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Sustainability Transition in Industry 4.0 and Smart Manufacturing with the Triple-Layered Business Model Canvas

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Received: 29 February 2020; Accepted: 16 March 2020; Published: 18 March 2020



Abstract: Sustainability transition is becoming increasingly relevant at a manufacturing level, especially for resource- and energy-intensive industries. In addition, the 4.0 industry paradigm opens new opportunities in terms of sustainable development. The aim of this research is to analyze the introduction of sustainability in the corporate value proposition, through the evolution from a traditional to a sustainable business model. The business model innovation will be investigated in the case of a ceramic tile producer in the district of Sassuolo, Italy. The company has introduced several sustainability practices over the years and, through investments in Industry 4.0 technologies, is able to conduct impact assessments of its production process. The applied tool for the business model transition will be the Triple-Layered Business Model Canvas by Joyce and Paquin. The results illustrate the new company's sustainable value proposition, considering all three pillars of sustainability: environment, economy, and society. Despite the limitations resulting from the individual case study, the findings can be easily adapted to other ceramic tile companies in the sector. Besides, the paper could inspire other manufacturing companies in the drafting of a sustainable business model. The paper explores the still limited literature on the application of sustainable business models in operational scenarios.

Keywords: Industry 4.0; sustainability; manufacturing; business model canvas

1. Introduction

In recent years, the theme of sustainability in manufacturing contexts has been assuming a primary role in the political agendas of many states and public opinion, the latter increasingly sensitive to the commitment of companies on this issue [1]. In response to this pressure, manufacturing companies have reacted by introducing new sustainability pathways in their production processes and they have increased the level of communication of these practices to customers and stakeholders [2].

In support of manufacturing enterprises, industry 4.0 technologies have made production processes more efficient and less impacting [3]. In addition, the new industry 4.0 management and data collection tools, which are able to collect timely process data, can facilitate companies in the evaluation of the sustainability practices introduced [4]. This sustainable transition process, facilitated by the industry 4.0 paradigm, is naturally based on the successful operational introduction of sustainability practices, but it cannot disregard the strategic evolution of the company in terms of value creation. In this regard, the implementation of sustainability is usually a complex process, which requires a medium-long

term strategic vision and effective communication between top management and operational business units and between the company and its stakeholders [5]. In order to address these challenges, the topic of sustainable business models, as tools to represent sustainability within the value proposition of companies, has become extremely widespread in the academic literature [6]. The business model represents the value that a company promises to deliver to customers if they choose to purchase its product. Sustainability, if properly introduced and communicated, can change this value proposition and differentiate the product or brand from the competition [7].

The purpose of this paper is to explore the literature on sustainable business models and to contribute through the implementation of a model within an operational case. Despite the great interest in the subject, there are still few articles that apply formal business models in operational contexts [8]. In addition, researches that analyze implementations of business models in manufacturing contexts tend to focus on the environmental aspect, not investigating the economic and social dimension of sustainability in a triple bottom line perspective [9]. In order to address these issues, the model selected for the study is the Triple-Layered Business Model Canvas (TLBMC) published by Joyce and Paquin [10]. The model consists of three separate business model canvas, one for each pillar of sustainability. By consequence, the model integrates the three pillars of sustainability and does not limit the analysis of the value proposition to the mere economic aspect. The company taken as a reference is one of the main producers of ceramic tiles in the ceramic Sassuolo district, in Italy, which has reached a high level of automation and control of the production process due to investments in industry 4.0. Through the drafting of a sustainable business model, the paper tries to offer a framework for future research on the operational innovation of business models within manufacturing contexts and for the introduction of sustainability into business strategies.

The paper is organized as follows: Section 2 deals with an analysis of the academic literature on the concept of the business model and its innovation in terms of sustainability. Section 3 deals with the methodology applied in the drafting of the new company's business model. Section 4 focuses on the company under analysis and the sectoral context in which the company operates. Section 5 deals with the results and the new sustainable value proposition of the company. Finally, Sections 6 and 7 offers some concluding remarks.

2. Theoretical Background

2.1. Business Model Concept

In order to outline the process of value creation, the business model has been considered for years as an essential tool in business activities. From an academic perspective, the concept of a business model (BM) has aroused much interest among researchers [11]. Despite the numerous papers published on the subject, the studies on the field are still in an early stage and there is still no univocal definition of a BM [12].

With the growth of technology and internet-based business, Amit and Zott [13] stated that "A BM depicts the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities". In this case, the BM was considered as a construct that could be used to explain and predict value creation in an e-business context. In 2005, Shafer, Smith, and Linder [14] addressed the problem of defining a unique BM concept, not influenced by different business contexts. The authors defined BM as "a representation of a firm's underlying core logic and strategic choices for creating and capturing value within a value network". Following the authors, the BM was a tool that reflected the company's strategic choices, which must lead to creating value and consequently generate profit. The BM not only concerned the company itself but also involved the stakeholders who interact with it.

Some authors, in identifying the concept of BM, extended their analysis by specifying the difference between BM and strategy. In order to explain the two concepts, Magretta [15] considered the example of Walmart as a company which, starting from the BM of the discount supermarket also used by

competitors, created a competitive advantage through its strategy of offering national brands at low prices. On the other hand, other authors like Massa, Tucci, and Afuah [11] argued instead that the business model was not a new field but simply an extension of the concept of strategy. The BM relaxed some of the assumptions that were implicitly present in traditional strategic management theories (such as Resource-Based View), considering, in addition, externalities and the lack of perfect information for customers. By consequence, the BM simply extended the breadth of the strategy field.

In parallel with the definitions, studies were also being developed on how to formally represent a business model. In this respect, one of the most common representations of BMs has been the Business Model Canvas (BMC), firstly introduced by Osterwalder, Pigneur and Clark [16]. The BMC is simple and intuitive, but it does not oversimplify the complexity related to companies' functions. In specific, the BMC describes through nine blocks (key partners, key activities, key resources, value proposition, customer relationships, customer segments, channels, cost structure, and revenue streams) the logic of how a company expects to generate profit. The value proposition is the heart of the BMC and it explains the benefit that the company creates for the client and why he should choose that company among many others [11]. BMC is one of the many alternatives present in the literature. Gassmann, Frankenberger and Csik [17] illustrated a model representation based on four dimensions: who, what, how, why. The model is represented as a triangle in which the customer is at the center (who). At the corners, there are the value proposition (what), the value chain (how) and the profit mechanism (why). The reason why these three aspects are at the corner of a triangle is that the modification of one of the three aspects requires, therefore, the modification of the other two as well. Some authors, even without offering a business model representation, offered some guidelines regarding BM design. Zott and Amit [18] argued that the BM must be based on the interdependence of activities that span the company's boundaries. Weiller and Neely [19] claimed that the design of business models must necessarily be centered on the ecosystem in which the company operates.

The notion of BM was initially considered from a static perspective. In more recent times, several authors have considered the dynamic evolution of business models, through processes of business model innovation [20]. Specifically, one of the most relevant research topics in the last years has been the relationship between business models and sustainability [21]. The introduction of sustainability practices requires companies to rethink their process of value creation. In this regard, sustainable business models allow for the introduction of sustainability practices into the business value creation process [22]. The paragraph leads to the following proposition:

Proposition 1 (P1). *Business models describe the value proposition of the company and can be a useful instrument for the integration of sustainability.*

2.2. Business Model Innovation through Industry 4.0

The literature on business model innovation (BMI) has developed independently from the more extensive business model theory. BMI is generally referred to as a process addressed to reduce costs, optimize processes, access new markets or improve financial performances [23]. Compared to product and process innovation, BMI consists of a systemic change that affects the companies' values proposition and how this value is generated. If the BMI is successful, the innovation process should lead to a positive company's transformation and renewal [24]. The development of a BMI process is usually linked to a stimulus deriving from a change in the competitive environment, as, for instance, the pressure caused by the introduction of new disruptive technology [25]. This transformation is also fostered by the choices of policymakers, who in turn monitor the company's business model evolution to understand how to stimulate innovation within a sector [26].

Among the disruptive technologies which are affecting the business value creation model, the transition to industry 4.0 in manufacturing companies should be analyzed. Industry 4.0 is an approach, first developed in Germany, based on the exploitation of four new technological paradigms:

Cyber-Physical Systems, Internet of Things, Internet of Services, and Smart Factory [27,28]. In contrast to previous industrial revolutions, industry 4.0 acts in several different areas and focuses on an exchange of information between people and digital tools and between tools among themselves [29]. Industry 4.0 concept is based on the principle of Smart Manufacturing, a flexible system in which production lines are adaptable to product diversity and changing conditions [30].

The adoption of industry 4.0 technologies is leading enterprises to an increase in productivity and a higher level of awareness of the mechanisms that drive production processes [31]. In this context, the higher productivity, namely the provision of the highest level of output with the lowest amount of resources, is made possible by the efficiency and flexibility offered by cyber-physical systems, which allow a continuous optimization of resource and energy consumption [32]. In connection with productivity, the impact of industry 4.0 also concerns the reduction of industrial costs, in particular production, logistic and quality management costs [28].

Industry 4.0 technologies can also increase the perception of the customer with reference to the product value. The implementation of identification and tracking technologies enable the manufacturer to collect information throughout the product life cycle and to exploit its content to communicate the value of the product [29]. This kind of product, manufactured in a smart factory context and linked to technologies that allow interconnection with the user, can be defined as a smart product [33]. These products provide a significantly different role for the user, who is actively involved and can participate in the product design process [34]. In addition to the topic of smart products, industry 4.0 is affecting competition rules between companies in the same sector, because digital technologies provide customers with new digital options and highly personalized products [35]. The competitive advantage of the enterprise resulting from the implementation of industry 4.0 depends on its ability to exploit the amount of data available and its capacity to manage a wide range of heterogeneous devices [36].

The implementation of industry 4.0 technologies, other than generating numerous benefits for companies, requires them to transform their value proposition through a business model innovation process [3,37,38]. The business model innovation process can be of a limited entity if the introduction of industry 4.0 consists of incremental innovation. On the other hand, in the case of radical innovations, the process can lead to a total reconfiguration of the company's value proposition [39]. In this regard, in recent years, the appearance of a high number of disruptive technologies in the context of industry 4.0 has led many companies to abandon traditional business models in favor of more complex digital market models [40].

Business model innovation through industry 4.0 can, therefore, generate many advantages, intensifying customer relationships and bringing them to mutually positive medium and long-term relationships. At the same time, however, this innovation leaves many open challenges, including the increasing need for a qualified workforce, financial resources and consumer resistance to change.

One of these challenges for manufacturing companies is to leverage the benefits of industry 4.0 to integrate sustainability into traditional business models [39,41]. Industry 4.0 can be considered as a new business mindset, helping companies in their sustainable transition [42]. In specific, industry 4.0 offers opportunities both in environmental terms by increasing the efficiency of the production process and in social terms, for instance by improving working time models and increasing employee satisfaction and productivity [43]. Other environmental advantages of industry 4.0 implementation are related to waste reduction, a decrease in resource consumption and energy requirements and an increase of circular economy practices [44]. The intertwining of industry 4.0 and sustainability must be reflected within a strategic business model context, which can no longer be limited to considerations of economic factors but must also include environmental and social factors, in line with the Triple Bottom Line of sustainability [45]. In this respect, the very role of the company itself cannot be disregarded, as industry 4.0 could be beneficial to introduce sustainable business models, but it could also be an inhibitor if merely used in a traditional business model perspective [46].

From the above discussion, we derive:

Proposition 2 (P2). *The business model innovation is a process that allows to internalize, from a strategic perspective, the external changes of the company's competitive environment.*

Proposition 3 (P3). *In manufacturing, industry 4.0 leads to greater efficiency and control of production processes and provides new opportunities in terms of sustainability introduction and impact assessment.*

2.3. From Traditional to Sustainable Business Models

From a business perspective, the introduction of sustainability into manufacturing production processes is usually analyzed according to the lower industrial costs. Recently, however, the impact of sustainability is increasingly considered from a triple bottom line angle, simultaneously assessing the environmental, economic and social benefits [47]. Regarding companies' value proposition, the development of sustainability practices should not influence the importance of providing value for customers but should complement it with environmental and social objectives [22]. Furthermore, the impact of sustainability practices should not be merely limited to an internal company viewpoint but should also involve stakeholders, especially those directly affected by these changes.

From a strategic perspective, the inclusion of sustainability within a traditional business model leads to the creation of what is defined in the literature as a sustainable business model, namely a model which create competitive advantage through premium customer value, with attention to the implementation of all the pillars of sustainability: environmental, economic and social [48]. Sustainable business models are a topic increasingly covered in the literature and increasingly applied operationally in different sectors [49]. The introduction of a sustainable business model should be based on three main considerations: sustainable value (based on the three pillars of sustainability), pro-active multi-stakeholder management and long-term perspective [50].

Among sustainable business models, a specific strand of research focused on circular business models. Linder and Williander [51] define a circular business model (CBM) as "a business model in which the conceptual logic for value creation is based on utilizing economic value retained in products after use in the production of new offerings". In a CBM, there is a return flow of value from users to manufacturers, which frequently passes through intermediaries. At the basis of the flow is the philosophy of the circular economy, whose concept is in turn based on the principles of reuse, recycling, and recovery [52].

The shift to a circular business model generally offers many advantages for the company that applies it, consisting of cost-saving through waste reduction, lower sensitivity to resource price volatility, and better relationships with customers [53]. The latter can result in long term relationships in which the customer can have an active role in the company's value creation. On the other hand, a circular model can be not viable because of the lack of profitability or excessive financial effort involved in it [54]. The lack of financial resources and the lack of support of public institutions are two relevant barriers in the adoption of CBMs, especially in small and medium enterprises. In addition to the financial issue, Linder and Williander [51] identify some other challenges and limitations. The first are the customer type restrictions (not all the customers would accept remanufactured products), followed by technological knowledge/expertise and the return flow challenges (predictability of the return flow). In addition, there is the risk of restrictions (products not suitable for remanufacturing) and the risk of cannibalization of the new sustainable products on the old ones.

In conclusion, the possibility that some circular practices may prove unsustainable under the three pillars of sustainability leads to the conclusion that circular business models cannot always be qualified as a subcategory of sustainable business models. [50] The possibility that circularity may not coincide with sustainability is mitigated in a case of industrial symbiosis, consisting of the sharing, between dissimilar companies, of materials (including waste), services and skills. The main reason

for companies to collaborate is to share the burden of environmental investment, thereby reducing business risk. [55] The following propositions thus emerge:

Proposition 4 (P4). *The introduction of sustainability must be associated with a strategic evolution of the value proposition, through the transition to a sustainable business model.*

Proposition 5 (P5). *With reference to the three pillars of sustainability, not all circular business practices (and circular business models), without adequate assessment tools, can be considered as sustainable.*

2.4. Building a Conceptual Framework

As a conclusion of the literature analysis, a conceptual framework has been drawn, which is shown in Figure 1. The model represents the theoretical link of the five propositions listed in the previous paragraphs.

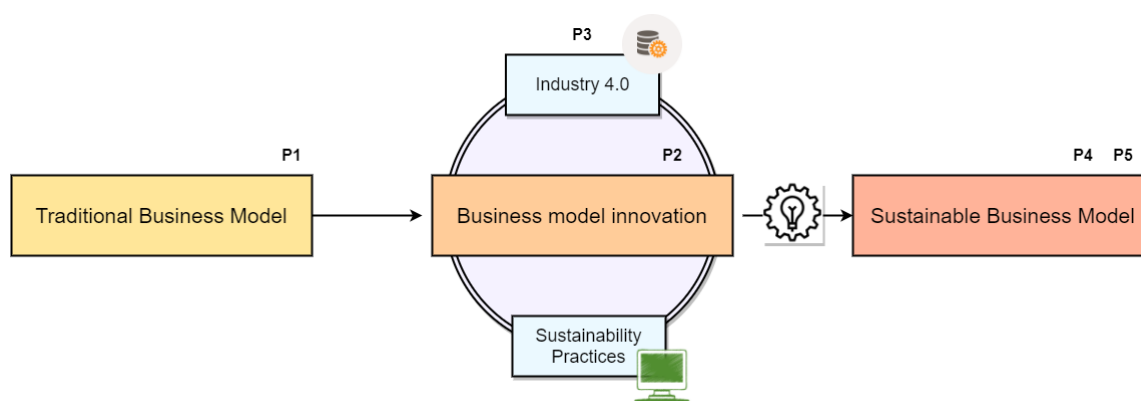


Figure 1. Conceptual framework (own elaboration).

The model illustrates the transition from a traditional business model to a sustainable business model, within a manufacturing context.

The baseline is a traditional business model, which does not consider sustainability in the company's value proposition. The first step in the transition to a sustainable business model is the introduction of some sustainability practices within the production process. In parallel, any sustainability practice should be evaluated with environmental, economic and social sustainability assessment tools, to assess its feasibility. Some sustainability practices could lead to a reduction of environmental impacts but at the same time, they may not be economically feasible. In a manufacturing context, the assessment of sustainability is facilitated by industry 4.0 paradigms, which have enabled companies to increase production efficiency and monitor their production process.

The successful implementation of sustainability practices, in addition to an operational process change, also requires strategic evolution. This evolution occurs through innovation in the business model, namely a change in the value proposition of a company. A sustainable business model must represent the sustainability practices that a company has decided to implement. At the same time, the new model must also represent how the sustainable practices introduced impacts on the company's customers and all stakeholders involved in the value creation process.

3. Methodology

In order to evaluate the transition from a traditional to a sustainable model, it has been decided to consider one of the largest producers of tiles in the Sassuolo ceramic district as a case study to test the conceptual model [56].

From an operational point of view, the managers of the different functions (see Table 1) were met and each was asked to identify the categories of people and organizations that from their perspective can be considered stakeholders with respect to the company's activities. They were then asked to aggregate the individual stakeholders into groups, in descending order of importance, based on three criteria: (1) Interest, (2) Power, and (3) Priority. The aim of the interviews conducted with top and middle managers was to obtain a view, from their perspective, of stakeholders relevant to the company. The interviews were audited and then digitally transcribed for subsequent evaluation of the results. The approach followed to interpret the results of the interviews was a phenomenological hermeneutical one inspired by Gadamer's vision [63] and applied by Settembre-Blundo et al. (2019) [64] using a hermeneutical circle as a tool to interpret reality. The interpretation process involved three stages:

- Phase 1—*Understanding*: A first construction of the reality provided by the texts of the interviews was made by the authors based on their own knowledge and experience. In this phase, a first hierarchical list of stakeholders was built.
- Phase 2—*Interpretation*: In this phase, the authors compared their first construction of reality (phase 1) with the individual perspectives offered by the interviewees. In this phase, a hierarchical list of stakeholders was constructed for each interviewee, assigning to each one a weighting index.
- Phase 3—*Application*: The lists have been merged together, respecting the weighting criteria to obtain a construction of reality that comes as close as possible to the vision that the company has of its stakeholders.

Table 1. Framework for carrying out the interviews.

Business Function	Job Position	Topics
Board of Directors	Chief Executive Officer	INTEREST: Which stakeholders have an interest in the company's business?
Top Management (C-Level)	Chief Financial Officer B2B Sales Director B2C Sales Director Procurement Director Technical Director	POWER: Which stakeholders have the power to influence the company's business?
Management (B-Level)	Innovation Manager Marketing Manager Administrative Manager Controller Manager HR Manager IT Manager Credit Manager Sourcing Manager Logistic Manager Security Manager Quality Manager R&D Manager Plant Manager 1 Plant Manager 2 Plant Manager 3	PRIORITY: Depending on the level and type of stakeholder involvement, what priority should be given to their needs?

In addition to the identification of stakeholders, the interview continued with a second phase related only to the company's top management (C-Level). Starting with the identified stakeholders, who are the basis of the social business model canvas model, information was collected on the other items of the model. On the basis of the stakeholders that were identified, and the additional information collected for each of them, the other items of the social business model canvas were then compiled.

The methodological model of the hermeneutical circle is simple and easy to apply one, but it has the limit of the subjectivity of conducting the analysis: one's personal experience and the

criteria adopted for the fusion of the interpretative horizons [65] of the people interviewed, due to their subjective nature, can influence the factual construction of reality. However, the adoption of a multiple analysis perspective, which takes into account the individual visions of the interviewees, mitigates this bias. From a procedural point of view, this approach can be easily replicated to any other organizational reality.

4. Case Study

The case study on which this paper is based concerns a major tile producer in the ceramic district of Sassuolo, Italy. The ceramic district of Sassuolo is one of the most important industrial entities in the Emilia Romagna region and in Italy itself. In this territory, the ceramic sector comprises over 90 companies that employ more than 17,000 people, contributing to the economic and social development of the region [66]. The district, born around the 1950s, has evolved significantly in a relatively short time, experiencing several disruptive innovations such as the transition to a single firing process or the tile decoration by digital printing. Although innovation and industry 4.0 have made the production process increasingly efficient, the ceramic industry has always been considered a polluting industry. In order to limit the environmental impact of production, the ceramic industry has constantly invested in the field of sustainability to the point of turning the ceramic production process into excellence, according to European parameters. Despite the growing production values, the collaboration between the companies of the district and the dialogue between companies and public bodies has generated a strong commitment to sustainability and has made it possible to reconcile sustainable development with greater process efficiency [67].

Focusing on strategic analysis, the business model canvas in Figure 2 offers a first perspective on the functioning of the ceramic producer and its value creation process.

The value proposition of the ceramic tile producer is to provide “made in Italy” ceramic tiles collections for the best value for money. The customer segments are residential customers, commercial and public buildings and business customers. These customer groups generally expect a high-quality product but are also extremely price-sensitive, aware of the different competitors offering quality ceramic tile products. In customer relations, the strength of the company is a quality sales network, in close contact with distribution and able to offer after-sales services of a high level and highly appreciated by customers. The distribution channels are different and range from large-scale retails to specialized stores. As far as company resources are concerned, the company has three production plants, five logistic warehouses, an IT structure with cloud servers, human capital and know-how of production processes and, finally, a solid financial structure. The main activity that distinguishes the company is the production of porcelain stoneware tiles. The group also has purchasing, accounting, quality and management control, sales and marketing offices and research laboratories for the design of new tiles. The main partners with which the group interacts are the suppliers of raw materials, glazes, and inks. These are added the suppliers of machinery and of electricity and methane, which are fundamental for the ceramic production process. Finally, there are the suppliers of financial and IT services. In conclusion, it is necessary to evaluate the cost and revenue flows for the company. The main costs identified in the model are manufacturing, commercial, research, and development, administrative and financing costs. Revenues, on the other hand, given a generally standardized sales price, are almost entirely based on the sales volumes that can be achieved.

Focusing on industry 4.0, the company under analysis has invested during the last few years in various technologies within the 4.0 industry paradigm. In addition to the automation of part of the production process, resulting in a consequent increase in productivity and reduction of industrial costs, an important part of the investments has concerned the equipment of sensors and meters for the collection of process data. As highlighted in the literature analysis, one challenge companies face with the introduction of these technologies is the capacity to exploit the amount of data resulting from the production process. The ceramic producer under study opted to exploit the data available for a sustainability assessment of the production process, evaluating the three pillars of sustainability:

environment, economy, and society. This evaluation was conducted with the Life Cycle Sustainability Assessment (LCSA) methodology, one of the most widely recognized methodologies in sustainability evaluation [68]. In particular, the environmental analysis conducted through LCA was the one that benefited most from the implementation of Industry 4.0. Due to the data acquisition tools, it was possible to collect important process data that allowed us to complete the inventory analysis, on the basis of the LCA environmental impact analysis. The presence of a company ERP system easily connected to the company data collection systems has also facilitated economic impact assessments, through the Life Cycle Costing tool and social impact assessment, through the Social Life Cycle Assessment tool [69].

Industry 4.0, with the role of supporting the manufacturing process impact assessment, has thus favored the implementation of sustainability within the company analyzed. The sustainability practices implemented by the company can in this way be evaluated and communicated externally to the stakeholders involved and interested in them. Despite the importance of these practices, the implementation of sustainability is not strategically perceived through the use of a traditional business model. In this regard, the following paragraph will consider the transition from a traditional business model to a sustainable business model, highlighting the path of sustainable development pursued by the company.

5. Results

5.1. The Triple Layered Business Model Canvas

The traditional business model canvas is a tool that analyses value creation by focusing on an economic perspective. However, the perspective of a traditional business model canvas does not allow the reader to intuitively perceive the path of sustainability that a company is undertaking. Specifically, the environmental and social pillars of sustainability assume a secondary role, being concealed by an analysis that remains merely economic. The partial analysis of sustainability and a lack of harmonization of the three pillars enables to exploit only part of the benefits resulting from a sustainable transition [70].

In order to extend the analysis to all the three pillars of sustainability, an instrument adopting a triple bottom line perspective is needed. In this regard, the TLBMC created by Joyce and Paquin [10] is a comprehensive choice to better represent also the environmental and social point of view. This model consists of three separate business model canvas, one for each pillar of sustainability. The economic pillar is represented by the traditional canvas while the other two are organized on different items. The following paragraphs, therefore, deal with the environmental and social layer of the TLBMC, entering the specifics of each item.

5.2. The Environmental Layer

The environmental layer of the TLBMC is based on a view of the entire life cycle from a life cycle assessment perspective. The fundamental purpose of this model is to understand the environmental benefits deriving from the company's sustainability path and the major environmental impacts deriving from the product's life cycle. The advantage of this model is the possibility to understand the most critical environmental issues of the company and the most important practices of circularity and sustainability that the company is undertaking [10].

Figure 3 below shows the result of the environmental layer:

In conclusion, instead of costs and revenues, environmental benefits and impacts are considered. As for benefits, namely all actions taken in favor of sustainability, the actions that emerged in the previous paragraphs are selected. As a result, it has been included energy co-generation, water reuse, the choice of local raw materials and the choice of raw materials for glazes that do not contain heavy metals. These represent the main sustainability and circularity practices introduced by the company, whose positive effects on the environment have been verified through the LCA instruments. As far as environmental impacts are concerned, the sources of the greatest environmental impact of the ceramic production process are highlighted, respectively air-polluting emissions, production waste, and virgin resources consumption.

5.3. The Social Layer

The social layer of the TLBMC represents the social pillar of sustainability and it investigates the relationship between stakeholders and the organization. The objective of the model is to understand the major social impacts arising from relations with key stakeholders [10].

Figure 4 below shows the result of the social layer:

SOCIAL BUSINESS MODEL CANVAS				
LOCAL COMMUNITIES	GOVERNANCE	SOCIAL VALUE	SOCIETAL CULTURE	END-USER
Private business	Privately-owned group	Develop long term value for customers, offering a quality product produced and designed by local labour force	Culture of cooperation deriving from the district context	High quality product
Staff and employees	Functional specialization			Italian style and design
Local Public Institutions	Transparency in communication	Production in compliance with regional, national and European regulations on sustainable development	SCALE OF OUTREACH	Traceability
Trade channel operators				Eco-friendly products
Suppliers				Quality-price rate
Trade unions				
Partners				
Public and private organizations				
Final Product Consumers				
Media				
Competitors				
Environment				
	EMPLOYEES			
	Local workforce		Global sales network	
	High recruitment rate		Long term relationships with local suppliers	
	High level of gender equality		Strong link with local trade associations	
	Low level of turnover			
SOCIAL IMPACTS		SOCIAL BENEFITS		
Damage from industrial activity		Job creation		
		Transparency of financial information		
		Regulatory compliance		
		Fair management of suppliers		
		Respect for human rights		

Figure 4. Social layer of the TLBMC in a ceramic tile company (own elaboration from [10]).

The heading “local community” must be the first to be analyzed, because it concerns the relationship established between the company and the stakeholders present on the company’s territory, including suppliers. The stakeholders identified from the semi-structured interviews for each individual interviewee were merged into a single list that optimally represented the reality of the stakeholders with whom the company interacts. The list is represented in the social business model canvas and the order of stakeholders is hierarchical by importance.

The heading “social value” is the part of the corporate mission that focuses on how to create benefits for stakeholders and society. There is always a social value within an organization, even though the company may appear to be solely profit-driven. In the company case study, the social values that have been identified are, first of all, the development of long-term value for customers, offering a quality product produced and designed by the local labor force. Secondly, another value is to produce in compliance with regional, national and European regulations on sustainable development.

Employees are a key aspect of the social pillar of a company and are treated in a separate section. This aspect concerns the characteristics and management of the workforce. In this case, the most important factors highlighted in this analysis are the high percentage of the local workforce and the high levels of recruitment rates, given by the favorable financial performance of the company. Furthermore, it is relevant to underline the high level of gender equality reached by the ceramic company during the last years.

The heading “governance” explains the organizational structure of the company under analysis. It is possible to consider different structure frameworks, such as functional specialization v. unit specialization, privately-owned companies v. publicly traded companies, etc. The company consists of a privately-owned group, managed by the two sons of the first company’s owner. The group is characterized by a functional specialization, with different offices for the various areas of marketing, administration, sales, etc. In addition, the ceramic company is characterized by a high level of transparency in communication, with high degrees of inter-office communication.

The heading “societal culture” represents the potential impact of an organization on society. The focus is on the potential actions of the company that can positively or negatively influence society. As for the paper case study, a positive impact that has been highlighted is the cooperative culture that the company adopts in interaction with other organizations in the district.

The scale of outreach provides information on the breadth and depth of the relationship between the company and its stakeholders. This relationship could be based on the short-term interest of both parties or could be focused on a long-term perspective. Another factor to consider is the outreach in terms of geographical area. The company could be focused on the local territory or it could act from a global perspective. In this connection, the ceramic company has strong links with the local territory for what concerns production and design, but it presents a global sales network. Furthermore, the positive relationship with trade unions allows to enlarge the company’s network and facilitate the dialogue with other stakeholders.

Finally, the heading “end-user” consists of the subject who consumes the value proposition offered by the company. In the ceramic context, the client can be different from the end-user. The ceramic company, for instance, sells the major part of its final products to large scale retailers who act as intermediaries between the producer and the end customer. Regarding ceramic tiles, the end-user expectations are to buy a high-quality product based on Italian style and design. At the same time, the interest is also directed to the level of sustainability of the product and the traceability of the production chain. In the end, one of the most important aspects is undoubtedly the selling price, which has a strong impact on the choice of one product over another.

Social impacts and social benefits are the last two headings of the model and they represent the core of the social business model canvas. Regarding social benefits, it was highlighted the increasing ability to create jobs for the local community, the transparency of financial information, compliance with laws in the field of production, the fair management of suppliers and the respect for human rights. At the same time, the most important social impacts consist of pollution deriving from the production process and traffic congestion.

6. Discussion

This paper illustrates the theme of the transition from a traditional business model to a sustainable business model in a manufacturing context. The literature analysis highlights the business model innovation process that leads to the drafting of a sustainable business model. This process is theorized by several authors who have investigated the introduction of sustainability within the company’s value proposition [21,41,48,49,71]. Furthermore, the paper explores the role and importance of industry 4.0 in the sustainable transition of enterprises. This topic has also been extensively covered in the literature, with emphasis on the advantages offered by industry 4.0 and the possible barriers that companies face when introducing these technologies [36,41,44,45,71]. Despite numerous contributions to sustainable business model innovation and industry 4.0, there are still few papers that provide a visual representation of a sustainable business model within a manufacturing context. Moreover, there are almost no papers that address this issue with reference to the ceramic tile production sector, which has an important impact on European and global levels [37]. In order to bridge the gap in scientific research, the previous paragraphs present the triple-layered business model canvas tool [32]. This TLBMC model represents, with one single model each, the three pillars of sustainability.

Regardless of the success of this model, very few authors have attempted to apply and adapt it to a manufacturing context.

The application of the TLBMC in this paper concerns a ceramic tile manufacturer from the Sassuolo district in Italy, chosen as a case study. The district is formed by companies that are extremely virtuous in terms of sustainability, as there have been strict regulations and sustainability practices in production processes for years. In many cases, however, companies lack greater awareness of the reduced environmental impact of their processes, the ability to assess their level of sustainability and the inclusion of sustainability in their value creation process. In the context of the Sassuolo ceramic district, the implementation of sustainability is facilitated by industry 4.0 tools, which allow for greater efficiency in manufacturing processes and the possibility of dynamically monitoring production processes. The implementation of process data collection tools has allowed the company under analysis to exploit this information in the evaluation of environmental, economic and social impacts. The factory sensors and meters, connected to the company ERP management system, provided the database for environmental impact analysis through LCA tools and supported economic and social assessments. The introduction and evaluation of sustainability have led the company first to the drafting of a circular business model [60] and, through this paper, to the drafting of a more comprehensive sustainable business model that assesses sustainability in terms of the triple bottom line.

Looking at the results obtained, in the model concerning the environmental pillar, important details of the ceramic production process are highlighted, including the raw materials used, the distribution channels and the process phases throughout the entire life cycle. In addition, the main environmental impacts created by the production activity and the greatest benefits in environmental terms, deriving from sustainability practices undertaken by the company analyzed, are considered. The simultaneous reading of the traditional and environmental business model allows the reader to have a much more detailed picture of the company's activity. In particular, it reveals how the company has individually engaged in a path of sustainability that not all other companies in the sector may have chosen to pursue. This choice can be exploited by the company to create value for its finished product, no longer based solely on price or quality. The business model represented in this way is already an intuitive tool that can be communicated externally in this respect.

In the model concerning the social pillar, instead, the functional structure of the company, the company's governance and the main stakeholders involved are specified, with a focus on employees and the end-user. Furthermore, the main social impacts and benefits deriving from business activity are also analyzed. In this situation, the social model added to the other two further increases the information provided to the reader. In particular, the model provides details of the social benefits that the company generates, which could be important information to share with the company's main stakeholders. In addition, the social model provides guidance for a possible social audit by the company's authorities or clients or for the preparation of a sustainability report that also includes the company's social commitment.

In summary, the results show the company's value proposition in a revised and significantly more detailed form than the previous traditional business model. From the results of the paper, the sustainability path undertaken emerges and the reader perceives the awareness that the company has of its production process and the environmental impact it creates. In parallel, the considerations on the social sustainability dimension are also relevant. The environmental damage produced by industrial activity inevitably has social repercussions, particularly in the territory in which the company operates. At the same time, however, no less important are the social benefits that the company generates, especially in creating several jobs in the area and in communicating transparently and ethically with suppliers and customers. The absence of the transition to a sustainable business model tool such as the triple-layered business model canvas, which highlights the creation of social value, does not allow the company to become aware of the social benefits it generates and, by consequence, these benefits are also not communicated to customers and stakeholders.

7. Conclusions

The transition from traditional to sustainable business models and the revision of value proposition is a complex but fundamental step to become aware of the sustainability path that a company is undertaking. The sustainability transition of enterprises should be based on sustainability objectives formulated by top management in a long-term orientation [72]. Furthermore, the sustainable objectives should not be limited to an environmental analysis but should include the three pillars of sustainability in a triple bottom line perspective [9]. Despite the importance of strategic analysis, manufacturing companies very frequently introduce sustainability practices on the basis of an economic benefit, regulatory imposition or other external factors [73] without being aware of the environmental and social benefits generated by these choices. In the ceramic tile sector, an example of this process concerns the reuse of water consumed in production processes, which has a reduced cost compared to water from aqueducts or wells. In addition to the economic advantage, this circular economy practice brings a high environmental benefit which, with the use of impact assessment methodologies, can be properly quantified. The innovation of the business model allows these practices to be considered not only from an operational perspective but also in the company's value creation strategy.

In addition to enriching the increasingly comprehensive literature on sustainable business models, the paper offers interesting insights into managerial implications. As far as ceramic tile companies are concerned, the importance of a correct impact assessment of sustainability practices emerges. Impact assessment case studies already exist in the literature, although they tend to concentrate solely on the environmental pillar of sustainability [74–76]. In particular, ceramic companies that have implemented data collection systems based on industry 4.0 paradigms have the opportunity to create dynamic monitoring systems of the impact of their processes. The issue of impact assessment also concerns other manufacturing companies in other sectors, as corporate social responsibility programs are playing an increasingly important role in generating social legitimacy, trustworthy relationships with stakeholders and improved reputation [77]. Another area of interest regards the top management of manufacturing companies which, in the introduction of a sustainable development path, should carefully assess the evolution of the value proposition of the company through a shift to a sustainable business model. In this regard, the TLBMC consists of an intuitive and easy to implement tool, which allows companies to better understand their value creation process and to evaluate at the same level the three pillars of sustainability. In order to be truly effective, however, the sustainable business model should not be considered as static but should be continuously updated according to the sustainable transition of the enterprise.

Despite the good degree of detail achieved by TLBMC and the progress compared to previous research, the results show some limitations. First, the major limitation of this paper derives from the single company case study in a specific sector such as ceramic tiles. Nevertheless, the case study remains valuable because, in addition to the importance of the sector worldwide, ceramic companies in the most important European districts have very similar production processes, the same type of machinery suppliers and similar sustainability practices implemented within the processes. In particular, the similarity of production processes within the Italian (Sassuolo) and Spanish (Castellon) ceramic district makes the model a useful reference for further studies of sustainable business models within the sector. Secondly, other limitations are those related to the TLBMC itself and they are already highlighted by the authors of the model. Although the model is comprehensive, it remains an instrument that cannot individually assess the potential of innovation and should subsequently be followed by more extensive analysis [10]. Finally, regarding the social pillar, unlike the environmental pillar based on LCA impact studies, the results were based on semi-structured interviews with a limited number of respondents.

In conclusion, future research could be dedicated to integrating the circular business model developed previously in the same case study with the results of this article [60]. In addition, another area of research could concern a fourth dimension that is frequently omitted, namely the technological dimension concerning the technological performance of the product. In the ceramic tile sector, as in

other manufacturing sectors, the introduction of sustainability into the processes must maintain the technological characteristics of the product, otherwise, the risk arises of creating a product of a lower quality or not complying with national and international regulations. Finally, future research will be devoted to the implementation of the TLBMC model in other manufacturing realities within the ceramic supply chain.

Author Contributions: Conceptualization, F.E.G.-M.; methodology, M.S.M.-S.; supervision, A.M.F. and writing—review and editing, M.C. All authors have read and agree to the published version of the manuscript.

Funding: This research was co-funded by the European Union under the LIFE Programme (LIFE16 ENV/IT/000307: LIFE Force of the Future-Forture), under which a research grant has been activated at the Department of Sciences and Methods for Engineering (DISMI) of University of Modena and Reggio Emilia, Italy.

Acknowledgments: The authors would like to acknowledge the editor and the two anonymous reviewers for their helpful suggestions to improve the paper.

Conflicts of Interest: The authors declare no conflict of interest.

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