

Article

Blockchain Technology and Sustainable Business Models: A Case Study of Devoleum

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Abstract: The lack of transparency along global supply chains poses challenges in the areas of fraud, pollution, human rights abuses, and inefficiencies. In this context, the blockchain has the potential to offer an unprecedented level of transparency, with a shared and decentralized database in which immutable and encrypted copies of information are stored on every node of the network. Using a single case study methodology, this paper investigates how blockchain technology can improve and facilitate sustainable business models. The aim of this paper is to understand how blockchain technology can drive the development of sustainable business models. Recent studies show the importance of sustainability perspectives for business models. The study was conducted by applying the CAOS (“Characteristic, Ambience, Organization, Start-up”) model to a start-up operating in the agri-food sector, not yet institutionalized, called Devoleum. The results indicate that blockchain technology can increase sustainability through realizing the traceability, security, and non-manipulability of information, which are particularly useful in the agri-food sector. Furthermore, the absence of intermediaries in blockchain technology contributes to reducing transaction costs and the time required to consolidate relations between the company and the environment. The limitations of this study must be identified in that the company is operational but not yet incorporated.



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Keywords: blockchain; case study; transaction cost; sustainability; CAOS model

1. Introduction

In recent years, scholars have dedicated increasing attention to the use of the blockchain in business models. In fact, research on the scientific database Scopus shows that, while there are more than 17,975 documents published on the blockchain according to the data on 2 January 2021, when considering only the subject area of “Business, Management and Accounting”, the documents available totaled 2402.

An interesting element regarding the growth in the number of papers about blockchain in the last few years is the following: in 2016, the contributions in the subject area “Business, Management and Accounting” totaled 21; in 2017, they totaled 115; in 2018, there were 579; in 2019, there were 702; and, finally, they totaled 899 in 2020.

According to the definition given by the European Commission, the blockchain has been recognized as a necessary tool to foster the development of equity and to make the digital economy inclusive, secure, and democratic in such a way as to have an impact on the way we think about our economic, social, and political institutions (EU 2020).

According to [1], the blockchain is a digital, decentralized, and fair share tracking system in which transactions are recorded and added in chronological order with the aim of creating permanent tracks free from possible modifications or tampering. In 2018, blockchain ranked among the top five technologies [2,3]. In general, innovative technologies have been studied as a vehicle for increasing efficiency and promoting sustainability [4].

In particular, some studies concluded that the blockchain is able to lay the foundations for the creation of a new economic–social system [5,6].

This study, following multiple recently published studies, calls for increased research efforts toward a better understanding of the role of emerging technology in the sustainability of organizations [7–9] and focuses on the blockchain as a vehicle for sustainability in business models.

Following the approach of previous research, this work investigates the role of blockchain as an incentive tool for sustainability in business models.

Building on this research field, this paper uses a single case study methodology [10] to investigate how the blockchain technology might be used to develop sustainability in business models.

In particular, the research question (RQ) of this study is the following:

RQ: How can blockchain technology support and facilitate the development of sustainability in business models?

The case study to be examined relates to a start-up, not yet institutionalized, named Devoleum, which aims to offer a transparent and accessible service to consumers and producers using the immutability of blockchains as an added value, proving the authenticity of the impossibility of manipulating the stored data.

To answer our research question, we applied the CAOS model [11–14], which makes immediate the description of all the variables affected by the case study and is able to showcase the potential relationships supported by the blockchain (primary links of the first, second, and third types) that lead to the development of sustainability.

This paper is structured as follows: Section 2 provides a review of the literature on blockchain technology and sustainability. Section 3 describes the methodology used for the analyzed case study. Section 4 shows the findings of the case study, Devoleum. Section 5 provides the discussion. Finally, Section 6 presents the conclusions and limitations of our paper.

2. Literature Review and Background

In order to review the literature on the sustainability of the current business models and the impact of blockchain on enterprises' performance, we will provide a review of blockchain technology (BT) concepts, investigating how BT influences the application of sustainable practices within the supply chain.

2.1. Blockchain Technology

In 2008, Satoshi Nakamoto introduced and conceptualized the blockchain, which has been defined in different ways. The mainly accepted definition is that it consists of an open, shared, decentralized, and distributed digital ledger (i.e., a ledger of all payment transactions) in which transactions and data relating to the parties involved in the transaction are recorded and added in chronological order, with the aim of creating permanent and tamper-proof records [15]. Blockchain is also considered part of the distributed ledger (DLT) technologies, which are systems based on a distributed ledger—that is, systems in which all the nodes of a network have the same copy of a database that can be read and modified independently by the individual nodes.

Blockchain solutions are those in which the ledger is structured by blocks, also called “nodes”, containing multiple transactions, and the nodes are linked together through a cryptographic system. These nodes allow the immutability of the chain, since for each of them, the system requires a consensus function to verify the transitions. This structure allows the network to act as a server that hosts non-modifiable data, where it is possible to identify potential anomalies by participants [16].

The main differences between blockchain technology and other information system projects are identifiable according to four key characteristics: (a) non-localization (decentralization), (b) security, (c) verifiability, and (d) smart execution [8]. As already mentioned, a blockchain is a digital ledger that is stored on multiple computers in a public or private network. When a transaction occurs, it is inserted into interconnected “blocks” that generate an irreversible chain that can no longer be modified. Once the node is verified and

added to the blockchain, a chain of trust is generated by creating multiple copies created in a decentralized way.

Blockchain technology can be considered one of the greatest revolutions in the digital world, even if it is considered by some as the natural consequence of the development of the Internet [17]. Its effects could be compared to those that occurred several years ago in the commerce sector with the adoption of the Internet, which had disruptive effects and heavily influenced supply chains [1].

Different sectors of heterogeneous nature are witnessing an increasing use of blockchain technology within them, such as medical records management, supply chains, banking and financial services, insurance, the long-term preservation of digital archives, the Internet of Things (IoT), the sharing economy, and distributed access control [18]. The blockchain is not a technology in its own right but is based on a number of other technologies as well as cryptography and the Internet, which is used as an infrastructure; the actual blockchain is used to store transaction records and establish consensus rules [1]. Based on the type of access control, two main types of blockchains can be distinguished: public or private. In a public blockchain, transactions do not require any kind of authorization and users can remain anonymous. The most important examples of a public blockchain are Bitcoin and Ethereum, the use of which does not require the authorization of other members. Instead, within a private blockchain, participants must obtain an invitation or permission to join. Groups of people or a single organization control the access [19].

Smart contracts are one of the main innovations generated by blockchain technology [6]; they are self-managing contracts or contracts that, once defined, do not need a person or a notary to allow their implementation but are self-executed upon the occurrence of established conditions. In this way, it is possible, for example, to pay due compensation or to initiate an action provided for under certain circumstances. Smart contracts have made it possible to create the so-called “smart marketplaces”, which allow for the disintermediation of transactions owing to the technology that has so-called “trust-less” characteristics; i.e., they do not require a guarantor for the validation of transactions. In this sense, the IoT (Internet of Things) introduces the opportunity to certify events that occur automatically, also through smart contracts, and without the intervention of human beings.

2.2. Blockchain for Sustainable Supply Chain

The genesis of the new sustainable business models, which are progressively expanding in contemporary society, is to be found in the growing digitalization. This transformation moves from the adoption of industry 4.0 technology such as the Internet of Things (IoT), Artificial Intelligence (AI), big data analysis, cloud computing, and 3D printing [20–22]. The adoption of blockchain technology has contributed to promoting a sustainable and secure implementation of enabling technology, such as IoT [23], 3D manufacturing [24], additive manufacturing [25], food supply [26,27], and healthcare [28].

In the context presented here, blockchain can contribute to developing and coordinating novel sustainable business models, promoting elements of sharing, optimizing, virtualizing, and, most importantly, exchanging. This constitutes a driving force to achieve sustainability goals. In this context, blockchain can be valuable as a tool for coordination, helping to connect and coordinate multiple distributed and updated databases [29]. Moreover, blockchain technology adopts decentralization and tamper resistance [30], which, combined with its functionality for smart contracts [8] and tokenization [30], can help achieve the above sustainability outcomes.

The promotion of a new business model can lead to the reduction in waste and the promotion of an increasingly traceable and safe product offer, increasing social responsibility, which should be considered as a key element for achieving sustainability objectives [31].

This is where blockchain technology can make an important contribution by providing an interconnected complex system that is able to update servers simultaneously and irreversibly. A necessary condition for blockchain to be effectively implemented is that the companies belonging to the network also reconfigure their business model in adopting

the elements required by the new technology. The adoption of blockchain technology can represent a positive instrument to better achieve sustainable goals and to increase the performance of the companies involved.

3. Research Methodology and Data Collection

To bridge the gap between theory and practice and to have a critical and structured overview of the proposed topic, we used the case study method [10,32–34], examining a single case as well as cases recommended by the literature [10,35–38]. A case study is appropriate for the analysis of single phenomenon against the background of their context in terms of personal, historical, and life history aspects [39].

Case studies are tailor-made for exploring new processes or behaviors or ones that are little understood [40] and thus represent an ideal methodology when a holistic, in-depth investigation is needed [41]. The strengths of case studies are related to the opportunity for researchers to obtain a holistic view of a phenomenon or a series of events, providing a well-defined snapshot of a set of sources used to conduct the analysis [42]. Another advantage of using a case study is related to the possibility of obtaining a flow of information on the organizational activity of companies, especially in sectors subject to rapid changes [40], and it allows the researcher to “go deep” to learn what works and what does not [43].

The methodology used for the implementation of our case study is based on the indications of previous studies in the literature [10,34], following the methodological approach of Yin [10], which identifies four phases to follow in defining the case study (design the case study, conduct the case study, analyze the case study evidence, and develop the conclusions and implications) and respecting a process that includes the following qualitative methods of data collection: literature review, document analysis, and qualitative interviews.

As mentioned previously, similar to prior studies [33–39], this research uses a range of qualitative data for the analysis of a single case study.

3.1. Research Protocol

To achieve the paper’s aim, the research methodology was structured in four phases [44]:

- (1) The first step was structured according to two topics: blockchain technology and sustainability. Through this phase, the link between these two themes and the need to develop further studies in empirical terms has emerged;
- (2) The second step aims to find the existing link between the selected topics and the recent scientific papers published;
- (3) During the third step, an explorative phase, information was gathered. Devoleum, an Italian start-up, was chosen as a case study. This start-up represents a decentralized solution that tracks and analyzes food supply chains using Ethereum Blockchain, AI, and IPFS;
- (4) In the fourth step, an interview was carried out by performing a content and qualitative analysis. Through the interview, the collected information was categorized in order to understand how the topics impact on business models.

The analysis was carried out by a research protocol [10] to validate the results.

3.2. The CAOS Model

As mentioned earlier, we used a single case study to analyze the blockchain process carried out by Devoleum. The collection of the information necessary to analyze the case study, in compliance with the regulations in force on the containment of infections due to the COVID-19 virus, took place through online interviews, using Google Meet software for remote virtual meetings.

To answer our research question, we used the CAOS model [11], which represents the anglicized acronym of “personal characteristics, environment, organizations, start-up” and highlights all the factors that contribute to the characterization of relationships and is

therefore effective in giving them a vision of the whole, of the reciprocal connections, and, at the same time, of existence in an independent form [11].

The CAOS model has acquired considerable importance in recent years, including at an international level. The use of this model is transversal. This is demonstrated by the work carried out on the subject of relational capital, particularly regarding the start-up phase of micro-enterprises [12]; the model was also used to investigate how relational capital is able to increase the performance of small and medium enterprises (SMEs) run by women [13]. The CAOS model makes it possible to analyze the factors that can influence the start of new activities and, in particular, the role that relational capital can play in female-run enterprises [14]. Furthermore, the CAOS model was used to conduct research on the use of “mini-bonds” to support and develop the sustainability of the agro-food sector and local products, such as pecorino cheese [45], and to analyze the link between innovation technology, relational capital, and the intangible value for the environment, focusing on the SMEs of the agro-food sector [45].

As mentioned, the CAOS model takes into consideration four elements on which it bases its conceptualization:

- (1) The entrepreneur (C), considering his personal characteristics;
- (2) The environment in which the company operates (A);
- (3) The organizational and managerial aspects (O);
- (4) The motivations behind a new business and the particular phase in which the business is observed (S).

Therefore, referring to the CAOS model [11], the determinants of the analysis are the following:

The entrepreneur (C): This concerns the personal distinctive factors of the entrepreneur, one’s ability to influence the organization, and the choices made by the company, as well as the ability to create networks and benefit from them. The elements that characterize these dimensions are the following:

- (1) Information relating to the entrepreneur or company;
- (2) Motivations behind the business;
- (3) Company objectives;
- (4) Legal status;
- (5) Implementation of the decision-making process.

The environment (A): This describes the social, economic, and cultural context in which the company operates. These elements have the ability to influence the relationships that the company creates by interacting with the subjects not only in this context, but also on the national economic system as a whole.

Organizational and managerial aspects (O): This level identifies the objectives to be achieved and the tasks and responsibilities of the entrepreneur within the company. The following are the elements to consider:

- (1) Identification of roles;
- (2) Assignments of responsibilities;
- (3) Procedures necessary to allocate tasks and responsibilities, as well as to define the procedures for executing corporate roles and actions.

The motivations behind the business and its life phase (S): This describes the initial start-up phase of the business in which the entrepreneur focuses on the following:

- (1) Study of the environment;
- (2) Writing a business plan;
- (3) Acquiring financial sources;
- (4) Choice of legal form;
- (5) Definition of the organizational structure;
- (6) Establishing the business.

The choice of the CAOS model is justified by the fact that Devoleum is in a start-up phase and, at the time of writing, it is not yet legally constituted.

3.3. Data Collection and Analysis

In order to obtain the data and ensure the validity of the construct [10], we collected the necessary information from multiple sources.

In particular, we examined the public information available from the company's official website, as well as everything that emerged from the interviews with the founders. We also collected third-party information about the company: interviews with experts not related to the organization, posts published on social media, and interviews with the founders [9,46,47]. Case study data were primarily collected between October 2020 and February 2021.

We followed a multi-stage process: we started with an initial interview with Lorenzo Zaccagnini for cognitive purposes to capture the first elements of the start-up. Subsequently, we carried out three other interviews in the presence of the co-founder Elisa Romondia. The interviews were held on the digital platform Google Meet for reasons related to the epidemiological emergency due to COVID-19, lasting an average of 90 min, and were carried out following an inductive approach, asking the interviewees open-ended questions. In this way, we were able to check and compare our initial theoretical knowledge with respect to what was explained to us by the interviewees. The overall analysis was also verified and accepted as accurate by multiple key informants at Devoleum [10].

3.4. The Model to Analyze the Case Study

The factors of the CAOS model described above are interrelated and influence each other; together they can contribute to determining the quality, quantity, and intensity of existing relationships. The following graphic (Figure 1), which is a representation of these factors [11], placed at the extremes of what the author calls "the rectangle of CAOS", illustrates the complex set of connections existing between the personal aspect (C) and the macro-company (A), corporate (O), and temporal (S) aspects of enterprises. The dashed lines represent the primary connections between the elements that distinguish the model, while the solid lines represent the secondary connections.

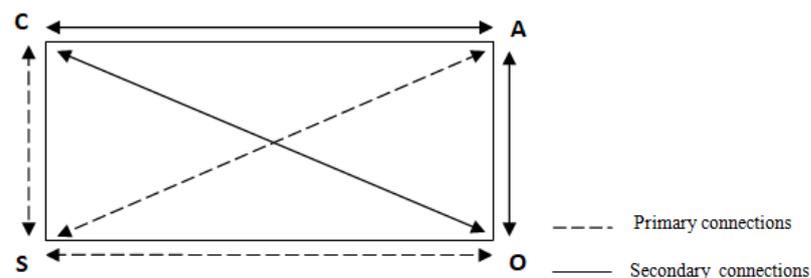


Figure 1. The CAOS rectangle. Source: adapted by [11]. The model we used to analyze the relationships in this case study can be explained by referring to the matrix proposed by Paoloni [45], which bases its analysis on four types of relationships.

The matrix is made up of the type of temporal link between the company and the variable under consideration (permanent or temporary) and the type of relationship (formal or informal).

The model, as mentioned earlier, highlights four types of relationships, as shown in Figure 2.

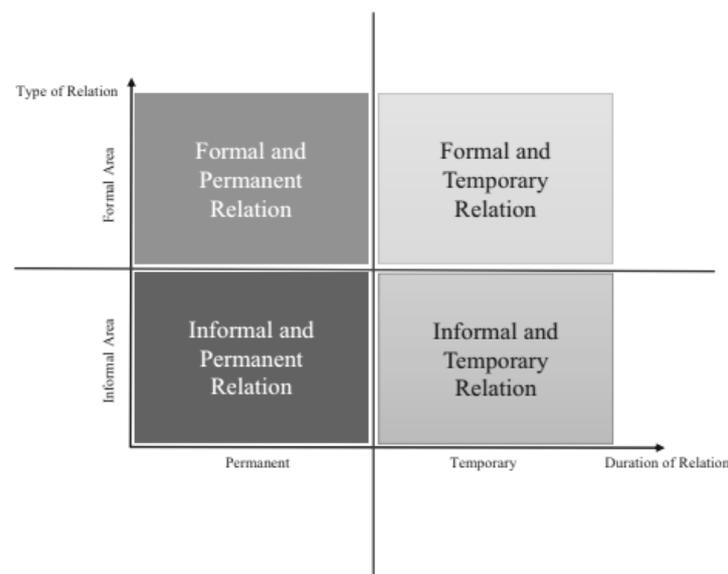


Figure 2. Type of relations in the CAOS model. Source: [45].

The CAOS model [11] subjects its four elements to rigorous analysis. Specifically, the connections that connect point S with points C, O, and A are the primary connections because they represent the focal point of all commercial relations.

As mentioned, connections are characterized by different types of relationships: formal, informal, temporary, and permanent.

Hence, the primary connections are:

- (1) First (S–C/C–S);
- (2) Second (S–O/O–S);
- (3) Third (S–A/A–S).

The first primary connections concern the initial phase of contact between the firm and the subjects necessary to start the activity; this depends on the characteristics of the company and the needs and motivations of the subjects involved. The formal relationships present in the start-up phase are, among others, all those that are established in a preliminary manner between the company and the competitive players (customers, suppliers, lenders, and stakeholders).

In particular, in Devoleum, the formal relationships present in the start-up phase are the contacts with the companies that decide to use the blockchain to declare the sustainability of the supply chain.

The second primary connections are those relationships established between the entrepreneur and the organizational structure of the business, to define the roles, tasks, and responsibilities, as well as the relationships between the various top management bodies. Such links are not yet defined in Devoleum as it is not yet incorporated as a company and, therefore, will be formalized within the structure only after the company has been incorporated.

The third primary connections during the start-up phase concern the company and the environment in which it operates. These relationships are exogenous with respect to the firm (as they derive from the outside), and the environment represents the beating heart of the relational circuit. Relations with the environment represent the heart of the relational circuit, as the business idea of Devoleum is based on the willingness of companies to certify the sustainability of the supply chain through the blockchain.

4. The Case Study

Devoleum is an open-source web app that transforms data from physical or digital supply chains into living and authentic stories.

To describe the case in the following subsection, an exploratory and descriptive approach was utilized [45].

4.1. *The Entrepreneur (C)*

Devoleum is a start-up in the process of being established, which represents a decentralized solution that tracks and analyze food supply chains using Ethereum Blockchain, AI, and IPFS. It organizes data from physical or digital supply chains into meaningful stories, making each step immutable on blockchain or other distributed systems. Furthermore, Devoleum automatically creates a product storytelling, easily accessible from any device, simply by scanning a smart tag, and is an open-source project, free and open to all.

Although the legal form has not yet been defined, the owners have already started some non-profit collaborations with three different companies operating in the Italian territory to make their product offer known and increase their network of acquaintances.

The company has two co-founding partners, Lorenzo Zaccagnini and Elisa Romondia, both graduates in psychology. Their idea comes from their previous experience in the psychological field through a remote security application known as “Dammi la mano”, which uses a special algorithm capable of tracking the position of a user with maximum precision, allowing the caregiver to provide assistance in real time. That idea gave birth to the Devoleum project as the founders have preserved the added value of traceability, moving from “people” to companies. In particular, Devoleum tracks the supply chain of companies without sector constraints.

4.2. *The Environment (A)*

Devoleum is potentially open to the international market. The business idea was awarded at the “Station F” in Paris and, in this start-up phase, it invested in advertising through the main social networks. At the time of writing, Devoleum has shaped three different experiments to track the sustainability of the supply chain through the blockchain of companies operating in the agri-food sector. The choice of the agri-food sector is motivated by the fact that it is a sector in which the consumer is particularly sensitive to sustainability disclosure [48,49].

In particular, Devoleum deals with managing the blockchain of three different companies:

- (1) Coltivatori di Emozioni e Cascina Bosco Fornasara, a company specializing in the cultivation and sale of “Carnaroli Classico” rice, with headquarters in the province of Pavia;
- (2) Inserrata, a farm specialized in the production of olive oil and organic wines, located in the Tuscany region;
- (3) MonteFedele, a farm operating in southern Italy, in Puglia, specializing in the production of extra virgin olive oil in the territories of the Apulian Monti Dauni.

4.3. *Organizational and Managerial Aspects (O)*

From our interview, it emerged that the start-up Devoleum, not yet duly registered in the register of companies, is in an organizational and managerial stalemate.

One of the two founders expressed some doubts from an organizational point of view, especially in the choice of external professional elements necessary to start the business, including an accountant. According to the owners, in Italy, the blockchain is still known at an extremely superficial level, and even the skills and knowledge required of specialized subjects seem to be scarce and not detailed.

Furthermore, due to the fact that the company does not yet have its own company name, as its legal form has not yet been defined, it operates with unpaid collaborations. If, on the one hand, collaboration with companies is a driving force for business from the point of view of the creation of the network at a national and international level, on the other hand this situation of stagnation does not allow the possibility of making structural investments to grow and expand the company and its business proposal.

Beyond these dynamics, which could be resolved in the coming months, the company operates through Ethereum, the reference blockchain for the creation of smart contracts.

According to previous studies [1], smart contracts increase trust among the subjects who decide to sign them, promote transparency, and, consequently, reduce transaction costs and increase the social proof effect. The reduction in transaction costs occurs through the traceability of the supply chain. As the founder Zaccagnini himself expressed it, “the basic idea is that all stages of the production process are traceable through smart contracts, which are transparent, public but impossible to manipulate. At the same time, Devoleum protects its users with a privacy-oriented design. Devoleum, through the notarization of anonymous cryptographic codes on the blockchain, gives authenticity to the supply chain”.

According to this perspective, it has been observed that smart contracts allow better coordination between the different activities, generating a new way of doing business and eliminating intermediaries, so that this direct mechanism can improve the traceability and transparency of transactions, enhancing the trust between the parties [29,50–53].

One of the main reasons that pushes companies to adopt the blockchain is the desire to trace the phases of the production process in order to attract consensus. From this perspective, the blockchain can be considered a “sustainability disclosure”.

The participants (the nodes of the blockchain) verify the accuracy of the information reported, then the digital agreement becomes part of a block. In this way, through the cryptographic proof that refers to the passage of the supply chain, the signature becomes immutable and cannot be manipulated, which allows Devoleum and the customer greater control and transparency.

The data of the passage are given by the company’s customers, who assume civil and criminal responsibility for false declarations on the quality, origin, and authenticity of the product.

4.4. The Motivation behind the Business and Its Life Phase (S)

This section explains the reasons behind the business and what the advantages may be from the activity carried out by Devoleum in its start-up phase.

As mentioned previously in Section 4.1, Devoleum organizes data from physical or digital supply chains into meaningful stories, making each step immutable on the blockchain or other distributed systems.

In practice, Devoleum does not track the product itself, but the data of the supply chain that are provided by the companies on a specific product; in this way, through a standardized data format, comparisons and an automated service can be obtained. The data of the supply chain are provided directly by the client companies.

Devoleum, through a pyramidal structure, organizes the data in chronological order and with different degrees of detail, tracing every single step of the supply chain that the product has followed, as shown in Figure 3.

In particular, the base of the pyramid shows the elements relating to the tracking of the inputs used for the creation of the product, the starting date of the manufacturing process, and the specific technical/qualitative characteristics that the product must respect. Going upwards, in the second section of the pyramid, the elements relating to the place of processing of the product, the quantities processed, the processing method, and place of departure of the product are traced. The penultimate block of the pyramid specifies which product was made, as well as the mode of transport and the place of delivery. Finally, at the top of the pyramid, the price of the product is traced and a code is assigned to it in order to make it easy and fast to track the product through time and space.

From our interview, it emerged that the company’s business model is based on what is called in the jargon “notarization”: through this procedure, Devoleum is able to notarize the individual steps of the supply chain of a given product by inserting cryptographic evidence of each step that cannot be changed or manipulated. Every single notarized passage has a cost for the company’s clients, and it is therefore on this mechanism that Devoleum will be able to keep itself alive and expand both economically and geographically.

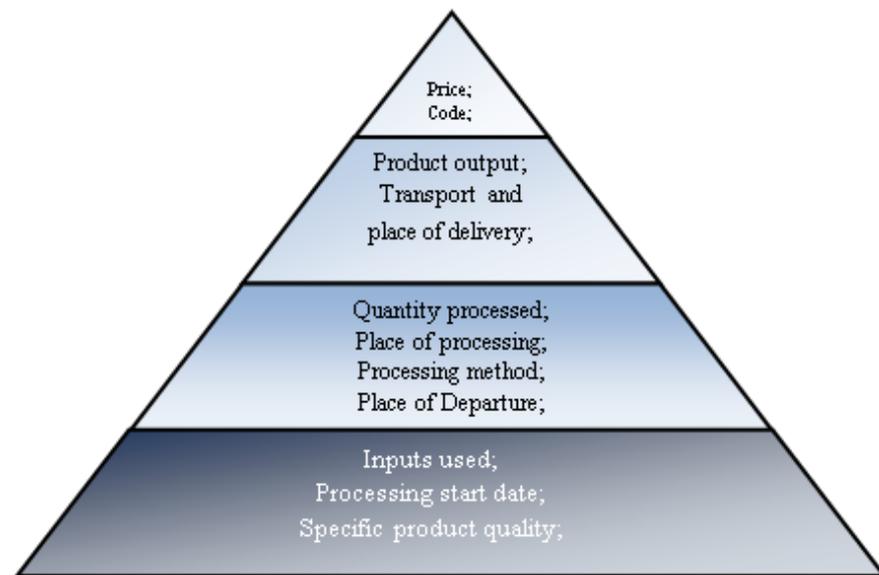


Figure 3. Pyramidal organization of Devoleum's blockchain tracking. Source(s): authors.

The reasons behind this systematic organization of the supply chain, as well as its traceability, lie in the need of companies to have a decentralized system to transparently show their products to their customers, who are increasingly attentive to the traceability of the supply chain and increasingly skeptical with regard to the authenticity of the products placed on the market. The lack of confidence felt by consumers in companies, especially those in the agro-food sector, favors the development of the entrepreneurial idea of Devoleum, which is broadening its horizons and intends to direct its offer not only towards the agri-food sector, but also towards highly technological sectors and the field of rights to musical works.

4.5. Analysis of the Relations

In the developed CAOS model, the relationships to Devoleum are shown in Figure 4:

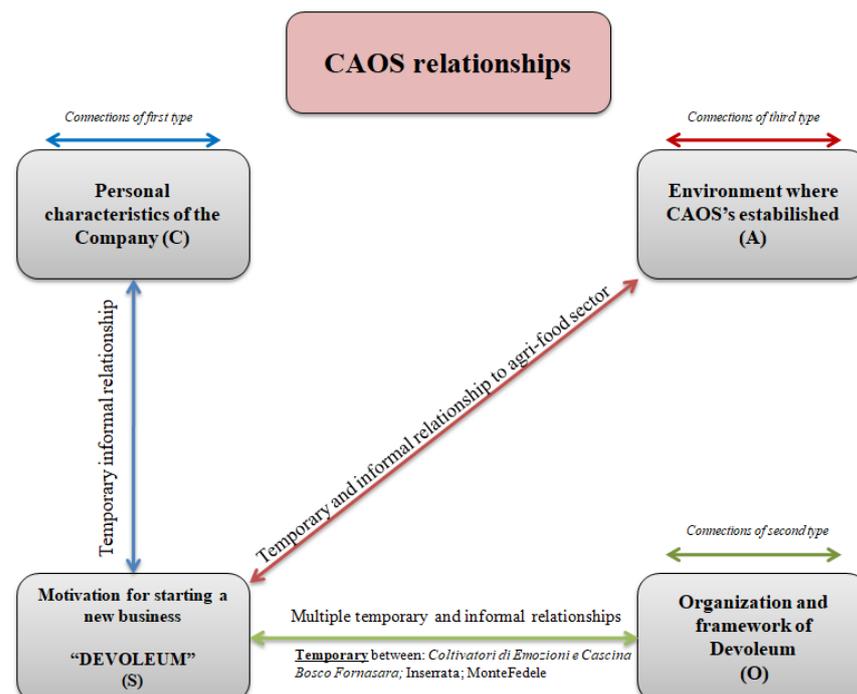


Figure 4. CAOS relationships of Devoleum. Source(s): adapted by [45].

- (1) First primary connections (S–C): This phase is characterized by informal and temporary relationships. At the time of writing, as the company has not yet been formally established, the S–C relationship is limited to the natural persons of the two founding partners, Lorenzo Zaccagnini and Elisa Romondia.
- (2) Second primary connections (S–O): This phase is characterized by multiple informal and temporary relationships, which could develop into formal and permanent relationships after the company is registered in the commercial register. Devoleum operates only through free trials and collaborations with partners not bound by a contract in order to establish a formal and permanent relationship. At the time of writing, there are three experiments that Devoleum has put in place:
 - (1) Between Devoleum and *Coltivatori di Emozioni e Cascina Bosco Fornasara*;
 - (2) Between Devoleum and *Inserrata*;
 - (3) Between Devoleum and *MonteFedele*.

However, all three companies benefit from contracts on the Ethereum blockchain. For example, the *Carnaroli Classico 2019* supply chain has notarized the following steps: tillage (highlighting the low use of pesticides), the sowing of the grass, the type of seeds (certified), the dry rooting, the harvest, the drying, storage, processing, packaging, and finally, the warehouse.

- (3) Third primary connections (S–A): This phase is characterized by informal and permanent relationships. The link between Devoleum and the environment in which the start-up operates is, at the moment, the agri-food sector (rice, oil, and wine) which represents one of those sectors in which the traceability of the production chain is a driving force for the business, especially from the point of view of transparency and reliability of the quality and authenticity of the products. Devoleum and the client companies involved have not yet entered into formal contracts, but, without a doubt, the agri-food sector in which the company wants to operate in the future represents an important value driver on which to focus to develop the business idea and expand it towards new horizons in order to promote sustainability through the reduction of transaction costs.

5. Discussion

Empirical analysis highlights the link between innovative technology (blockchain) and sustainability. The purpose of this study was to explain how the blockchain can lead the development of sustainable business models. The findings of the literature review indicates that blockchain technology has the potential to create new foundations for an economic and social system and sustainable business models. Our results are in line with previous studies; in fact, this paper confirms how the adoption of blockchain technology in Devoleum leads to a reduction in transactional costs.

The adoption of this technology improves the consolidation of customer trust and thus generates a leverage effect on relational capital.

The results of our research are in line with previous studies relating to the relationship between the use of blockchain in the supply chain and the reduction in transaction costs [1,15,29,50–52,54,55]. According to [56], “technologies based on the blockchain architecture has a potential to revolutionize transaction costs, both in terms of cost and convenience”.

Devoleum, by tracing all the phases of the production process through smart contracts, allows the reduction of transaction costs, since the transparency of the elements contained in the smart contract is combined with the impossibility of manipulating data by external parties, and, consequently, it eliminates intermediaries from the supply chain. The smart contract is seen as a key factor in strengthening trust between the company and its customers, making behavior transparent and consequently reducing transaction costs. In this way, smart contracts permit the automation of the process, avoiding the need to control the agreement’s execution affecting internal and external transaction costs simultaneously, thus leading to the reshaping of a company’s boundaries [1].

Through the notarization of anonymous cryptographic codes on the blockchain, the authenticity of the supply chain is favored in such a way as to attract the consent of end consumers. The blockchain, therefore, shortens the time for consolidating relationships.

According to the CAOS model [11], which shows the relationship between parties, the relationship between variables A and S should be considered the strongest since the agri-food sector represents one of those sectors where the traceability of the production chain is seen as a key element to obtain a competitive advantage both from the point of view of the reduction of transaction costs and strengthening stakeholder confidence in the company.

If this relationship did not exist, the other two existing relationships, specifically S–O and S–C, would have no reason to exist, since the pivotal element on which the entire supply chain tracking process is based would be missing.

6. Conclusions and Future Research

Our work was inspired by research contributions focused on the impact of emerging technologies on the sustainability of business models. Following this setting, we analyzed with the case study method an Italian company (in the start-up phase at the time of writing) that uses the blockchain tool to promote the traceability of all the process phases. In particular, our results have shown that tracking all the phases of the production process with the blockchain guarantees transparency, as the data are not editable. Still, our results point out that the use of the blockchain reduces the information asymmetry of stakeholders and also reduces transaction costs. The information transparency obtained with the use of the blockchain becomes a strategic element to consolidate company–customer and company–stakeholder relations and to create durable value over time.

In the agri-food sector, in particular, there is a need for traceability, and a new sustainable business model can be fostered and developed with new technologies. Our contribution demonstrated how blockchain technology can lead to a driving force of sustainability through the traceability, security, and non-manipulability of notarized information.

Furthermore, the absence of intermediaries helps to reduce transaction costs and reduces the time needed to consolidate S–A (Start-up–Environment) relationships. In particular, traceability and safety can be particularly useful in the agri-food sector.

Like any study, this paper has some limitations. First, we considered a company that is not yet established but is only an embryonic idea. Additionally, we should remember what Yin [10] says: “case studies like experiments are generalizable to theoretical proposition and not to populations or universes.”

This study emphasizes the importance of following multiple recent calls for increased research efforts towards a better understanding of the role of the new technology of the fourth industrial revolution on the sustainability of organizations, as stated in the Introduction. Future research must analyze how, in a practical way, the blockchain may enhance the development of sustainable business models in more detail.

In particular, it is recognized that blockchain studies have to be implemented through empirical methods, even within the intellectual capital framework. This is because blockchain technology application increases customer trust, reducing transactional costs through the traceability, security, and non-manipulability of information, which are particularly useful in the agri-food sector.

Future investigations should be implemented once Devoleum is fully established.

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