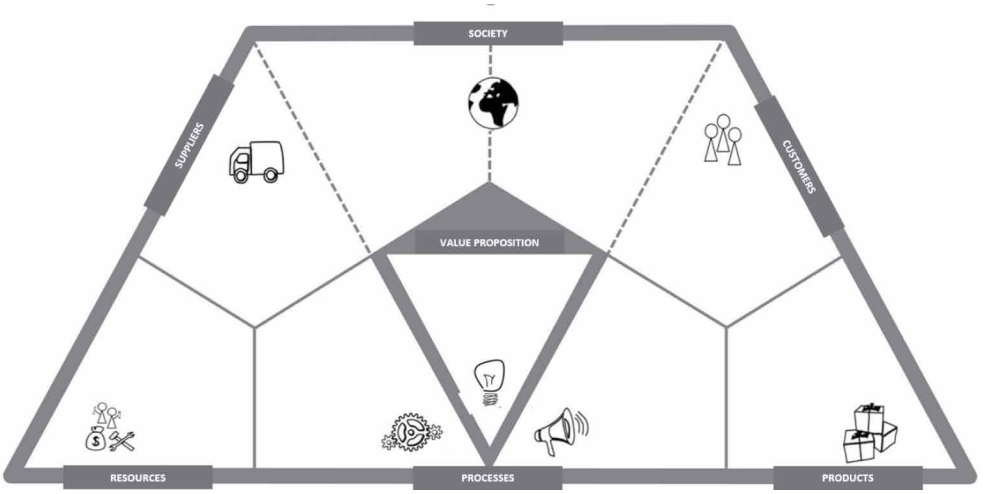
2. LITERATURE REVIEW

2.1. Strategic Innovation and the BM Canvas

BMs represent the underlying logic of how the company is doing business, creates value for stakeholders and captures a share of value for itself (Biloslavo et al., 2018; Bagnoli et al., 2018 (a); Bagnoli et al., 2018 (b); Nielsen et al., 2018; Nielsen et al., 2019). The business model "Canvas" is a strategic tool that uses visual language to create and develop innovative BM. It represents the way in which a company generates, distributes, and captures value. The value offered is the reason for customers to choose a company rather than a different one by solving a customer issue or meeting their needs. Each value consists of a selected set of products or services that fits the requirements of a specific customer segment. Some value propositions can be innovative and represent a new or disruptive offer, others may be similar to the ones existing on the market, but with additional features and attributes.

The framework adopted in our study is the one by Biloslavo et al. (2018), which consists of a reworking of the famous model of Osterwalder and Pigneur. The model starts from a triangular figure that can be "open," thus configuring a direct and straightforward visual reference scheme, suitable for a lean but complete representation of all the eight elements of the business model: suppliers, resources, internal processes, external processes, products, customers, society, and value proposition.

Figure 1. Our framework (Source: Biloslavo et al., 2018)



2.2. Strategic Innovation and Industry 4.0

The growing attention on the role BM canvas follows the development of the literature on innovation. Scholars distinguish three different sources of strategic innovation: Technology Push, Market Pull, and design-driven (Verganti, 2011). These three different types of change start from different assumptions and therefore lead to equally mixed results.

The technology push innovation derives from the exploration of new technological possibilities by the organization. Typically, they lead to radical innovations in technical and technological terms and changes in consumer needs. According to Schumpeter, the company imposes "change," and the consumer is instrumental to the fact that the activity of the producer is successful (Schumpeter, 1971). The company, therefore, moves independently, and the introduction of innovation does not take place according to the needs of consumers. In this way, the firm "educates" its consumer, to push him/her to let the new products be included among his/her preferences. Strategic innovation, however, cannot derive only from a technology push innovation. Change cannot focus only on the increase in technical or technological characteristics, without considering the needs of the client (Verganti, 2008).

Market pull innovation, on the other hand, originates from an understanding of the needs of customers or end users, or direct requests from the market. It usually starts with the analysis of the clients/users' needs, and with the following search for technologies that can satisfy them in a better way. These innovations are purely incremental because the market and the customers are rarely able to express needs that go beyond their usual consumption experience (Verganti, 2008).

Design-driven innovation is not a technological innovation, nor it does derive from the needs expressed by the market, but it is an innovation of meaning. This type of change arises from the exploration and understanding of existing and future trends in socio-cultural models and offers new visions, new concepts and radically new senses to existing products or services and therefore acts on potential needs or emotional and symbolic aspects. These are, therefore, innovations pushed by the vision of the company regarding the possible changes in meanings and languages that could emerge in the future (Verganti, 2008) and not from current customer needs.

Design-driven innovations can be both radical and incremental. They can bring about a change in language, which in turn determines the message transmitted to the client and therefore the meaning of the products or services offered, only partially or different from that existing in the current socio-cultural models. According to Biloslavo et al. (2018), design-driven innovations are the only way for companies already present in the market to renew their position of success. At the same time, they

represent a way for new entrants to overcome the significant disadvantages compared to companies already present in the market.

Interestingly, the development of the innovation called "Industry 4.0" is providing new sources of innovations that draw on all these characteristics, presenting new challenges for changing companies' BM. Indeed, Industry 4.0 leads to a digital transformation, which takes the form of interconnected systems able to interact with each other and to collect and analyze data to adapt to changes. It disrupts the value chain, and for this reason, companies must not limit themselves to a technological analysis of transformation but are forced to rethink their BM, their way of working to create value for their customers.

3. RESEARCH METHODOLOGY

This paper employs an SLR (Massaro, Dumay, et al., 2016). Conducting an SLR "can help experienced scholars develop new and interesting research paths by accessing and analyzing a considerable volume of scholarly work" (Massaro, Dumay, et al., 2016). Additionally, Massaro et al. (2016) state that an SLR can "contribute to developing research paths and questions by providing a foundation" for future investigation. Interestingly, SLRs seem to provide an alternative to more 'traditional' literature reviews, to reach more "defensible" and "replicable" results. This approach has already been used to investigate interdisciplinary fields of accounting, auditing and accountability (Guthrie and Parker, 2011), Knowledge Management in the Public Sector (Massaro et al., 2015), Knowledge Management in Small and Medium Enterprises (Massaro, Handley, et al., 2016), organizational knowledge protection (Manhart and Thalmann, 2015), human capital accounting (Guthrie et al., 2012; Guthrie and Murthy, 2009), the use of content analysis (Dumay and Cai, 2014), Integrated Reporting (Bernardi et al., 2014; Dumay et al., 2016) and Intellectual Capital (IC) (Dumay, 2014). Figure 1 depicts the model described by Massaro et al. (2013).

Following Massaro et al. (2016) approach, first, we developed a Research Protocol describing the steps shaping an SLR (Figure 2). A total number of 140 documents divided into journal articles, consulting reports, institutional reports and other sources have been searched using keyword searches in databases such as Scopus, Ebsco, Google Scholar and professional or institutional websites focused on the topic of Industry 4.0 (e.g. a specific section of the Economic Ministry of Italy). More than 18,770 references have been coded in 162 nodes using an open coding approach (Miles et al., 2013). The inquiry was developed around two main research questions:

RQ1: How does Industry 4.0 affect existing BM?
RQ2: How could Industry 4.0 lead to the development of new BMs?

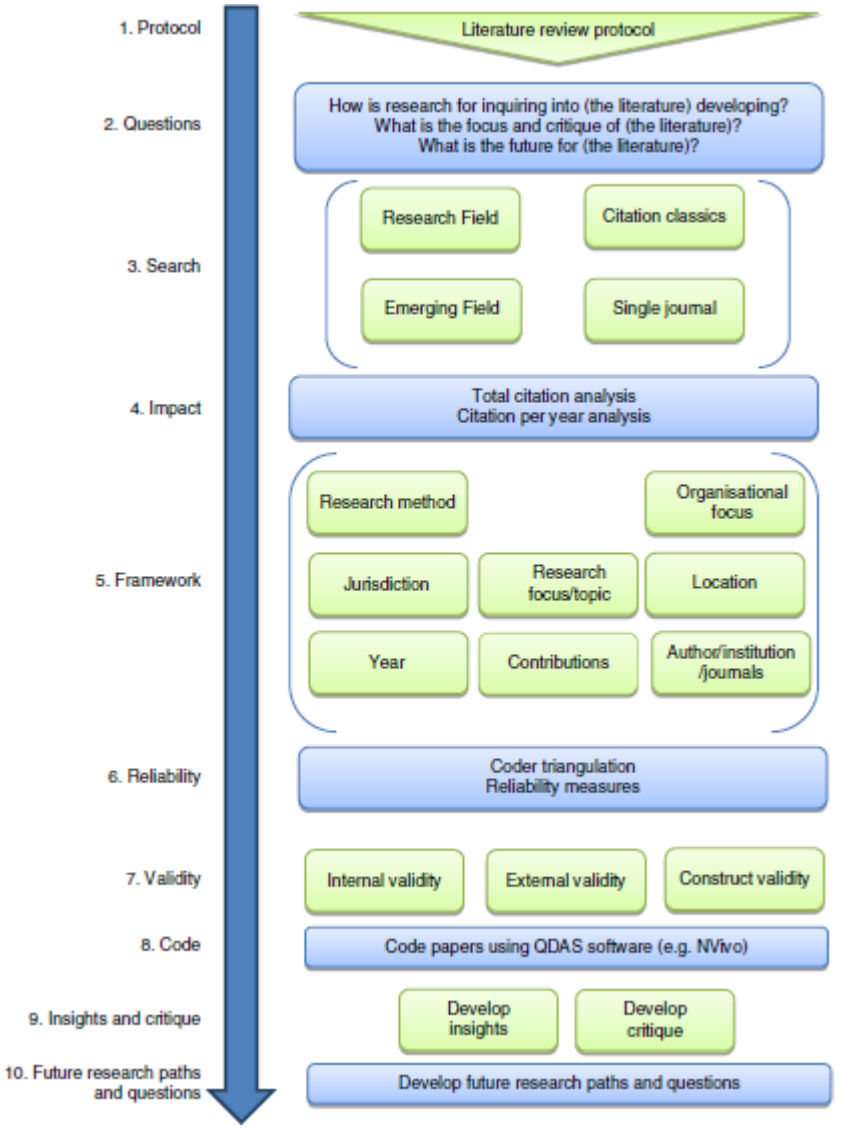
Considering that we employed an open coding approach, they could not apply validity measures such as the Krippendorff's alpha. To ensure validity, results were discussed by whole the research team to ensure consistency of the coding approach. Additionally, word searches were employed to ensure that relevant nodes were not missed or underestimated. The following sections describe the findings of the research.

4. RESULTS

4.1. Impact of Industry 4.0 to Existing BMs

This section depicts the results of the SLR focusing on the first research question: how does Industry 4.0 affect existing BM? To answer the first research question we analyzed current definitions provided by the authors. According to (Schumacher et al., 2016, p. 162) "Industry 4.0 refers to recent technological advances where the internet and supporting technologies (e.g., embedded systems) serve as a backbone

Figure 2. SLR methodology (Source: Massaro et al., 2016)



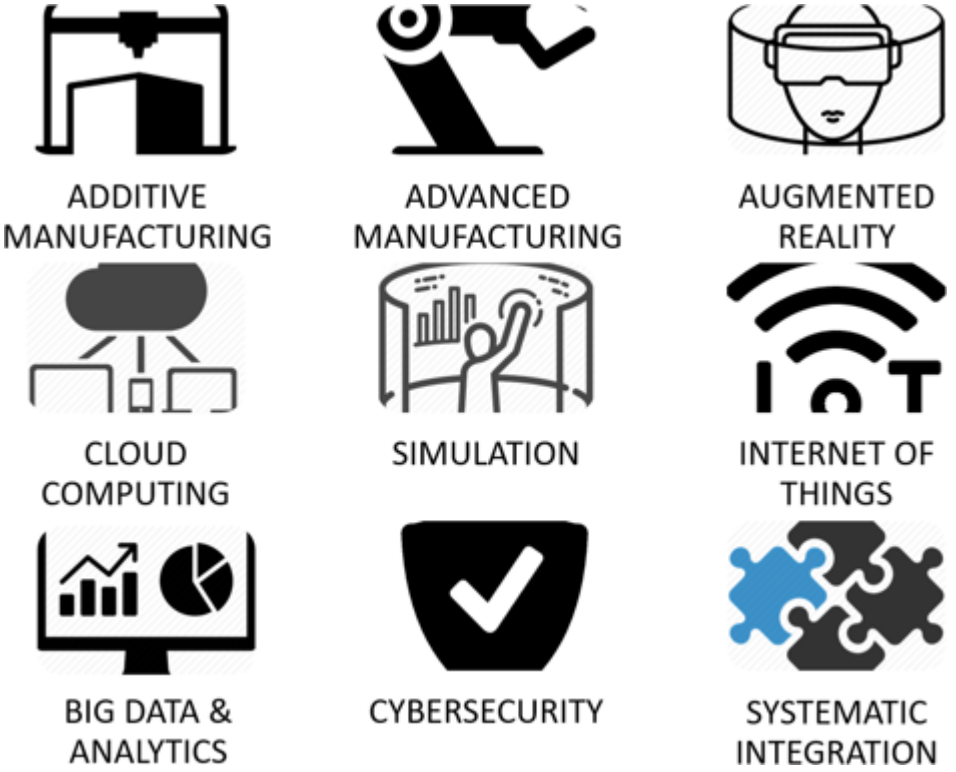
to integrate physical objects, human actors, intelligent machines, production lines and processes across organizational boundaries to form a new kind of intelligent, networked and agile value chain." Main technologies considered within the concept of Industry 4.0 are depicted in Figure 3.

To better focus the research, we analyzed how these technologies are described regarding their impact on the company's BM. Results of this analysis are depicted in the following Figure 4.

The figure shows the synthesis of the nine heatmaps referring to each enabling technology. The intensity of the color of each building block in the heatmaps is associated with the importance recognized by the literature to the change due to the development of the technology.

The literature focuses its attention on the internal part of the company and, in particular, on internal processes and resources, interpreting Industry 4.0 as a tool to improve productivity and efficiency of the methods. However, we could find a keen interest in the literature towards customers

Figure 3. Industry 4.0 technologies (Source: Bagnoli et al., 2018a)



and their increasingly central and collaborative role in the value chain and also on products, which are now more innovative and full of smart functionality. There is an openness towards elements of the business model addressed to the outside, such as customers, products, external processes of the company and society. On the other hand, literature seems to neglect the impact of technologies on the value proposition, adopting a more operative perspective. The following tables (Table 1a and Table 1b) provide more details describing how each technology can affect each building block shaping the company's BM.

Figure 4. Industry 4.0 technologies heatmap according to the literature (Source: Our elaboration)

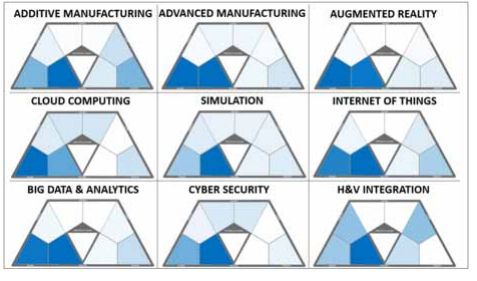


Table 1. Results of the literature review on the impact of industry 4.0 on company's BM

Technology	Business Model Canvas Building Blocks							
	Suppliers	Resources	Internal processes	External processes	Products	Customers	Society	Value proposition
Additive manufacturing	Suppliers of 3d technologies Reduction of components' suppliers	3D technologies Human resources Innovative & sustainaible materials	Product development Assemblying Prototyping Design	Faster delivery time Transport reduction Digital distribution channels	Complex products Increased range of products Customization	User entrepreneurs Customers' involvement in processes	University Start ups Research institutes	
Advanced manufacturing	Supply chain optimization	Collaborative robot Robot coordinator	Efficiency and flexibility Quality & precision Inbound logistic	Autonomus veicles Faster delievery time	Smart products Life Cycle optimization Customization		Agreement with schools, universities, and governments	
		Human machine interaction						
Augmented reality		Smart devices HR training	Simplified assembly & maintenance Less errors Virtualization	Logistics	Customized products New after-sale services	Active role in product design		
Cloud computing	Cloud services providers	Real time data Remote control HR flexibility	Predictive & remote maintenance		Smart products New services via cloud		Data protection and privacy regulation	
Simulation		Real time data New skills Resources optimization Virtual manufacturing technologies	Digital twin Virtual prototyping Process modelling Warehouse and plant optimization	Transport & outbound logistics simulation	Simulation test on products		Networks for sustainable Value Chain	
Internet of things		Real time data Technical staff Communicating devices Sensors & actuators	Remote control Processes virtualization Predictive maintenance Real Time adaption	Produts localization Means of transport localization	New services Smart products Customization	Customer experience	Integration of actors for cocreation processes Integration along the value chain	
		Smart machines						
Big data & analytics	Suppliers of hardware, communication services & system integrators	Data Collection & Analytics tools	Predictive maintenance Collection, analysis and storage of data Process monitoring	Delievery time optimization	Self control and self-diagnosis Customization	Fidality Deep understanting of cutomers' needs		
Ciber security	Selected suppliers	Data protection Capabilities	Risk management processes Framework provision Threat monitoring		Protection of Data Embedded in Products		Institutions (e.g. CERT, intelligence)	
H&V integration	Direct connections Integration in production processes Real time information flows	Real time data Smart machine integrated into Value Chain	Effective decision making Flexible control Processes Data & knowledge sharing Less data lost	Most effective outbound logistic		Direct connection Customer need satisfaction Improved customer relationships		
	Low		Medium				High	

4.2. Impact of Industry 4.0 to the Development of New BMs

Findings of the SLR show that Industry 4.0 allows the development of new BM starting a strategic innovation that creates new market spaces through a unique value proposition. Findings allowed us to identify twelve new BM characterized by innovative value propositions, thanks to the new technological opportunities provided by the Industry 4.0. Finally, we were able to group the 12 new business models into four categories, namely: Mass customization BM, data & analytics BM, as a service BM and platform BM. Each group is described in the following subsections.

4.2.1. Mass Customization BMs

In the category "Mass Customization" we can identify specific BMs that work on the value discipline of Operational Excellence (Treacy and Wiersema, 1993). Technology provided by the Industry 4.0 allows transforming traditional paradoxes such as "man vs. machine," "profit vs. sustainability," "craft production vs. industrial production" and "knowledge exploration vs. knowledge exploitation."

Value production plays a central role for Industry 4.0, as it involves integrating the product with all the actors in the value chain, as it acts as an interconnection tool. This connection lays the foundation for cyber-physical systems, intelligent networks of machines, ICT systems, products, and people. In this context, the production of value is automated and dematerialized and makes it possible to combine large-scale production with customization, thus moving to a more dynamic and on-demand approach, increasing at the same time efficiency and productivity.

Therefore, BM is set up for the production of high-tech goods that use increasingly sophisticated materials and can adapt dynamically to changing market conditions. This adaptation is also favored by the proximity to the customers, which allows to fully understand the clients' needs by establishing a proximity relationship both in a physical and virtual sense. The products are so unique and customized, being designed directly to the requests of the final consumer. The following table depicts main impacts of Industry 4.0 on the BM of Mass Customization. The color in Table 2 describes the magnitude of the effect.

4.2.2. Servitization BM

Services are taking an increasingly central position, allowing the creation of valuable proposals based on the combination of services and products, integrated through technologies. The digital transformation is offering the possibility of creating BMs based on the provision of services, and increasingly customer-oriented. The services allow to combine the virtual world with the physical one, and to set up new profit models such as performance-based contracts, product-as-a-service, pay-per-use, subscription-based and machine-as-a contracts -service.

The new BM of the "servitization" category try to identify the "why" behind the need to purchase and to respond to this by transforming products into services. In fact, the logic of these models lies in the fact that the value is not represented only by the product itself, but by what is made possible through its use. The service thus becomes the very foundation of the exchange and provide the base

Table 2. Mass customization BM and the impacts of industry 4.0 on the BM building blocks

Business Model Canvas Building Blocks							
Suppliers	**Resources**	**Internal processes**	**External processes**	**Products**	**Customers**	**Society**	**Value proposition**
Vertical integration Cloud computing Cyber security	Internet of things Cloud computing Adv Manufac Big data Aug reality	Add manufac Internet of things Cloud computing Adv Manufac Big data Aug reality Simulation Vert integr	Cloud computing Big data	Cyber security Cloud computing Internet of things Big Data	Vert integr Cyber security Cloud computing	Vert integr	
	Big data	Add manufac Internet of things Adv Manufac Big data		Add manufac Big data Adv Manufac	Big data Cloud computing Internet of things		
	Big data	Big data Cyber security		Big data			

of the value discipline of product/service leadership (Treacy and Wiersema, 1993). The following Table 3 depicts main impacts of Industry 4.0 on the BM of Servitization. The color in the table describes the magnitude of the effect.

4.2.3. Data-Driven BM

The exploitation of the value generated by the data obtained and the recognition of the centrality of the client lead to the development of new BM based on big data & analytics technologies. The data represent the core driver of innovation and competition, as they are necessary to achieve leadership positions in the creation of value.

These BM allow the development of innovative methods for the collection and use of data, and to benefit from the value embedded in information. The data make it possible to increase product functionality but can also be exploited as a product to obtain incremental revenues. The information collected is used by companies for production and commercial purposes, and this requires attention to the legal profiles of their use in the private sphere, but also about the price policies. Therefore, Data-driven BM allow the development of a new perspective on the customer intimacy value discipline is reducing barriers to reach customers and customize products (Treacy and Wiersema, 1993). The following Table 4 depicts main impacts of Industry 4.0 on the Data-driven BM. The color in the table describes the magnitude of the effect.

Table 3. Servitization BM and the impacts of industry 4.0 on the BM building blocks

Business Model Canvas Building Blocks							
Suppliers	**Resources**	**Internal processes**	**External processes**	**Products**	**Customers**	**Society**	**Value proposition**
	Cloud computing Big data	Cloud computing Big data Internet of things		Cloud computing Internet of things	Big data Internet of things		
	Big data	Big data Internet of things		Cloud computing Big data Internet of things	Vertical integration		
	Big data	Big data Internet of things		Cloud computing Big data Internet of things	Vertical integration		

Table 4. Data-driven BM and the impacts of industry 4.0 on the BM building blocks

Business Model Canvas Building Blocks							
Suppliers	Resources	Internal processes	External processes	Products	Customers	Society	Value proposition
Vertical integration Big data Internet of things	Internet of things Big data	Cloud computing Big data Internet of things	Big data	Internet of things Big data	Internet of things Big data Vertical integration		
Big data Internet of things	Big data	Cloud computing Big data		Big data	Big data Internet of things		
	Big data Internet of things			Internet of things Big data Cloud computing	Big data Internet of things		

Table 5. Platform BM and the impacts of industry 4.0 on the BM building blocks

Business Model Canvas Building Blocks							
Suppliers	Resources	Internal processes	External processes	Products	Customers	Society	Value proposition
Additive manufacturing Vertical integration	Additive manufacturing Cloud computing	Additive manufacturing Internet of things	Additive manufacturing Internet of things Augmented reality	Additive manufacturing	Additive manufacturing		
	Big data		Internet of things	Big data Internet of things	Big data Internet of things		
Big data Internet of things	Big data Internet of things	Big data Internet of things Cloud computing	Big data Internet of things Cloud computing		Big data Internet of things		
Low			Medium				High

4.2.4. Platform BM

The distribution of value is undergoing significant changes thanks to technologies that reduce the distance between the company and the customer through a deeper understanding of the latter's needs.

The proximity to the customer is a crucial feature of the distribution BM. It requires the development of platforms, which support the interoperability between various actors of the value chain, based on the shared representation and updated in real time, configured on the specific needs of the user. These platforms make it possible to co-create value among networks, to share experiences and meanings, because they facilitate the exchange of data and services among the actors of the ecosystem. The following Table 5 depicts main impacts of Industry 4.0 on the Data-driven BM. The color in the table describes the magnitude of the effect.

4.2.5. Evidence From the Field

To better understand the entrepreneurs' vision of the opportunities, risks and practical feasibility of Industry 4.0, an exploratory survey was carried out in collaboration with KPMG. The questionnaire was managed by KPMG in May 2017, and its results were presented at the event "Biennale Innovazione" organized by the Ca 'Foscari University of Venice in June 2017. The representatives of 111 companies belonging to different sectors were involved. The sample involved companies from all over Italy. However, the most significant part is represented by organizations from the North of the country, in particular from Veneto, Friuli-Venezia Giulia, Trentino-Alto Adige, Lombardy, and Emilia-Romagna. The sectors involved included iron and steel, engineering, pharmaceuticals, textiles, automation, food, and beverages. Both companies operating in the B2B industry, as well as B2C, were considered. The survey was also extended to technology providers with the aim of studying a different point of view. The questions were oriented towards understanding the opportunities and benefits that the technologies could offer.

The questionnaire consisted of 24 multiple-choice questions which themes can be traced to two different main sections. The first section included issues related to a broader context, that allowed to understand the more general view of companies on the impacts of Industry 4.0 both regarding opportunities, as well as the obstacles that can block the implementation. The section was further divided into two parts: the country system and the industrial system that allowed to draw a complete picture of the impact of Industry 4.0 in the external context, as perceived by the companies. In particular, the first section, entitled "The external context: the country system and the industrial sector", recorded the opportunities and benefits that companies expected from investments in Industry 4.0 about the dynamics of their sectoral and government policies. Besides, it sought to understand the main obstacles to the development of industry 4.0 by companies and their perception of the political and competitive aspects of their sector.

The second section specified the vision on the impact in the internal context, the organizational one, that an investment in Industry 4.0 can have on the strategic choices of the companies. Specifically, in the second section, "Internal context: technological feasibility and strategic opportunities," the questions were about the changes that companies are observing on their business model and what human and intellectual resources and technologies are necessary to implement innovative strategies and actions.

In this sense, we aim to compare the vision on the phenomenon of Industry 4.0 and Italian business, evaluating the Italian manufacturing point of view compared to the international one given by the literature. The results of the questionnaire showed that the Italian companies seem not to be yet fully aware of the phenomenon and are primarily behind the application of the technologies and skills necessary to use them.

The business models developed in our research can be used by companies. An example can be the attention to the personalization of products as an emerging trend, as shown by the study. The use of technologies allows improving the quality of production processes and outputs without a spending much money, allowing companies to invest in the personalization of products and, therefore, in a new experience for the consumer. This is made possible by additive manufacturing technologies and by the use of robots that allow refining the product and, therefore, guarantee the highest quality to the mass market (mass customization) at reduced costs, thus conquering new markets.

The challenge of the Industry 4.0 can be grasped by the Italian companies trying to find an original synthesis between the humanistic culture that is at the base of the success of the "Made in Italy" and the technical culture that the new technologies in some ways impose. Paradoxically, the fourth industrial revolution will bring back to life craftsmanship, linked to the ability to experiment with innovative solutions without losing sight of their cultural significance. Main results are depicted in the following Table 6.

5. CONCLUSION

Our research develops a Structured Literature Review to answer two main research questions related to the definition of Industry 4.0 and its role to promote the development of new Business Models. Results show that Industry 4.0 is a complex topic shaped mainly from nine different technologies. Each technology has specific impacts on a company's BM. Interestingly, while most of the impacts of Industry 4.0 focus on the production building blocks of the BM, there are significant and interesting effects also on other dimensions such as customers, external processes, and society. A questionnaire was then conducted among 111 Italian companies from a variety of industrial sectors to double check the status of Industry 4.0 in Italy. Results clearly show that Italian companies seem not to be yet fully aware of the phenomenon and are behind the application of the technologies and the necessary skills.

The paper is novel compared to previous studies since it tries to understand and map the literature to detect new successful BM, starting from the phenomenon of Industry 4.0.

Our findings show that when more technologies are combined they allow the development of new BM. New ways of developing relationships with customers, suppliers and other stakeholders are pushing new approaches to deal with the relational capital and the knowledge management processes. Additionally, new knowledge-based products can be developed thanks to Industry 4.0, and new approaches can be defined to deal with the whole society more sustainably. Results depict four main typologies of BM named: mass customization BM, Servitization BM, Data-driven BM, Platform BM and show how each BM uses innovations provided by the Industry 4.0 to review traditional building blocks. These new BM could be successfully implemented by firms and organizations.

The paper has several limitations. The survey was conducted only in Italy, and it reflects the situation and feelings of Italian entrepreneurs. Further researches could start from the results of this literature review providing concrete cases of companies that used the opportunities provided by the

Table 6. Industry 4.0 challenges as seen by entrepreneurs

The external context: the country system and the industrial sector	Industry 4.0 as an opportunity to change	The majority of firms thinks that Industry 4.0. represent an opportunity to change and enhance the Italian manufacturing industry
	Factors that foster the possibility to invest in Industry 4.0	The majority of firms thinks that human resources are the key enablers of Industry 4.0
	Obstacles or threats that limit the possibility to invest in Industry 4.0	The majority of firms thinks that organizational culture is the major obstacle
	Ability of the "Made in Italy" industry to fully embrace Industry 4.0 technologies	The majority of firms thinks that Italy will face several difficulties in embracing Industry 4.0 technologies
	Most effective industrial policies to enhance Industry 4.0	The majority of firms thinks that infrastructural investments are more effective than fiscal benefits
	Ability of Industry 4.0 to renew the current production models	The majority of firms agrees that Industry 4.0 can help to renew the current production models
	Competitive benefits from Industry 4.0	The majority of firms thinks that data from Industry 4.0 technologies can help fostering competitive advantage
	Occupational repercussions from Industry 4.0	The majority of firms thinks that Industry 4.0 will not decrease the number of employees, however, several of them will change their role
	Ability of Italian competitors to activate Industry 4.0 investments	The majority of firms thinks that their Italian competitors have not yet invested in Industry 4.0 technologies
	Ability of European competitors to activate Industry 4.0 investments	The majority of firms thinks that their European competitors have not yet invested in Industry 4.0 technologies
	Ability of Extra-European competitors to activate Industry 4.0 investments	The majority of firms thinks that their extra European competitors have not yet invested in Industry 4.0 technologies
	Ability of the firm compared to its competitors	The majority of firms are not yet able to define their positioning compared to their competitors
The internal context: technological feasibility and strategic opportunities	Path to integrate Industry 4.0 with existing technologies/operations	The majority of firms still needs to allocate a budget for this purpose
	Internal agents to enhance Industry 4.0	The majority of firms will rely on their CEOs
	External agents to enhance Industry 4.0	The majority of firms will rely on consultancy firms more than technology providers and universities
	Impact on BMs	The majority of firms thinks that resources and products will the most affected building blocks
	Expected general benefits from Industry 4.0	The majority of firms thinks that Industry 4.0 will allow them to better react to changes
	Presence of enough internal skills to use Industry 4.0 tools properly	The majority of firms thinks that internal skills should be improved to use Industry 4.0 tools properly
	Skills to be enhanced	The majority of firms thinks that organizational skills are the ones to be improved
	Ways of reducing skills gaps	The majority of firms is likely to use external sources, however internal classes/training are considered as well
	Areas of investments from Industry 4.0	The majority of firms is likely to invest more in Data Analytics
	Expected internal benefits from Industry 4.0	The majority of firms expect innovation in managing their industrial processes
	Presence of a specific budget devoted on Industry 4.0	The majority of firms has not defined a budget yet
	Future investments on Industry 4.0	The majority of firms will invest between 5 and 10% of their budget

Source: KPMG/Ca' Foscari

Industry 4.0 to develop new Business Models. In addition, the analysis of the questionnaire should be enlarged to other countries or contexts to better verify the results.

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