Blockchain in a Business Model: Exploring Benefits and Risks

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Abstract. Although a blockchain has the potential to redefine value creation, delivery and capture activities in organisations, research on business model innovation from a blockchain perspective is still developing. This paper provides an analysis of literature on the use of blockchain in business model innovation. This analysis reconciles the technological and management perspectives to explore blockchain technology characteristics in relation to benefits and risks for business models. The findings contribute to the emerging stream of research discussing the business implications of innovative technologies, describing how blockchain networks can have an impact on business processes.

Keywords: Blockchain · Business model innovation · Digital transformation

1 Introduction

A business model is the logic of doing business and a firm's activities directed at creating competitive advantage and improving company offerings to deliver value for all stakeholders involved [1]. Firms digitalise their business models to improve business competitiveness in the realities of the dynamic market, technological innovations and changing customer needs [2]. One of the technological innovations that has disrupted the way of doing business is the 'blockchain' [3]. This is a distributed ledger technology that records and stores digital data in blocks across multiple locations in the network connected via cryptography, thus ensuring the immutability of records [4, 5]. Originally used in the financial sector, nowadays the blockchain has found an application in a wide range of digital data transactions across multiple industries.

The literature on business model innovation and blockchains is under-researched. There are a few studies that have examined the impact of blockchains in creating strategic capabilities, without an explicit exploration of the role of technology characteristics in value creation, delivery and capture, though [7]. Also, the papers exploring the role of

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blockchains in firms' value chains discussed only the positive effects of the technology on firms' performance (Chong et al. 2019; Morkunas et al. 2019; Schlecht et al. 2021). Consequently, the research has paid no attention to technology functions that potentially lower business value.

To fill the gaps in research, this study pursues two objectives. First, the paper examines different types of blockchain and the technical characteristics. We analyse the literature to understand how open, closed and consortium blockchain networks differ by the degree of control, data validation mechanisms, participants' access to data and operational complexity. Second, the paper draws on prior literature in the domain of business model innovation to analyse the role of blockchain technical characteristics in companies' value chains. We discuss how data access and validation mechanisms, the degree of operational complexity and control can be beneficial and risky for companies' value chains. Benefits and risks are mapped and explained in relation to the stages of business model innovation, namely, value creation, delivery and capture.

2 Business Model Innovation: A Blockchain Perspective

2.1 Business Model Innovation

A business model defines the logic of a firm by articulating the methods of value creation and delivery, and outlining associated costs and revenues [11]. For any company to grow in the market, a business model needs to be under constant improvement to generate a new value [12]. The transformation of the business model concerns value creation, value delivery and value capture functions [13, 14]. Value creation is rooted in resources/capabilities, technology, partnership networks and activities, representing sources of competitive advantage [13]. The value delivery function defines the ways in which offerings are delivered to customers [1]. It includes the modelling of company offerings, identifying customer segments/markets, customer relationships and promotion channels [13, 14]. Value capture concerns the activities that are directed at ensuring the company's long-term development [13, 14]. Firms may innovate the value capturing mechanism by adjusting revenue generation schemes and cost structures [13, 14].

The changes in value creation, delivery and capture can reflect the introduction of new activities, a new structure and/or a new form of governance of company activities. These changes result in the creation of novel customer experiences and offerings or lead to operational improvements captured by four value drivers, namely novelty, lock-in, complementarity and efficiency. Novelty captures the degree of innovation introduced to activities. Lock-in refers to the value-added and bundled to an existing offering, which increases switching costs. Complementarity relates to a value-enhancing added offering. Efficiency refers to cost-savings realised by interrelating activities [47].

2.2 Blockchain

The adoption of the blockchain in organisations could potentially drive business model innovation by bringing new value creation, delivery and capture mechanisms. A blockchain is defined as *"a technology which made possible to build an immutable,* *distributed, always available, secure and publicly assessable repository of data (ledgers), which relies on a distributed consensus protocol to manage this repository (e.g., to decide what valid new data to include) in a distributed manner"* [15]. Technically, a blockchain is not a single technology, but rather a protocol operated on a distribution ledger [16, 17]. The distribution system works as a *data validation mechanism,* making data exchange secure and trustable. Data is inscribed into blocks that are stored on the computers of all actors of the network. The blocks are cryptographically protected, making data difficult to tamper with. The inclusion of a new piece of data is controlled by the consensus mechanism [18], while the implementation of the rules of transactions are controlled by smart contracts [19]. A smart contract is triggered automatically when the conditions of negotiations are met, thus eliminating the need for a trusted intermediary to oversee a transaction [19]. Although it is suggested that technology can offer a novel service and an efficient and reliable channel of data exchange [8, 9], it can cause privacy, scalability and interoperability challenges [20]. Such risks could potentially undermine the success of business model innovation.

There are public, private and consortium blockchains, that differentiated by the degree of *data accessibility*, *decentralised control* and *operational complexity* they provide [9, 16]. A public blockchain does not restrict access to data, as the participation in the network is free for all actors [16]. The fact that all parties can see transactions makes it the subject of privacy concerns [9]. Since records are duplicated for a large number of participants, it is almost impossible to alter data, which is more secure. Public blockchain services are completely decentralised and uncontrollable by any party [17]. Given that an open blockchain is larger because of the number of actors, it requires more computational power and complex mechanisms to keep data secure [9, 17]. Private and consortium blockchains are similar in terms of the conditions of participation in transactions [17]. The participation is based on permission, which means that the details of transactions are accessible for reading and validation only by the participants of the network [16]. The networks are smaller, which implies some risk of data tampering, although they are easier to operate and produce greater throughput (the frequency of transactions per second) [9, 17]. When it comes to the degree of decentralisation, a private blockchain is controlled by a group, while a consortium one is partially centralised [17].

The three types of blockchain have inherent benefits and risks for the company value chain, stemming from their technical characteristics (data validation, data accessibility, operational efficiency and decentralised control) (Table 1). A blockchain can create value by facilitating collaborations and controlling value, deliver value by maximising network effects, and capture value by enabling cost efficiencies. The deployment of a blockchain can also destroy value by making transactions inflexible and undermining privacy, creating scalability challenges and incurring additional costs. The following sections will provide a detailed discussion of the technical characteristics of public, consortium and private blockchain technologies, resulting in benefits and risks for business model innovation.

Table 1. Blockchain characteristics in relation to benefits & risks for business model innovation.

Value chain stage	Benefits and risks for BMI	Public blockchain	Consortium blockchain	Private blockchain
		Permission-less access, validation mechanism, lack of control, decentralised, high complexity	Permissioned access, validation mechanism, some degree of control, partially decentralised, medium complexity	Permissioned access, validation mechanism, high degree of control, centralised, low complexity
Value creation	Trustable collaboration Inflexible collaboration	X	X	
		X	X	
	Controlled value Privacy issue		X	X
		X		
Value delivery	Network Effect Scalability Challenge	X		
		X		
Value capture	Cost Efficiency Increased Investment		X	X
		X		

3 Value Creation, Delivery and Capture: A Blockchain Perspective

3.1 Value Creation

Trustable Collaboration – Inflexible Transactions: Blockchain technology can enable the development of a platform facilitating collaborative interaction, affecting the company's value chain. *Trustable collaboration* is an important asset for value creation as it ensures the development of ideas and the co-creation of value by horizontally integrating company stakeholders [16, 21, 22]. Collaboration between stakeholders serves as a strategic success factor for the creation of novel solutions [23]. Stakeholders receive the ability to control the development of value offerings by leveraging the potential of the blockchain system to maintain the free exchange of ideas [22]. For trustable collaborations blockchain platforms should offer strong data validity and high data accessibility [8, 16, 24]. Data validity is provided by the blockchain system and smart contracts ensuring that data records are immutable, and transactions are trust-free and disintermediated. The trust-free disintermediation mechanism guarantees that stakeholders receive verified data, which the value offering must be based upon [16]. Since a smart contract is a self-enforced mechanism, which functions based on pre-defined rules, it automates the value transfer among each stakeholder of the blockchain network [25]. The smart contract contributes to collaborative activity by processing data in such a way as to achieve pre-defined and targeted consequences, thus ensuring the accuracy of the end result [26]. This mechanism enforces the fulfilment of contractual obligations and helps determine rewards or inflict a penalty for the breach of the transaction's conditions [22]. The second determinant of trustable collaborations is high data accessibility. The transaction data, which is recorded and synchronised at every node in the system and which is validated by consensus mechanisms, is accessible by every member of the network [10]. The accessibility of data makes the blockchain a useful value-creation tool. The history of transactions can be accessed and traced at any point in time [8]. This enables companies to control the supply chain, check the quality of products and services and use the data for creating future product development scenarios [8, 24]. Technically, trustable collaborations endure in open or consortium blockchain networks, as they are more inclusive in terms of the number of stakeholders [9, 21]. While an open blockchain can be more challenging to manage, consortium networks facilitate inter-organizational collaboration and the development of a business ecosystem, aiding the implementation of common business tasks [21].

The data accessibility and validity offered by the blockchain has a value destructive consequence too, due to the *inflexible nature of transactions*. The data validation mechanism implies the irreversibility of records, which adds rigidity and inflexibility, eliminating the possibility of ad-hoc experimentation. If transactions have been processed erroneously, a distributed system of storing and recording data does not make it possible to retrieve the data [27]. The deployment of smart contracts is bound to the programming code. Therefore, changes that were not predicted and factors that were not considered cannot be handled during data transactions [28]. Therefore, owing to the irreversibility of the records, once commenced the transaction proceeds without functionalities, which could be crucial for outcome accuracy [7]. Such technical functions are useful for hypothesis-driven experimentation, whereby the technology is tested for different business scenarios and applications [29]. However, they are not favourable for unexpected discoveries through trial and error and the influx of new ideas [30]. Inflexibility of transactions reduces the possibility of the exploration of new routes for business development and the innovation of firms' offerings [7]. To decrease the immutability of data, companies may deploy private blockchains, which, due to the relatively lower number of nodes, provides the possibility to edit records [17].

Controlled Value – Privacy: The adoption of a blockchain can create a trade-off between *controlling value* by compromising on actors' privacy and ensuring greater *privacy* by loosening the control over transactions. The control of value represents the activities that companies direct at tracing the use of services and goods to identify the degree to which the quality is met and determine customer preferences to customise offerings [16, 32]. Such an activity makes customers the co-creators of value, as insights driven from their transactional data (i.e. big data) give an opportunity for companies to improve products or services and provide value-added complementary offerings [33]. Customisations creates lock-in effects (the motivation to participate in repeated transactions), maximises customer loyalty and increases switching costs [34, 35]. It does not radically change the offering, but rather enhances the value of the product [36]. Also, disintermediated interaction between customers and firms increases customers' trust in companies, which positively affects the customer journey [37]. Value control through customisation and quality management is contingent on data accessibility, data validity and centralised control. The customer's approval to access data is possible when customers build trust toward the company and confidence that the data will not be misused [16]. Trustable relations between the company and customers are fostered by the mechanisms of verifying and authorising the data supplied by different actors in the system [17]. To obtain information and create added-value service, companies dynamically access data by being assured that the data stored in the system is correct [16]. Technically, the ability to control value is inherent to closed or consortium blockchain networks, where access is based on permission and the central entity has the right to fully or partially control the operation of the system and the transactions carried out [17, 32]. A closed blockchain owing to the limited number of actors offers better traceability, which, consequently, simplifies the process of managing and analysing records [32].

Even though the control of data by the third party and data accessibility provide a variety of ways to add value, they create *privacy* concerns and the risk of unauthorised data usage [10]. Privacy is an important aspect to consider for value creation. Companies should not only be concerned about business model innovation for a new product or service creation. They also need to consider the value that business stands for from the social perspective, such as health and safety [38]. Therefore, by sharing control over personal data, customers experience a risk undermining the value of firms' offering. Although privacy risk is inherent to all types of blockchains, it increases when the technology is deployed for public networks. In such scenarios, the entry into the network is permission-less, which provides more favourable conditions for unauthorised activities [5]. Privacy measures, such as the implementation of proof-of-costs, proof-of-stake and proof-of-space mechanisms, create barriers for malicious intrusion, although they massively increase the complexity of the system and resources for deploying these mechanisms [4, 39]. In contrast, private and consortium blockchain-based networks are more selective and exclusive. The identities are known for other actors in the group, as members are pre-validated. The decision to admit new members into the groups is laid on either the group authority or the existing member of the network. The closed nature of transactions increases privacy [9]. However, when it comes to the control over data, public blockchains have a decentralised application layer, which reduces the involvement of firms in the supervision and control of transactions [17].

3.2 Value Delivery

Network Effects – Scalability Challenge: *Network effect* is an intrinsic capability of the blockchain, revolutionising the way in which people exchange digital and physical goods and services [40]. Network effects have become possible primarily due to the disintermediated system of blockchains, leading to the integration of all actors in the platform [41]. It is a feature that enables efficient value delivery by accelerating activities among actors, leading to the extension of the network scope in the long term. That is why the stimulation of a positive network effect is so important for catalysing sales through new channels [42]. The utilisation of a blockchain in crowdfunding has become a powerful tool for creating network effects by establishing connections between potential investors. By leveraging on technical features that enable trust-free, transparent and secure transactions, the technology helps eliminate bureaucratic procedures and establish direct channels of communication and value delivery with organisations' stakeholders [30]. High data accessibility and decentralised control are important for achieving a positive network effect. The more people adopt the technology, the more widely the system becomes adopted [40]. Given that for the creation and delivery of value a sufficient diffusion of the blockchain is needed, the technical precondition for this capability is to deploy a public blockchain. The permission-less nature of participation drives the growth of the network, while it remains decentralised [40].

On the other hand, an open blockchain creates *scalability issues*. Scalability concerns the limit to the number of transactions per second that can be managed through blockchain platforms [43]. To ensure data validity, the decentralised system requires data to be stored and processed at multiple locations and replicated across the network to keep the nodes updated. These system characteristics increase the reliability of the data, although they add enormous operational complexity. The complexity causes a delay in transactions and transaction throughput [5]. The challenge to address data validity, decentralised control and scalability has been coined the scalability trilemma. The trilemma indicates the difficulty of addressing all three aspects and the need to prioritise any two of the three capabilities. In a permission-less blockchain, a relatively higher number of decentralised transactions affect the size of a block and the interval between blocks' creation, thus decreasing the frequency of transactions per second [43]. Consequently, public blockchain offers decentralised control and security, which is the precondition of the network effect, while compromising on scalability [44]. The seriousness of the scalability challenge for the business depends on the sectors and the area of application. It is not usable for markets, where delays in transactions can cause serious value delivery disruptions and undermine competitive advantage [5].

3.3 Value Capture

Cost Efficiency – Increased Investments: Due to its distributed consensus algorithms, the blockchain has been considered to hold business value as it makes it possible to restructure revenue - cost scheme to ensure value capture [17]. *Cost efficiency* is achieved in three ways. First, data access and validation reduce the transaction costs on the coordination of activities, tracing data and the integration of resources [19]. For example, in the finance sector, blockchain deployment can reduce costs that firms spend on manual processes, search and the negotiation of deals, which do not add business value to the firm. In total, the innovation of infrastructure in the finance industry is expected to bring up to 20 billion US dollars worth of savings [9]. In real estate, the technology authenticates the documentation for facilitating the transaction of ownership transfer from a seller to a buyer. Such transactions are carried out without notary intermediary, thus eliminating the associated costs for their service, which are often expensive [9]. This is enabled by the distributed system of data recording and storage at multiple locations in the network and among all nodes of the transaction through the copies of a ledger. Put differently, the disintermediation and the removal of associated labour costs decrease the time spent on verifying and accessing data, optimising transactions and decreasing the cost of product supply [6, 19]. Second, the firms whose transactions are operated based on a blockchain protocol benefit from decreased security and financial fraud risks due to the immutability of transactions [6]. Third, the disintermediated exchange requires less power consumption for a consumer due to the cut of around 20% of the price, which is usually added by a middleman. Consequently, the reduction in costs affects other firms' pricing models, thus leading to the refinement of cost structures across the energy market [45].

The utilisation of a blockchain may require *increased investments* to develop and maintain the network for digital transactions. Companies will most likely encounter the need to increase spending if they deploy a public blockchain. There are two main reasons that determine the negative effect of a public blockchain on value capture. First, overhead costs increase when a blockchain is deployed for public networks promoting anonymous participation. Since the entry into the network does not require authorisation [5, 30], firms need to invest financial resources and effort to increase the operational complexity associated with the utilisation of proof-of-costs, proof-of-stake and proof-of-space mechanisms [4, 5]. These mechanisms make the creation of new blocks of data costly, thus discouraging nodes (i.e. members) from disseminating corrupted information and eliminating the risk of Sybil attacks (cyber-attacks through the creation of a large number of anonymous and deceiving identities) [46]. Second, given the standardisation challenge, different blockchain architectures require investment to increase the interoperability and standardisation of systems to ensure seamless integration and operation [9].

4 Discussion of Implications for Business Model Innovation

The analysis of the literature made it possible to identify four groups of benefits and risks conducive to value creation, delivery and capture. As far as value creation is concerned, a blockchain can facilitate a trustable collaboration, which is possible by adopting open or consortium blockchain networks. These networks are characterised by strong data validation mechanisms and a higher degree of user access to data. The rigidity of the data validation in the public blockchain also implies the inflexibility of transactions and limited possibility of ad-hoc experimentation, which reduce the efficiency of collaboration. The second benefit in the value creation process is the possibility to control value offerings. This benefit is inherent to private or consortium blockchains, which have centralised or partially decentralised control and a higher possibility to trace data. At the same time, the control over transactions raises a privacy risk, which is stronger when adopting a public blockchain. Blockchain can facilitate value delivery through network effects. Such effects are realised through the decentralised control of transactions and permission-less access to data in public blockchain infrastructure. On the other hand, the increase in the load of the network decreases system capacity. Therefore, to address scalability issues, private or consortium blockchains could be more favourable. When it comes to value capture, the adoption of a blockchain impacts firms' cost-revenue scheme. The deployment of a private and consortium blockchain redefines transactional cost structures by introducing a disintermediated data validation mechanism and decentralised control. However, if organisations utilise an open blockchain, unlimited access to the network and operational complexity can result in higher spending on the system's deployment and maintenance.

From the business model innovation perspective, any benefits stemming from the adoption of a blockchain represent the introduction of new company activities, the change of the sequence or the structure of existing activities or new governance of activities. A blockchain enables companies to innovate business models by restructuring their existing activities in such a way as to remove an intermediary and make data traceable and accessible upon customers' request [8, 16, 24]. Through collaborations, disintermediation and traceability improve the efficiency of data exchange between stakeholders. Trust-free collaboration can also create complementary services for customers by offering transparency in transaction data [21, 24]. Network effects stimulated by disintermediation can improve efficiency by extending stakeholders' scope and catalysing sales through new channels [41, 42].

A blockchain facilitates business model innovation through the introduction of new activities for creating new markets. This strategy can be used for the launch of a new service, as a result of the company service portfolio diversification. Such a scenario is possible when a company that has been using direct offline channels redefines the business model by digitalising business processes. For example, the value of crowdfunding services based on the blockchain infrastructure is their potential to create network effects by establishing connections between investors and customers [30]. Similarly, Bitcoin was a novel service which partly gained its popularity due to the network effect [48].

Business model innovation through the introduction of new governance is underpinned by the ability of blockchain networks to grant companies control over transactions and save costs. Since a blockchain gives the opportunity to oversee data exchange, companies can take the role of a controller of value for customising and improving their offerings. Such activities make it possible to design value-added complementary services, which can create a lock-in effect (the motivation to participate in repeated transactions) [34]. Cost-efficiency enabled by a blockchain can have a complementary value, when revenues are secured not from the reduction of transaction costs, but from a new form of governance of the infrastructure. Given that the use of a blockchain reduces the risk of frauds and incurred financial losses [6], firms can market their services by promoting associated security features.

Table 2 presents the BMI design elements and value drivers, associated with the benefits of the private, consortium and public blockchain.

Table 2. Business Model Innovation enabled by a blockchain

Design elements of BMI	Blockchain benefits	Value drivers
New structure	Trustable collaborations	Efficiency, complementarity
	Network effects	Efficiency
	Cost-efficiency	Efficiency
New activities	Network effects	Novelty

(*continued*)

Table 2. (*continued*)

Design elements of BMI	Blockchain benefits	Value drivers
New governance	Value control	Lock-in, complementarity
	Cost-efficiency	Complementarity

5 Conclusion and Future Research

This paper aimed to address the gap in the literature on business model innovation, concerning the lack of understanding about the benefits and risks created by the utilisation of blockchains in business processes. First, we analysed the literature and identified the characteristics of the technology inherent to the public, consortium and private blockchain. The three types of blockchain differ by the varying degree of accessibility to data, decentralised control and operational complexity. The findings of such an analysis contribute to the literature by identifying differentiating factors in assessing the advantages and limitations of the technology. Secondly, drawing on the prior literature in the domain of business model innovation, we analysed the benefits and risks that technical characteristics of different blockchain networks create in the company value chain. The paper provides an understanding of the conditions for successful business model innovation and discusses the design elements of business model innovation rooted in blockchain benefits.

A direction for future research concerns the empirical validation of the findings of the present study. Scholars need to use methodologies to draw primary insights into the role of the different types of blockchain and their technical characteristics in the company value chain. In regard to value creation, a case study approach can be used to examine the degree to which permissioned and permission-less blockchains facilitate or hinder efficient collaborations between parties. To confirm the benefit of the traceability of customer preferences, future research needs to examine the impact on profits over time before and after blockchain utilisation. In terms of value delivery, scholars need to focus on negative implications that both permission-less and permissioned blockchain architectures have for ensuring interoperability between organisations and efficient business ecosystem. Finally, to progress research on the role of blockchain in value capture, more research is needed for developing systems addressing standardisation, security and interoperability challenges that negatively affect firms' revenues.

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