The blockchain as a sustainable business model innovation

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Abstract

Purpose – The purpose of this paper is to strive to close the current research gap pertaining to potential implications of the blockchain (BC) for sustainable business models (SBMs) in the agri-food industry.

Design/methodology/approach – To answer the research question, the authors utilised the Value Triangle framework by Biloslavo *et al.* (2018) in order to explore the potential innovation of BC for SBMs in the agri-food industry. Then, the authors apply it to an in-depth exploratory case study of the Placido Volpone winery. The authors draw data from strategic plans, annual reports, corporate website and a semi-structured interview with the winery's founder.

Findings – The authors show how BC technology could be a source of SBM innovation in the agri-food industry.

Research limitations/implications – BC technology has the potential to significantly change SBMs. Given the huge set-up investments by the industry, academic research investigating potential implications and supporting companies in their application of BC is needed. This paper explores how the implications of BC as source of innovation on SBMs can be investigated.

Practical implications – The research results of this study can be used by company leaders and managers to support the development of SBMs through the introduction of BC technology in their business activities.

Originality/value – The paper is novel because it investigates the relationship between SBM innovation and BC providing theoretical justification to SBM technological innovation in an agri-food setting. Additionally, the paper provides an empirical application of the framework by Biloslavo *et al.* (2018) for understanding the development of SBM through BC in the agri-food industry.

Keywords Innovation, Sustainability, Business model, Agri-food, Blockchain

Paper type Research paper

1. Introduction

The business model (BM) is the organization's system of transforming inputs through its business activities into outputs and outcomes and deals with the way in which a company creates, delivers and captures value over the short, medium and long term (see, for example, IIRC, 2013; Osterwalder and Pigneur, 2010; Teece, 2010). The BM is a conceptual tool that helps managers take strategic decisions and guides them during the implementation process that emphasizes a system-level, holistic approach towards explaining how firms do business (Di Carlo *et al.*, 2016; Zott *et al.*, 2011). According to Chesbrough (2007), each company working in a competitive environment has a BM, explicitly recognized or not.

However, all the environmental and social challenges affecting companies nowadays show the unsustainable nature of production and consumption the way it is. Krantz (2010, p. 7) affirms: "companies will need even bigger changes, including new business models, greater trust and greater stakeholder engagement." The answer is represented by the

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introduction of a sustainable business model (SBM), able to define company's goals not only from a financial and economic perspective but also in social and environmental terms (Strubbs and Cocklin, 2008). To address these issues, we draw on an established research framework, named Value Triangle (VT), proposed by Biloslavo *et al.* (2018), reprocessing the original framework in light of the introduction of Smart Technologies inside companies, namely, all those technologies able to manage huge amounts of data with little or no human intervention (Gretzel *et al.*, 2015).

Nowadays, data is considered to be the main value of every transaction because each kind of physical operation, service providing or communication entails a data transfer. Dealing with big data requires assurance on quality and availability of information. To be useful to stakeholders, data-driven decisions require transparency, accountability and verifiability, and data has to be assured, verifiable and tamper-proof. Blockchain (BC) technology, mostly used and studied in financial transactions and applications (Nakamoto, 2008), has the features to meet all those requirements also in physical and service providing markets (Wang *et al.*, 2019), like the agri-food industry.

Specifically, the BC "has the potential to simplify and integrate agricultural supply chains, enhance food safety, reduce risk in trade finance and promote inclusive trade, increase access to agricultural financial services, generate smarter market information and provide greater legal certainty to land-tenure systems" (Tripoli and Schmidhuber, 2018, p. 2). Indeed, providing immutable permanent information, this technology has the potential to reduce food frauds and adulteration. Nevertheless, to the best of our knowledge, the potential of BC to foster SBM in the agri-food industry has not been studied yet.

All these considerations lead us to formulate the following research question: how could the BC be a source of SBM innovation in the agri-food industry?

Therefore, the purpose of the paper is to investigate the BC potentiality to drive business models towards sustainability, exploring the application of the BC technology in the agri-food industry and providing the analysis of a best practice, the Placido Volpone winery (the company), which is the first Italian winery company to introduce the BC.

The rest of the paper is organized as follows. The second section reviews the literature regarding SBM innovation, with a focus on the agri-food industry. The third section provides an analysis of the technical characteristics of BC as organization's innovation and explores the potential applications of BC technology in the agri-food industry. In the fourth section, the research method is described. The fifth section investigates how BC could be a source of innovation in SBMs through the lens of the VT framework, followed by the case study analysis in the sixth section and the conclusions in the last section.

2. Sustainable business model innovation

2.1 The concept of sustainable business model

Living in a historical period characterized by climate change, growing population, resource depletion, raising pollution, increasing inequality amongst people, health issues and environmental impact obliges companies not only to consider these phenomena but also to include them in their way of doing business. Traditional BMs do not pay attention to environmental and social impacts, while a fundamental shift is required in the way companies do business. On the contrary, SBMs, which include social and environmental elements, are able to fully engage with the era of sustainability. A SBM can be described as "a business model that creates competitive advantage through superior customer value and contributes to a sustainable development of the company and society" (Lükede-Freund, 2010, p. 23).

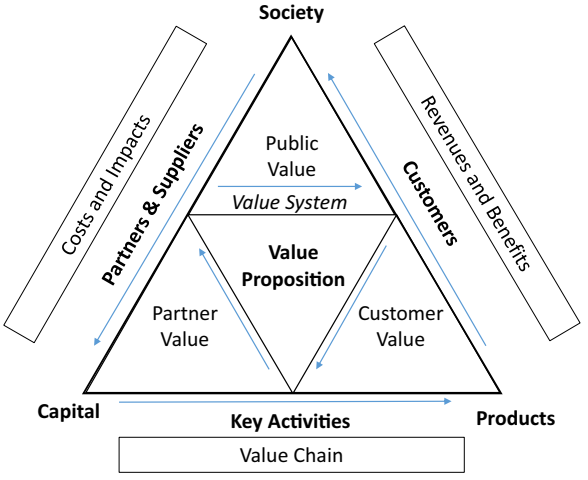
According to Strubbs and Cocklin (2008), who firstly theorized a framework for SBM, a SBM has the following features: it defines the purpose of a business in wider terms than

financial, emphasizing environmental and social aspects; it produces a triple bottom line approach in reporting environmental, social and financial performance (Elkington, 1998); it takes into account the needs of all stakeholders, without focusing on shareholders (Freeman, 1994); it considers nature as a stakeholder; it uses company leaders to embed sustainability in the company culture; it modifies the taxation system, shifting the tax burden to business practices with a negative impact on the environment (like the consumption of non-renewable resources); it considers the reinvestment of local capital.

Currently, SBMs are considered as a key source to obtain competitive advantage through sustainability (Porter and Kramer, 2006 and 2011). The value proposition of a SBM provides measurable ecological and social value together with economic value (Boons and Lüdeke-Freud, 2013) integrating social and environmental aspects and goals into the business and considering the environment and the society as key stakeholders to be taken into consideration (Evans *et al.*, 2017).

In this paper, to analyse the effects of BC technology on SBMs, we adopt the framework proposed by Biloslavo *et al.* (2018) named the VT, whose visual representation is the Value Triangle Business Model Canvas (VT BM Canvas). According to this approach, a firm co-creates and co-delivers value with its stakeholders in a circular value system. The VT has its basis in a previous work by Richardson (2008), whose definition of BM involves three main components: value proposition, value co-creation and co-delivery system and value capture system.

More specifically, the VT BM canvas includes nine components. To better highlight the different ecological and social effects on firm and society, we split the last two components (benefits and costs) into four components. For this reason, our version of the VT BM canvas includes 11 components, becoming a VT Sustainable BM canvas (VT SBM canvas) (Figure 1): (1) the society, which includes all the stakeholders interested in firm's activities and the natural environment in which the firm operates; (2) the value proposition, composed of public value, customer value and partner value; (3) the customers, composed of all the people the firm wants to reach with its products and services; (4) the products, meaning goods and services produced by the firm to satisfy customer needs; (5) key operational activities, including logistics, research and development (R&D), operations and



Source(s): Adapted from Biloslavo *et al.*, 2018

Figure 1.
The VT SBM canvas

marketing; (6) capital, i.e. financial, manufactured, intellectual, human, social and natural; (7) partners, meaning other firms involved in several kinds of relationships like joint ventures, networks, consortia and strategic alliances; (8) revenues or rather all the economic flows retained by the firm as remuneration; (9) benefits, addressed to society and environment as a result of firm's activities; (10) costs, negatively influencing the economic result of a firm and (11) impacts that are the effects of firm's activities over the natural and social environment.

2.2 Sustainable business model innovation

The literature is unanimous (see, Amit and Zott, 2012; Casadesus-Masanell and Ricart, 2010 and Mitchell and Coles, 2003) in affirming that BM innovation represents an important success factor for companies, generating real and long-term sustainable value and representing an essential element for company's competitiveness, renewal and growth (Lambert and Devidson, 2013). A BM innovation is "a process that deliberately changes the core elements of a firm and its business logic" (Bucherer *et al.*, 2012, p. 184). According to Gambardella and MacGahan (2010, p. 263), "BM innovation occurs when a firm adopts a novel approach to commercializing its underlying assets". Specifically, SBM innovations are "innovations that create significant positive and/or significantly reduce negative impacts for the environment and/or society, through changes in the way the organisation and its value-network creates, delivers and captures value (i.e. create economic value), or change their value proposition" (Bocken *et al.*, 2014, p. 44).

Building on the previous work of Boons and Lüdeke-Freund (2013), Bocken *et al.* (2014) propose a categorization of SBM archetypes, according to the main type of BM innovation: technological-, social- and organizational-oriented innovation, according to the nature of the dominant innovation. Firms can select one or more archetypes in developing their SBMs, also combining different archetypes. As stated by the same authors, however, the principal limitation of their work is represented by the presence of possible new radical approaches not considered in the analysis. More in detail, focusing on the technological grouping, the authors do not pay attention to the advent of Smart Technologies, as they admit in the limitations of their paper where they affirm that the proposed categorization "cannot predict entirely radical new approaches" (Bocken *et al.*, 2014, p. 54).

In the field of information and communication technology(ICT), the acronym "Smart" stands for "Self-Monitoring, Analysis and Reporting Technology" (Mashhadi *et al.*, 2018, p. 1,108). The term is often applied as a prefix to indicate that a technology can function without little or no human intervention (Gretzel *et al.*, 2015). In this sense, Smart Technologies contribute to SBM innovation, being able to collect huge amounts of data to provide functions like sensing, processing, controlling, communicating, predicting, healing and preventing (Debnath *et al.*, 2014).

There are several Smart Technologies that can produce SBM innovation in many different ways. Specifically, in this paper we focus on the BC, one of the emerging technologies that can be disruptive to how companies do business, investigating how it can advance on SBMs through technological innovation. We choose to focus on the BC because, unlike all the other Smart Technologies that are based on heavily centralized infrastructures, the BC is a distributed ledger technology that is immutable by design, able to guarantee security, anonymity and data integrity, without any external actor in charge of the control on the transactions (Yli-Huumo *et al.*, 2016).

The strongest feature of BC, data security, is the reason why, even if it was firstly applied to financial markets (i.e. Bitcoin), now its uses are extended also to other markets, such as the agri-food industry, where data security and the validity of an entire history of transactions is of central importance.

2.3 Sustainable business model innovation in the agri-food industry

The agri-food industry refers to "the production, processing and inspection of food products made from agricultural commodities" (McCarthy *et al.*, 2016, p. 1,134). Agri-food represents a crucial industry because many of the future challenges are related to agricultural sustainability and food production (Barth *et al.*, 2017).

Although, traditionally, the literature about innovation is focused on high-tech industries (McCarthy *et al.*, 2016) and tends to omit the capability of innovation of low-tech industries, in recent years there is increasing attention towards traditional industries (Caiazza, 2016). Even though agri-food is considered a mature industry with low investments in R&D (Costa and Jongen, 2006), the literature shows the dependence of firm's returns on its capacity to innovate (Alfranca and Huffman, 2003). In the agri-food industry, innovation refers to new products, processes, strategies and organizational or external practices (Caiazza *et al.*, 2014).

According to Barth *et al.* (2017), companies in the agri-food industry that have successfully engaged with innovation in their BMs have also developed new BMs, including greater community involvement and a focus on environmental issues. However, to the best of our knowledge, scholars have paid little attention to innovation of BM towards sustainability in the agri-food industry.

On the other hand, agri-food is an industry where transparency, accountability and verifiability represent a key value driver in operators' decisions and where consumers' choices are moving towards food safety and sustainability (Trienekens *et al.*, 2012). For these reasons, several specific Smart Technologies like Radio Frequency IDentifications (RFIDs), wireless sensor networks and everyday-cheaper connected devices have been introduced in the agri-food industry to facilitate remote monitoring in food production and transportation (Caro *et al.*, 2018).

A kind of innovation which has gained huge interest in the agri-food industry in the last few years is the BC (Ge *et al.*, 2017). BC represents a useful tool to facilitate the sharing of data, enhancing its transparency, accountability, efficiency, safety and traceability (Tripoli and Schmidhuber, 2018) and protecting it from tampering, deletion and revision (Iansiti and Lakhani, 2017) in the agri-food supply chain.

For all its features, BC technology represents a valid example of SBM innovation, being able to produce huge benefits for the society (in terms of data transparency, integrity and security) and also for the environment (in terms of reducing the waste of resources and energy).

Before investigating the potentiality of BC technology as a source of SBM innovation, the next section explores the technical characteristics of the BC technology as organization's innovation and its application in the agri-food industry.

3. Blockchain

3.1 Why should organizations adopt blockchain? A technical description

Current data storage and management procedures are commonly based on centralized ledger systems (Pereira *et al.*, 2019) whereas BC technology is based on a different data storage and management protocol, namely, the Distributed Ledger Technology (DLT) system (Yli-Huumo *et al.*, 2016). Distributed ledgers use independent parties' hardware to record and synchronize transactions and each transaction is publicly announced so all participants have access to data of the transaction itself, recorded on their own ledger. Every record is assured by each of the parties, as everyone is able to validate each transaction and the consensus of the users certifies the record by a proof-of-work, proof-of-stake or rather other more advanced consensus strategies (Maull *et al.*, 2017). In a system with such features, no trust of other parties is needed as the community itself may assure the transaction through consensus, while diffused recording ensures the unchangeability of the transcription.

The main feature in BC technology is that no record or data can be overwritten and every transaction is certified in time through a timestamp. All information and transaction that has been validated through consensus is included in a block of data immutably linked to previous blocks, so records are indelibly transcribed in each ledger. Every new set of data, the block, has to be encoded and encrypted through a procedure called mining (Crosby *et al.*, 2016; Zheng *et al.*, 2018).

Through the identification of strengths and weaknesses of this technology (Garavaglia, 2018), it is possible to point out features to be taken into account when evaluating the chance to adopt this protocol in an organization.

Taking into account strengths, advantages on information systems' efficiency arise as every party is sharing its processing capacity, and the consensus is generated by the validation provided from each user. Records cannot be overwritten and are accessible to each party of the transaction, so transparency, accountability and verifiability are assured by the protocol for every data or record (Crosby *et al.*, 2016). No trust is required amongst the parties and single points of failure are avoided (Bunjaku *et al.*, 2017). BC could be really effective in every environment, industry and application where transparency, accountability and verifiability are key value drivers (Tapscott and Tapscott, 2016).

Examining the weaknesses, it is important to focus on the data entry process: despite the fact that BC avoids single points of failure, the input procedure in the protocol may involve a "transaction malleability," when material errors due to mistakes or frauds ends to be recorded in a block (Sward *et al.*, 2018). Indeed, a misrepresented and validated data will be interpreted as effective by the other parties: once data is added, it is very difficult to modify the chain. Changing data in a BC may be really complicated and requires a *hard fork*, which is a radical change to a network's protocol that makes previously valid blocks and transactions invalid. Moreover, a privacy problem is engrained in BC technology: while it is not necessary to be aware of counterparts' real identity, in public DLT no transaction could be hidden from other users. Yet, as validation of blocks requires a considerable processing capacity (i.e. the records are redundant), the more widespread (and effective) the protocol is the more costly it is in terms of time (i.e. latency) and computational capacity required. Another major downside of BC is that if compared to traditional centralized systems, BC presents a limited efficiency and requires a larger storage capacity. Finally, being an informatics system, it may be subject to a cyberattack.

Despite these negative aspects, BC technology has unique advantages, and it is destined to remain in future years. The road to general adoption is still long, but many industries are experimenting with the application of BC systems for various uses.

3.2 Blockchain in the agri-food industry

BC has been predominantly analysed by scholars as the technology behind Bitcoin and other cryptocurrencies (Nakamoto, 2008); however, one of the most relevant applications of the BC is in the production and supply chain quality control system in the agri-food industry (Bastian *et al.*, 2013).

BC provides the necessary protocol for ensuring traceability in agri-food supply chains through data security. It allows consumers to verify the history of every good from the production to the distribution to consumers. Even sustainable behaviours in processing agri-food goods, such as water consumption or compliance with regulations, can be monitored and audited by users (Zhao *et al.*, 2019), enhancing transparency of business activity. The trend of the organic food market is significant evidence of the relevance of food safety and sustainability for business operators and consumers.

Through the application of BC technology, five opportunities for improvement in the agri-food industry could be identified:

(1) Traceability;

(2) Labelling;

(3) Organic farming;

(4) Financial efficiency and

(5) Market data analysis.

Traceability through BC allows consumers to be aware of issues concerning the product quality and supply chain in real time. This assures compliance with regulations and procedures to guarantee food safety and, in the case of contamination, to track all the supply chain to the very beginning, in one way or to the shelf on the other way (Al-Jaroodi and Mohamed, 2019). The traceability of any transaction is a key driver in the agri-food industry, where transparency and verifiability of production process and product quality give the consumers the opportunity to be reassured regarding the quality and safety of their purchase (Bastian *et al.*, 2013).

Labelling involves marketing, and it is usually used to deliver a sale message. However, national and international regulations require companies to disclose some critical information about products, such as origin, ingredients and distribution. BC allows for the disclosure of a huge amount of data and avoids labelling frauds through QR code, the most frequently used RFID system which is the unclonable identification fingerprints of the product or through crypto-anchors that are microbiological stamps with unambiguous codes (Tripoli and Schmidhuber, 2018).

Organic farming, as for Food and Agriculture Organization (FAO) Codex Alimentarius, requires the use of agronomic, biological and mechanical inputs and certification of compliance with procedures and regulations, which has been done through labelling until now. Whereas introducing a set of BC and Internet of things (IoT) technologies, customers and auditors may be assured of farming processes in a more secure and efficient way (McCarthy *et al.*, 2016).

Financial efficiency is given by the widely studied use of cryptocurrencies and BC transactions. Disintermediation through peer-to-peer transactions, performed through digitalized and real-time payments, reduce transactions costs (Nakamoto, 2008). As BC allows accomplishing transactions without trusted parties, as the system will certify and enable the payment, risks of fraud are virtually removed. Indeed, efficient transactions in agri-food supply chains lead to greater financial inclusion and rural business development (Tripoli and Schmidhuber, 2018).

Market data analysis is facilitated by the large amount of data generated and recorded through transactions. Companies are exploiting big data to build and support marketing processes, as they allow deeper analysis of consumers' behaviours and preferences, in order to develop more effective marketing and business procedures (Jia, 2019).

To summarize, it is of critical importance to conduct research regarding the application of BC in the agri-food industry in light of the aforementioned arguments. To the best of our knowledge, the literature is missing a focus on the potential of BC to foster SBM innovation in the agri-food industry.

4. Method

To fill the gap in the research on SBM innovation in the agri-food industry, we use the VT framework by Biloslavo *et al.* (2018) to explore how BC could be a source of SBM innovation in the agri-food industry, in the first stage. This framework was chosen because it specifically focuses on SBM.

Then, in a second stage, we use a case study method to capture as much detail as possible and create in-depth insight (Eisenhardt, 1989; Miles and Huberman, 1994; Yin, 2014). Indeed, case studies are useful tools when using an existing framework (Han and Park, 2017). Thus, we build on an in-depth case involving the introduction of a new technology, the BC that improved the social and environmental performance of the cases' focal firm and created new market needs and can, therefore, be considered a sustainability-oriented innovation (Klewitz and Hansen, 2014).

The in-depth explorative case study regards a best practice in the application of BC technology in the agri-food industry that is Placido Volpone winery, the first Italian winery company that introduced the BC to certify its supply chain, as it represents a critical and representative case (Yin, 2014). According to Qu and Dumay (2011), we conducted a semi-structured interview with the founder, Domenico Volpone. As a supplement to the interview data, we also examined annual reports, the strategic plan and the company website.

5. Blockchain as a SBM innovation in the agri-food industry: the VT analysis

Nowadays business operators and consumers may suffer from informational problems and errors due to their paper-based processes and IT systems. Serious problems are represented by: (1) the high costs and inefficiency of paper-based systems; (2) the possibility of fraud and errors on paper and IT systems and (3) human errors that can compromise digital records' integrity. All these problems represent a serious threat to food quality, safety and sustainability (Tripoli and Schmidhuber, 2018). Thus, the agri-food industry could benefit from the introduction of BC, which has all the features to represent a huge SBM innovation towards sustainability.

The BC has a positive influence on the society because data entries are digital and immutable. Information about quality (e.g. geographic origins and freshness), safety (e.g. healthiness and no modification) and sustainability (e.g. fair-trade) of the products are guaranteed by the BC, which ensures data transparency, integrity and security. Moreover, accumulating detailed data on each transaction enhances the reputation of the supply chain participants and facilitates their credit access (Tripoli and Schmidhuber, 2018).

From an environmental point of view, the BC consistently eliminates the waste of safe food, being able to promptly locate and trace contaminated products. The ability of the BC to easily identify the origin of a product and to carry secure and reliable attributes in each transaction provides a remarkable step forward for food safety (Tripoli and Schmidhuber, 2018). In addition, the BC has the potential to allow agri-food companies to reduce natural resources consumption thanks to the compliance with environmental regulations and more efficient business processes and transactions.

Adopting the VT framework defined by Biloslavo *et al.* (2018), modified with the inclusion of two new components to better highlight the different ecological and social effects on firm and society, we propose an exploratory analysis of how the introduction of BC in the agri-food industry can advance on SBM through technological innovation.

5.1 Society

It includes all the stakeholders involved in a company's activities and the natural environment (Freeman, 1994). BC, due to its' capability to immutably track all the steps in a process, enables a company's stakeholders to be aware of the organization's behaviours (Zheng *et al.*, 2018) in order to enhance collaborative cooperation with all the parties directly or indirectly involved in the supply chain.

Indeed, the BC could be beneficial to society thanks to its ability to enhance data transparency, accountability, verifiability, integrity and security (Ge *et al.*, 2017), ensuring

public safety and corruption prevention or, in other terms, the application of BC can be a means to achieving many Sustainable Development Goals (SDGs) in the agri-food industry (Tripoli and Schmidhuber, 2018).

5.2 Value proposition

While value proposition describes the benefits a customer can expect from a specific product or service (Osterwalder *et al.*, 2014), the analysis may be widened to other stakeholders. An investigation of value creation in a business ecosystem must take into account the advantages and the value delivered to the different stakeholders of the system, i.e. customers, the public and partners.

Customer value is enhanced by the assurance the BC gives on food traceability and security, since the chance to point out every specific feature of the agri-food supply chain represents value for customers (Tripoli and Schmidhuber, 2018). Being informed allows customers to make more responsible and sustainable choices. A survey conducted in 2018 by Coldiretti (the Italian agri-food industry organization) concluded that organic food costs on average 60 per cent more than non-organic food; nevertheless, its consumption was growing at a 10.5 per cent rate. That is, consumers show their appreciation for organic food even in willingness to pay, as they are aware that what they are consuming comes from a certified, safe and sustainable supply chain. BC improves this process of awareness through supply chain traceability in the agri-food industry brought about by the growing adoption of this technology. Traceability is assured because each step of a productive process is recorded on a diffused ledger when the protocol is adopted. Data contained in the diffused ledger can be shared outside because the system can be made accessible to the public. In addition, BC enhances data security, thanks to the immutability of data (Crosby *et al.*, 2016). As a result, data traceability and security assured by the BC protocol improve monitoring of the products, enhance food safety and quality and build customer trust (Wang *et al.*, 2019), which are relevant features of a SBM in the agri-food industry.

Public value, namely, the value generated for society and natural environment, benefits from the BC adoption because the mechanism of reputation through data drives companies to be more compliant with regulations. Societal audit, through transparency and data availability, stimulates investment in environmental-friendly measures, even in order to develop a positive brand identity (Grover, 2019). Transparency strengthens the ability to respond faster to disease outbreaks and contaminated agri-food products, as they may promptly be detected and removed, wherever they are along the entire supply chain. In addition, the application of BC can be a means to achieving the SDGs, including for SDG 2 (i.e. Zero Hunger). Lower transaction costs reduce food prices and thus improve access to food; enhanced traceability ensures food safety and adds to the utilization dimension of food security for the public (Tripoli and Schmidhuber, 2018). Thus, the application of BC could improve public safety and corruption prevention that are central features of a SBM in the agri-food industry.

Partners value is enhanced in transparency and security through the BC, as commercial counterparts take advantages from a deeper knowledge of the supply chain as a whole and benefit in terms of organizational management from data collected from previous transactions, integrating and developing more effective information systems (Tapscott and Tapscott, 2016). Furthermore, through the support of smart contracts, supplier and customer management is more efficient (e.g. the number of intermediaries can be vastly reduced, the transaction costs can be lowered, the payments can be digitalized) as trade agreements are certified and self-fulfilled when a trigger (e.g. delivery or stock replacement) occurs. Thus, the application of BC enhances supply chain disintermediation, which is a focal feature of a SBM in the agri-food industry.

5.3 Customers

Customers are an underpinning component of the BC procedure. Through their involvement, the advantages of the BC introduction for agri-food firms and business behaviours become effective. Their interaction determines the co-creation of value, as companies are encouraged to fulfil customers' expectations regarding their behaviour (Richardson, 2008).

Customers in an agri-food supply chain are all the parties purchasing semi-processed or final products. When dealing with semi-processed products, the customer is expected to be part of the supply chain, looking for high quality raw materials and, if making use of the BC protocol, he/she becomes part of the informative chain and the market data analysis (Jia, 2019).

When customers are consumers, the focus is on the food quality as much as on its safety and the BC, enhancing data security and traceability, represents an assured source of data linked to the production batch or even to the single product (Trienekens *et al.*, 2012). Moreover, through the BC, the product's authenticity is ensured because all the information regarding the product is preserved and the customer can easily access it through the QR code on the label, in order to better understand all the features of the product he/she is buying (Tripoli and Schmidhuber, 2018).

Thus, the ability of BC to trace a product's origin, carry detailed attributes in each transaction and ensure its authenticity provides vast improvements in traceability and transparency, ensuring the customers trust which is a primary feature of a SBM in the agri-food industry.

5.4 Products

The introduction of the BC does not automatically improve the quality of the products, since it is a technology only responsible for certifying the fairness of the data. Nevertheless, as information about manufacturing process and production factors is disclosed, the transparency and accountability assured by the BC indirectly enhances the quality of the products: agri-food producers are conscious that consumers are always more attracted to healthy products, made with natural ingredients and resulting from not-adulterated processes, and consumers pay increasing attention to labels, spending time reading them, to get informed about the product's features.

With these assumptions, the BC can be seen not only as a monitoring technology but also as a quality improvement quality mechanism, able to force producers to offer high-level, quality products on the market (Trienekens *et al.*, 2012).

Furthermore, the adoption of BC in the agri-food industry improves product's quality also because it results in promotion and diffusion of organic farming, adoption of fair legal procedures and fraud prevention (McCarthy *et al.*, 2016).

Therefore, the BC introduction enhances food authenticity and legitimacy.

5.5 Key operational activities

BC is effective in a wide range of operational activities, as it certifies and efficiently transfers the data flow from one step to the other. Specifically, operating activities can be classified in inbound logistics, operations and outbound logistics (Osterwalder and Pigneur, 2010).

Inbound logistics benefits from the efficiency brought about by smart contracts as triggers that allow commercial trades such as a delivery to be fulfilled automatically, reducing transaction costs and enhancing digital payments. Furthermore, assurance on the quality of supplies allows companies to reach Total Quality Management procedures, as an assured knowledge of the correspondence of supplies with the firm's expectations, reduces the monitoring costs and allows firms to focus on their value-added activities (Kannan and Tan, 2005).

Operations benefit from an effective, tamper-proof and open access data flow with a considerable enhancement of information system. The adoption of BC in labelling may affect the operation processes, ensuring that firms are compliant with national and international regulations, sanitary and phytosanitary standards, sustainability certifications, etc. (Tripoli and Schmidhuber, 2018).

Outbound logistics benefits from the abovementioned features for inbound logistics. Furthermore enhanced traceability and open access to supply chain and food data allow for the collection of a wide set of market data.

Therefore, the introduction of BC fosters marked data analysis in the agri-food industry as well as compliance with environmental regulations and supply chain transparency and disintermediation.

5.6 Capital

BC allows for an efficient management of financial capital in two ways: reducing transaction costs as all the transactions are traceable and decreasing the cost of capital as a consequence of risk reduction due to improved efficiency and traceability of transactions.

Manufactured capital (i.e. semi-products and infrastructures) benefits from traceable and consecutive records, which often implies business process reengineering and allows the firm to effectively monitor productive processes and significantly reduce monitoring costs (Tripoli and Schmidhuber, 2018).

Knowledge and human capitals benefit from the introduction of BC because it improves shared knowledge and expertise thanks to employee training and the development of social community (Garavaglia, 2018).

Indeed, social and relationship capitals benefit from transparency of the supply chain, which provides the customers and society the assurance of who they are dealing with and from the data security and traceability that ensure food safety and quality (Tripoli and Schmidhuber, 2018).

Natural capital benefits from transparency in business procedures, as firms disclose their compliance with regulations aimed at preserving the environment. Thus, the introduction of BC fosters the sustainability of business behaviours. Indeed, according to Zhao *et al.* (2019) the paper and energy savings, the manufacturing and sustainable water management and the waste reduction generated by the introduction of BC are beneficial to the natural environment.

5.7 Partners

The BC technology can enhance trade facilitation and partner relations by bringing greater transparency, accountability, efficiency and traceability to the exchange of value (i.e. transaction) and information in agri-food supply chains (Tripoli and Schmidhuber, 2018).

Thanks to the BC, every transaction can be traced by the cryptographic fingerprint to ensure the security of supply chain, while the movements of the physical product along the supply chain can be traced by an immutable link that connects the product to the BC protocol to ensure the product's authenticity (Zhao *et al.*, 2019).

The product's traceability and the availability of information amongst partners improve the transparency of transactions and strengthen the compliance with trade agreements. Thus, the introduction of BC in agri-food supply chains has the potential to simplify partner relations, by reducing transaction costs, minimizing trade risks and facilitating access to trade finance (Wang *et al.*, 2019).

Indeed, the implementation of BC requires partnerships in order to develop an infrastructure and protocols commensurate to enabling it to work properly. When this technology becomes adequately widespread and the supply chain is totally covered by the BC

protocol, technological partnerships are no longer needed as the BC becomes an enabling infrastructure for agri-food supply chains.

Enhanced trade facilitation and partner relations simplification through BC can help achieve broader policy goals, such as food security and rural development and be a catalyst to meet the SDGs (Tripoli and Schmidhuber, 2018).

5.8 Revenues

Companies, becoming more compliant with regulations and implementing eco-friendly behaviours, in order to meet customers' and society's expectations, are rewarded with a better reputation and new revenue flows (Tripoli and Schmidhuber, 2018).

Moreover, with the implementation of BC, which is also a monitoring and control mechanism, companies benefit from lower monitoring costs (Zheng *et al.*, 2018).

5.9 Benefits

Many benefits, oriented towards different beneficiaries, are obtained from the application of BC. The society, as a whole, benefits from the enhanced transparency, accountability, verifiability and traceability of supply chain (Tripoli and Schmidhuber, 2018). These features allow the agri-food industry to meet the requirements of a SBM, ensuring the achievement of food quality and food safety.

Indeed, the application of BC can be a means to achieving the SDGs for the society, including food security, public safety and anti-corruption. When a contamination occurs, companies can promptly detect and withdraw hazardous or contaminated products with a significant positive influence on food security and public safety (Wang *et al.*, 2019). In addition, BC features, avoiding double spending, are expected to prevent counterfeiting and fraud (Tripoli and Schmidhuber, 2018).

Furthermore the natural environment could benefit from BC introduction thanks to the reduction of natural resource consumption (i.e. paper, water and energy) and the saving of safe food (Zhao *et al.*, 2019). Also the compliance with environmental regulations, sanitary and phytosanitary standards and sustainability certifications is beneficial to the natural environment.

5.10 Costs

BC is an expensive technology which requires significant set-up costs to be implemented. This means that only big companies can use it, while little companies are excluded from the possibility of applying this kind of technological infrastructure, at least as early adopters (Garavaglia, 2018). When knowledge regarding the BC technology and its potential for BM innovation is widespread, the set-up costs will decrease.

Moreover, since the BC is a completely new technology, the company implementing it has to sustain training costs for its employees and to (at least partially) reengineer its business processes, sustaining the related costs.

5.11 Impacts

Implementing BC solutions involves some challenges and risks. To support the new protocol, some technical challenges have to be addressed. A specific infrastructure has to be set up and the true scalability is obtainable only when every party of the supply chain adopts the technology. Technical essential facilities are required as BC is implemented on the Internet and sophisticated ICTs are needed for its application, so rural economic systems may suffer the impossibility to apply this innovation (Zhao *et al.*, 2019).

BC is a protocol which allows for recording unchangeable data and transactions, but certifying completely tamper-proof transactions, safe recording and storage are not enough. Input data may be misrepresented and manual data entry may suffer from forgery or mistakes (Sward *et al.*, 2018). However, the lack of data entry monitoring could be counterbalanced by the introduction of monitoring and control systems and other Smart Technologies that can interface with the BC, such as IoT, RFID systems, crypto-anchors, wireless sensor networks, everyday-cheaper connected devices and so on (Caro *et al.*, 2018).

6. Case study: findings and discussion

A single-case study of small-size Italian company, Placido Volpone winery, was selected to explore the implications of the introduction of BC in the agri-food industry in practice. In July 2019, we conducted a semi-structured interview (Qu and Dumay, 2011) with the winery's founder Mr Domenico Volpone, born in 1953 in Ascoli Satriano, in the Southern Italy countryside.

Placido Volpone winery, based in Southern Italy, was established in 2016 from a project implemented between Azienda Agricola Domenico Volpone, a company with a family's winery tradition born back in late '800 but formally established in 2008 by the Placido Family. The winery company is specialized in the production of some of the most typical red and white Italian wines, like Falanghina, Sangiovese, Nero di Troia and Aglianico. Bottling, distribution and marketing processes are provided by the Placido Volpone winery, while farming and winemaking are provided by Azienda Agricola Domenico Volpone. In 2018, the Company produced over 120,000 bottles, and the Azienda Agricola Domenico Volpone cultivated 19 hectares of land. It is worth highlighting that both companies implemented the BC technology in their processes.

Through the introduction of technological innovations in winemaking and bottling procedures and a rebranding of the products, the Placido Volpone winery is moving towards a more high-end and sustainable wine market, representing an effective example of how BC can be a source of SBM innovation in the agri-food industry.

Placido Volpone winery introduced the BC technology over its Falanghina production in 2016 in order to certify farming, harvesting, winemaking and bottling. According to the Business Plan, the company will apply the BC technology also to other wines in future years: "*This technology completely changed our way of doing business and thanks to the excellent results obtained, we are going to apply it also to other kinds of wines we produce*," said Mr Volpone.

The high quality of their product is ensured by the farming and harvesting procedures, conducted and monitored with the support of highly technological software, which allows for scheduling, monitoring and recording in BC of every procedural phase. The winemaking is operated by specialized employees with the task of recording in BC all the phases and data generated by this activity. Bottling and distribution are operated controlling every single drop of wine, sealing and certifying its composition, quality and safety in every bottle to the customers. This data is publicly disclosed, as every consumer can verify the history of each bottle, through a QR code printed on the label of each Falanghina bottle of wine.

6.1 Placido Volpone's business model

Analysing Placido Volpone's business model through the VT framework (Biloslavo *et al.*, 2018), we point out how the introduction of BC, which is a technological innovation, has driven the company BM towards sustainability.

6.1.1 Society. Through the introduction of the BC in its winery activity, Placido Volpone has allowed all the stakeholders to be aware of farming, harvesting, winemaking, bottling

and distribution processes, ensuring data transparency, accountability and verifiability. This knowledge ensures the product quality and safety for the whole society, avoiding counterfeiting and facilitating the efficiency of the entire supply chain.

Through the introduction of the BC, Placido Volpone winery enforces the relationship between the company and the local community living in the territory, focusing the attention on environmental issues and the sustainability of business behaviours. For these reasons, we can affirm that the introduction of BC technology in Placido Volpone represents a SBM innovation, creating a significant positive impact for the society.

6.1.2 Value proposition. BC allows customers to be more aware of what they are consuming, being assured of data security and traceability and food safety and quality. Moreover, Placido Volpone has pointed out another very specific target, namely, customers' education. Customers' education means the creation of more informed consumers, which leads to more conscious choices in their consumption behaviours. "*Providing information about the whole production chain, our Company aims to create the "consumer of the future", a new category of informed and conscious consumer who is also informed about products, virtuous in his behaviours and responsible in all fields of consumption*", said Mr Volpone during the interview.

Through the introduction of BC, Placido Volpone fulfils legal control requirements in an efficient way, which allows the society to be aware of firm's behaviours dictated by binding and non-binding business rules. Moreover, Placido Volpone is also conscious of the benefits for the society derived from data transparency and supply chain traceability. For this reason, it has decided to be the first winery company adopting this technology becoming a best practice.

Partners can benefit from an improvement of efficiency in business transactions thanks to BC and smart contracts, which enhance trade facilitations and partner relations simplifications. In the Placido Volpone case, the strategic partner of the winery, which is the Azienda Agricola Domenico Volpone, benefits from the BC introduction as well as the company because the BC technology simplifies their relationship making the dialogue between their information and accounting systems automatic.

Thus, we can affirm that the introduction of BC has increased the customer value, the public value and the partners value created by the company and represents a SBM innovation.

6.1.3 Customers. In this initial phase of development, Placido Volpone's customers are only consumers. Consumers can benefit from BC introduction in terms of data security. In fact, customers can access direct and immutable data about the products they are buying, and they can verify them by scanning the QR code on the label of the bottle using their smartphone.

Moreover, as the traceability of the products is ensured by the BC, in case of failure or health risks linked to some production batches, customers can be part of a very effective control and health risk prevention procedure.

Therefore, we can affirm that the introduction of BC represents a SBM innovation for customers mainly thanks to the product security and traceability.

6.1.4 Products. Placido Volpone has a vast assortment of wines, covering whites, reds and rosés, but in this preliminary stage the BC protocol has been applied only to the Falanghina production. Placido Volpone has always used the best grapes in terms of quality and taste, cultivated in a land free of pesticides and other artificial substances harmful for human health.

Nevertheless, even if the production of Falanghina wine is not directly affected by the introduction of BC, the transparency of operating processes and product quality is enhanced. Thus, we can affirm that the introduction of BC represents a SBM innovation because it assures food safety and quality.

6.1.5 Key operational activities. In the case of Placido Volpone winery, only the operations activity benefits from the BC introduction because it is not used in inbound and outbound logistics.

Specifically, the BC mainly affects the information systems of Placido Volpone winery. As a matter of fact, the company accounting and reporting activity has been directly affected by BC, which provides data traceability, transparency, integrity, security and accuracy. Labelling activity is also influenced by the introduction of BC, because data regarding the products is included in the QR code printed on the bottle's label. Finally, R&D activities are influenced by the introduction of BC, as the availability of certified data may contribute over time to operating processes improvements.

Thus, we can affirm that the introduction of BC seems to have a significant impact over some key operational activities of the company enhancing supply chain transparency and ensuring compliance with environmental regulations. Therefore, the BC represents a source of SBM innovation with regard to key operational activities.

6.1.6 Capital. Placido Volpone winery develops and protects different kinds of capital, even if all of them are not influenced by the BC introduction. Specifically, the financial capital is not influenced by the BC because the supply chain is not adequately covered to generate a reduction of transaction costs and risks.

Manufactured capital benefits from the value added in products and processes through the introduction of a new value-added technology. Knowledge and human capital are strictly connected as their development – which is represented by the knowledge, expertise and values that its founders, Domenico Volpone and Michele Placido, share with all the workers employed in the company through employee training – is linked to the growth in complexity and value of the new procedures introduced by the BC. Also, the natural capital benefits from the adoption of the BC technology. Placido Volpone winery is a company strictly tied to the natural environment in which it is located, near the founders' city of birth. "*This strong connection makes the Company the ideal setting to host local workers and to match tradition with new technologies*", said Mr Volpone. Of no small significance is also the social role of Placido Volpone, which ensures quality and safety of its products and assures the sustainability of its business behaviours.

For these reasons, we can affirm that the BC implemented by Placido Volpone represents a SBM innovation creating a significant positive impact over different kinds of capital.

6.1.7 Partners. Placido Volpone winery provides almost every part of the winery production chain with in-house procedures. Nonetheless, the Azienda Agricola Domenico Volpone is Placido Volpone's main strategic partner and it implemented the BC technology as well.

Thanks to the introduction of BC, Placido Volpone winery has the assurance of the quality standards used in the operating processes by its strategic partner. Indeed, the diffusion of BC may enhance and further simplify partner relations, especially through the adoption of smart contracts automatically triggering the stages of the business activities.

On the other hand, the external partners of Placido Volpone are represented by the bottles and the bottle caps suppliers, for whom it is not economically convenient to introduce BC technology, being Placido Volpone just one of their numerous partners and the only one using this technology.

Thus, we can affirm that the BC represents a SBM innovation creating a significant positive impact for strategic partners and, in the future, when the use of BC is widespread, for all external parties.

6.1.8 Revenues. Placido Volpone is the first winery company in the world to adopt the BC protocol as a quality assurance tool, which provides a significant advantage in terms of marketing performance and company reputation.

In addition, the introduction of BC, which is also considered an assurance mechanism ensuring trust, allows Placido Volpone winery to apply a premium price strategy thanks to

the higher perception of product quality. A product certified by the BC protocol is perceived on the market to be high quality and, for this reason, customers are willing to pay a premium price, which represents an increase in revenues for the company.

For these reasons, we can affirm that the BC implemented by Placido Volpone winery represents a SBM innovation, increasing company reputation and revenues.

6.1.9 Benefits. Customers and the entire society benefit from the introduction of BC in a company belonging to the agri-food industry, as food safety can be assured through the transparency, accountability and verifiability of the food quality and operating activities, reaching a very high level of social sustainability on food, i.e. wine production and distribution. Moreover, the introduction of the BC enhances the development of informed and food-educated consumers.

In addition, the introduction of BC enables Placido Volpone to guarantee fraud prevention over its Falanghina production, avoiding double spending costs. Furthermore, in case of involuntary placing on the market of hazardous Falanghina bottles, the company would be able to withdraw them immediately thanks to BC, which can also serve as a detecting mechanism. Finally, other benefits for the environment are represented by paper and energy savings due to the implementation of this computerized procedure.

For these reasons, we can affirm that the BC implemented by Placido Volpone represents a SBM innovation, creating benefits for the society and significantly reducing negative impacts for the environment.

6.1.10 Costs. When the BC was first introduced in 2016, Placido Volpone winery incurred some set-up costs. "*We have made a huge investment to implement BC technology but, on the other side, it works as an automatic control mechanism, enabling our Company to benefit from lower monitoring costs and quality control activities*", said Mr Volpone.

Being a very early adopter, the company had to address some problems linked to the limited knowledge of this new technology and the resulting employee training costs. Placido Volpone has nevertheless taken the chance to develop business procedures, introducing a new and efficient technological protocol which in the day-to-day activities, is able to significantly reduce the operating costs in the medium and long-term.

Thus, we can affirm that the introduction of BC seems to have a significant influence over a company's costs.

6.1.11 Impacts. The introduction of the BC over the Falanghina production involves only a part of the whole supply chain of Placido Volpone, which is composed of small suppliers (such as bottles and caps producers) and clients (i.e. shops and restaurants directly buying the products from the winery company) which, due to their small dimension, are not willing to sustain the implicit costs of the BC implementation. For this reason, effective impacts will be visible only when (and if) all the companies involved in the supply chain of Falanghina production introduce the BC technology.

Moreover, the BC needs to be integrated together with control mechanisms to avoid possible errors due to the manual data entry process. In doing so, Placido Volpone should integrate its BC technology together with a monitoring system able to prevent possible human errors in the initial data entry procedure.

6.2 Discussion

Placido Volpone is a true activist company that uses SBM to drive change and pursue its market leadership. The introduction of BC has significantly enhanced the sustainability of the company BM. Figure 2 shows how the implementation of BC technology has innovated the SBM of Placido Volpone, improving the BM sustainability within VT SBM canvas.

From the study of the Placido Volpone case, we identify several drivers of SBM innovation thanks to the introduction of BC technology, which confirms the findings of our exploratory

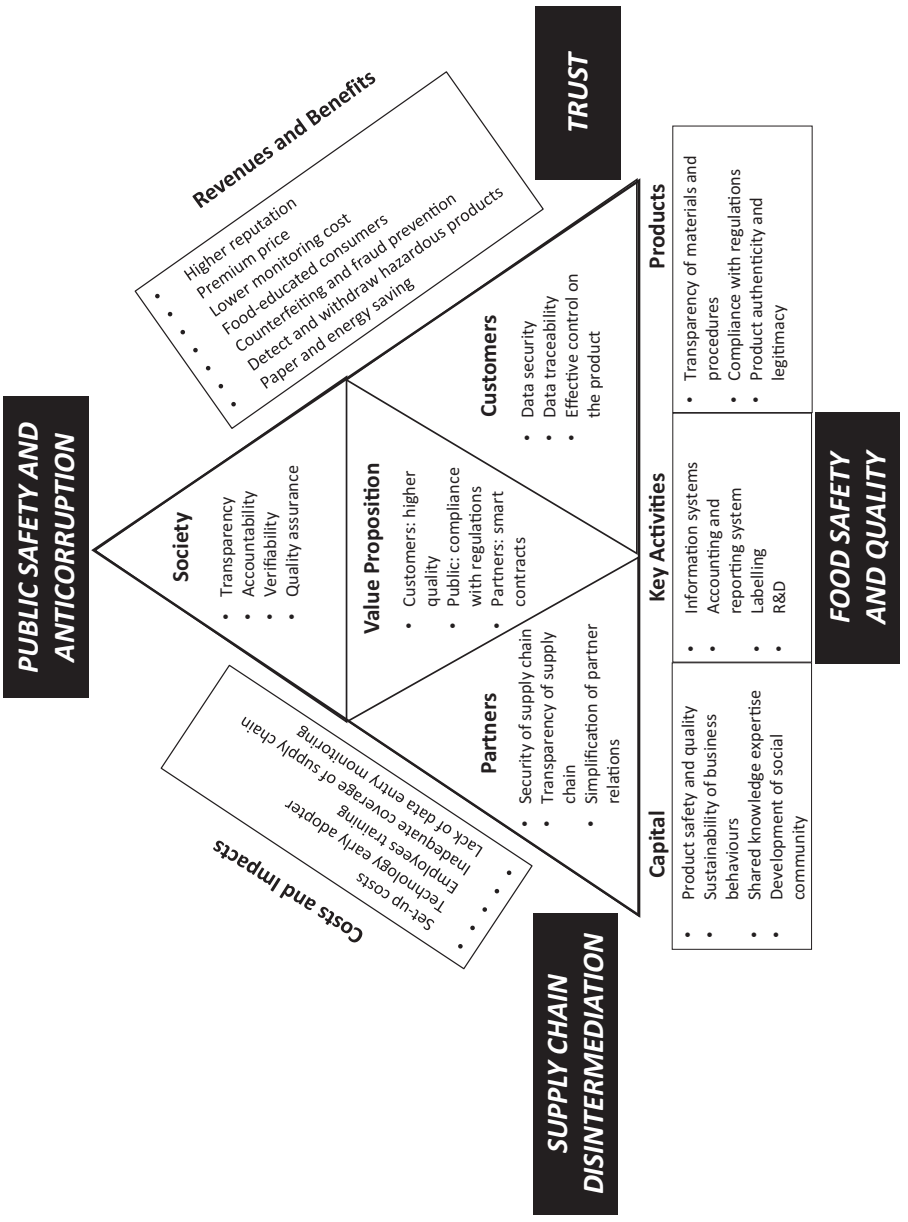


Figure 2.
Placido Volpone's VT
SBM canvas

analysis of the BC as a source of SBM innovation in the agri-food industry through the application of the VT framework. According to Wang *et al.* (2019), we classify these drivers into four main categories: trust, food safety and quality, supply chain disintermediation and public safety and anti-corruption.

First, trust is the main goal of BC. Consumers and, more in general, public trust are enhanced by the introduction of BC through data traceability, accountability and verifiability (Ge *et al.*, 2017). Second, food safety and quality are significantly improved by the BC introduction, thanks to data transparency and visibility (Trienekens *et al.*, 2012; Tripoli and Schmidhuber, 2018). Thus, BC is essential for improving the traceability of products and ensuring product authenticity and legitimacy. Third, supply chain disintermediation, which implies the absence of intermediaries because data integrity is guaranteed by the whole system, results in a reduction in error risks, delays and inefficiencies of transactions and leads to greater financial inclusion and rural business development (Tripoli and Schmidhuber, 2018). In addition, smart contracts simplify partners' relations through the supply chain (Wang *et al.*, 2019). Finally, providing data transparency and security, BC represents the best technology to fight against corruption, fake products and fraud and to assure compliance with laws and regulations by providing much needed data transparency (Zhao *et al.*, 2019). Thus, public safety and anti-corruption are enhanced by the introduction of BC technology in agri-food companies.

The main drawback of the BC introduction in the Placido and Volpone winery is that the BC is a specific technology that effectively and fully works when every actor of the supply chain adopts this technology. The supply chain of Placido Volpone involves several small suppliers (i.e. the bottle and caps suppliers or the restaurants and shops directly buying its products) who, due to their small size, are not able to afford BC implementation costs. Thus, the BC introduction will be fully effective when the coverage of supply chain has been completed.

7. Conclusion

To the best of our knowledge, this paper is the first that provides an approach for linking the VT framework to the SMB innovation provided by the introduction of the BC technology in the agri-food industry. The BC is still in an early stage of development, but it is considered to be a disruptive technology to be applied in those industries where consumers are always more often interested in transparency, integrity and security of data, such as the agri-food industry.

From our analysis, it is clear that in the agri-food industry consumers seek increased integrity, security and transparency of the products they buy. All these features can be guaranteed by the introduction of BC technology, which ensures data security, immutability and reliability (Yli-Huumo *et al.*, 2016). Thus, the implementation of BC in the BM of an agri-food industry company confirms the nature of this kind of technology as a SBM innovation, significantly creating positive benefits and reducing negative impacts for the environment and the society.

The positive effects of BC adoption as a SBM innovation in the agri-food industry can be summarized through four main drivers (Wang *et al.*, 2019): trust, food safety and quality, supply chain disintermediation and public safety and anti-corruption. Thus, the introduction of BC in the agri-food industry could be a source of SBM innovation, enhancing the sustainability of the company BM in many ways.

More in detail, through the implementation of BC technology, consumer and public trust is enhanced as a result of data traceability, accountability and verifiability. Companies improve food safety and quality thanks to data transparency and visibility. The absence of intermediaries results in a reduction in error risks, delays and inefficiencies of transactions

and greater financial inclusion and rural business development. Finally, through data security, BC represents the best technology to guarantee public safety and anti-corruption.

Indeed, the application of BC can be a means to achieving several SDGs for the society and the environment, confirming its nature as a source of sustainable innovation for the company's BM.

Academic scholars will benefit from this analysis as it provides a new perspective for the study of the BC as a SBM innovation. From a managerial point of view, our analysis can assist practitioners in the agri-food industry in showing all the potential benefits and opportunities linked to the application of this technology in economic, social and environmental terms.

The main limitation of the paper derives from the analysis of only one exploratory case study in the agri-food industry in Italy. Future research might apply the VT framework by Biloslavo *et al.* (2018) to other industries in different countries to help understand how the introduction of BC could drive SBMs.

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