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How blockchain technologies impact your business model

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Abstract Much of the attention surrounding blockchain today is focused on financial services, with very little discussion about nonfinancial services firms and how blockchain technology may affect organizations, their business models, and how they create and deliver value. In addition, some confusion remains between the blockchain (with definite article) and blockchain (no article), distributed ledger technologies, and their applications. Our article offers a primer on blockchain technology aimed at general managers and executives. The key contributions of this article lie in providing an explanation of blockchain, including how a blockchain transaction works and a clarification of terms, and outlining different types of blockchain technologies. We also discuss how different types of blockchain impact business models. Building on the well-established business model framework by Osterwalder and Pigneur, we outline the effect that blockchain technologies can have on each element of the business model, along with illustrations from firms developing blockchain technology.

1. Blockchain beyond bitcoin

Emerging technologies regularly serve as enabling forces for economic, social, and business transformation (Cohen & Amorós, 2014; Paschen, Kietzmann, & Kietzmann, in press). According to the *Gartner* Hype Cycle for Emerging Technologies, a tool to illustrate the maturity and adoption of specific technologies, blockchain placed among the top five technology trends in 2018 (Kietzmann, 2019; Panetta, 2018). Much of the attention on blockchain today has focused on its ability to change the financial services industry fundamentally. But the impact of blockchain technology goes beyond

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the financial sector (Hughes, Park, Archer-Brown, & Kietzmann, 2019) and encompasses any business that acts as or relies on an intermediary between two parties—for example, a buyer and a seller—and extracts economic rents from a brokerage position in the value chain. Therefore, blockchain is predicted to challenge existing business models and offer opportunities for new value creation.

Unfortunately for businesses, there is little guidance on the different blockchain technologies and solutions in existence today and how these might affect businesses and business models. While the blockchain technology underpinning Bitcoin is the most discussed variant, it is far from the only one. While it is easy to find sources that support blockchain's potential to disrupt all business activity as profoundly as the internet, email, social media, or mobile did (Swan, 2015; Tapscott & Tapscott, 2016), it is much harder to find material that explains how blockchain technologies vary and how the different types can offer value to businesses. Furthermore, there exists confusion over related terms, such as *the blockchain* (with definite article) and *blockchain* (no article), both distributed ledger technologies, and applications of these by which economic actors exchange digital representations of assets. Our article addresses these gaps.

2. Foundations of blockchain technology

The beginnings of blockchain go back to a white paper written by Satoshi Nakamoto (2008). Nakamoto introduced a peer-to-peer version of electronic cash, bitcoin, that allows online payments to be sent directly between parties without going through centralized financial intermediaries. As part of the implementation of bitcoin, Nakamoto also devised the ledger, which Nakamoto named "a chain of blocks" (Nakamoto, 2008, p. 7). This chain of blocks supports the new version of electronic cash (The Economist, 2015) and was later termed blockchain. Many other blockchain technologies have been developed since Nakamoto first introduced the blockchain.

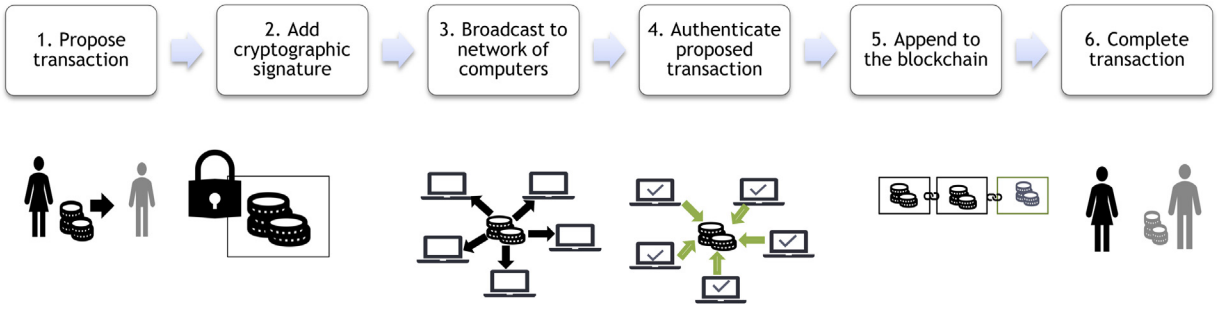
Blockchain provides a decentralized digital database of transactions, also known as a distributed ledger, which is maintained and updated by a network of computers that verify a transaction before it is approved and added to the ledger. It allows transacting parties to exchange ownership of digitally represented assets in a real-time and immutable peer-to-peer system without the use of intermediaries. Figure 1 illustrates the six steps of asset exchange between two economic actors using blockchain technology.

When a transaction between two parties is about to take place (Step 1), it is first converted into a hashed transaction proposal and stored as a candidate to be printed on the ledger. This proposed transaction includes basic information such as date/time, sender, receiver, asset type, and quantity. The proposed transaction is provided with a unique cryptographic signature that ensures the integrity and authenticity of the record (Step 2) and then broadcast to a network of distributed computers for processing and authentication (Step 3). These computers process and authenticate the transaction (Step 4) and, once authenticated, the transaction is added to the digital ledger (Step 5), which completes the asset transfer between the two parties (Step 6). Each new transaction is linked to those recorded previously, providing a complete, irreversible and verifiable history of all transactions ever made on this blockchain.

Before proceeding further, it is important to clarify noteworthy blockchain-related terminology. Consistent with the approach suggested by Swan (2015) and Evans-Greenwood, Harper, Hillard, and Williams (2016), we herein use the terms as follows:

- *Blockchain*, without the use of an article. Blockchain technology, or a blockchain (indefinite

Figure 1. The six steps of asset exchange using blockchain



Source: Adapted from Coinmama (2018).

article), refers to the underlying technology: A network of computers and algorithms that process Bitcoin and many other distributed ledger applications.

- *The blockchain*, using a definite article, refers to the technology underpinning bitcoin specifically.

At its core, a blockchain is a decentralized store of information (Swan, 2015) comparable to an information systems database that is updated in real time and distributed to its user base for validated record keeping. As outlined above, validators review and authenticate each proposed transaction before it is added to the ledger.

With regard to the type of access for the users of a blockchain, there exist two types of blockchains: public and private. Private can take on one of two subforms.

Public or open blockchain technologies allow anyone to interact with another transacting party. The identity between the two parties is either pseudonymous or even entirely anonymous (i.e., the transacting parties do not know each other prior to the transaction; Vaughn, 2015). An open blockchain implies little to no privacy for transactions, implying that all participants can view all transactions. An open blockchain also requires a substantial amount of computational power that is necessary to maintain a distributed ledger on a large scale (Jayachandran, 2017). More specifically, to achieve consensus in most public blockchains, each node in a network must solve a complex, resource-intensive cryptographic problem called a proof of work to ensure all nodes of the blockchain are in sync. Examples of open blockchain include Bitcoin, Litecoin (a cryptocurrency designed to be faster than Bitcoin), and Ethereum, which is processed in a different manner than Bitcoin and Litecoin and is used primarily for smart contracts. A smart contract consists of self-executing code on a blockchain that automatically implements the terms of an agreement between parties.

Private or closed blockchain technologies allow only prevalidated individuals or groups of individuals to access the ledger and enter and view data. Here, others know the identities of all users prior to transacting. A variant of the private blockchain is the *federated or consortium model*, in which the blockchain operates under the leadership of a group. This type of blockchain is a private network that maintains a shared record of transactions accessible only to those who have been prevalidated. Who grants new entrants permission to use the blockchain varies: Existing participants can decide on future entrants, a regulatory authority can grant new users licenses to participate, or a consortium can make participation decisions. In contrast to a public blockchain, a private blockchain offers more transaction privacy, which is critical for transactions involving sensitive data (e.g., the transmission of medical or financial data). The right to read the private blockchain may be open in some cases or this right is restricted to the participants only. Closed blockchains are easier to scale up, cut down costs, and feature greater transactional throughput. Additional advantages include added security, lower costs, added reliability, and a higher level of trust, as only preverified parties are able to initiate a new node in the blockchain (Coburn, 2018). Some members of the blockchain developer community do not consider private blockchains to be blockchains; heated discussions continue in web communities as well as during conferences (Kessels, 2018). Examples of closed blockchains include Linux-based Hyperledger, which supports the collaborative development of blockchains and tools in banking, finance, Internet of Things, supply chain, manufacturing, and technology, and R3, a distributed ledger technology company that leads a consortium of more than 200 firms and develops applications for finance and commerce on its blockchain platform (Vaughn, 2015).

Despite the differences described above, open and closed blockchains offer some common features:

- Both are decentralized peer-to-peer networks, in which each participant maintains a replica of a shared append-only ledger of digitally signed transactions;
- Both maintain the replicas in sync through a protocol referred to as consensus; and
- Both provide certain guarantees on the immutability of the ledger, even when some participants may be faulty or malicious (Coburn, 2018).

3. How can blockchain impact your business model?

Blockchain technologies offer many possibilities to grow entirely new businesses and pose direct threats of disruption to traditional incumbents. Organizations using conventional business models built on the predication of acting as an intermediary between two transaction parties must ask themselves if and how blockchain technologies may impact their value propositions, how they compete, and how they operate. Pilot projects are currently

underway in several industries including the use of blockchain to track the transport of goods inside of an industrial supply chain; use of smart contracts to enable secure, faster, and less expensive real estate transactions; and use of blockchain to enable consumers to send funds abroad without incurring delays or high exchange fees. Firms need to consider how their business model may be affected by rapidly growing blockchain applications. To allow for a structured discussion of the potential impacts that blockchain can have on business models, we use the business model framework illustrated by Osterwalder and Pigneur (2013, p. 14), who said a business model "describes the rationale of how an organization creates, delivers, and captures value" and consists of nine building blocks. These nine blocks cover the four main areas of a business: its customers, the offer, the infrastructure, and financial viability. The nine elements are (1) customer segments, (2) value proposition, (3) channels, (4) customer relationships, (5) revenue streams, (6) key resources, (7) key activities, (8) key partnerships, and (9) cost structure. When taken together and properly aligned, these elements create and deliver value. Osterwalder and Pigneur (2013) summarized the nine essential parts of a business model in a visual template termed the Business Model Canvas. The canvas is usually drawn on a large piece of paper with sections for each of the model's elements and thus serves as a tool to define, change, or evaluate a firm's business model.

In the following subsections, we provide a blueprint of how each of the nine essential elements could be affected by blockchain technologies and illustrate our propositions with examples that we collected from blockchain development startups in Europe, North America, and South Africa. We gathered public information from the startup firms' websites, as well as news articles, press releases, and other sources.

3.1. Customer segments

Osterwalder and Pigneur (2013, p. 20) defined *customer segments* as "the different groups of people or organizations that an enterprise aims to reach and serve." An organization using blockchain can address existing customer segments in a market. Individuals wanting to buy or sell real estate in Sweden can use a blockchain technology pilot project powered by ChromaWay to purchase or sell homes. Customer markets served by blockchain systems can be similar to the segments served by typical organizations: niche markets, diversified markets, and mass markets. However, blockchain is distinctive in that it can facilitate access to a target market that was previously not reachable (Larios-Hernandez, 2017) and therefore creates new customer segments for a business. These are the customer segments targeted by Everest in Africa, Asia, and South America. Everest, a firm that uses a private and permissioned Ethereum-based protocol, provides a decentralized distributed ledger technology that incorporates a payment solution, a multicurrency wallet, and a biometric identity system to facilitate microfinance transactions, land claims, and medical records to customer segments in developing countries. The potential market is the group of 2 billion people who have limited or no access to financial services.

3.2. Value proposition

The *value proposition* building block includes all of the firm's activities that create value for customers (Osterwalder & Pigneur, 2013). As Harvard Business School Professor Theodore Levitt (1974, p. 8) famously said: "People don't want to buy a quarter-inch drill, they want a quarter-inch hole." In other words, customers do not purchase products; they buy a solution to get an important job done. The value derived by the customer will increase in direct proportion to the importance that the customer places on the job to be done and by the level of satisfaction with the current options to complete this job, the availability of other options, and their cost (Johnson, Christensen, & Kagermann, 2008).

Blockchain technology can influence customer value by providing access to products or services that were previously not available or could only be garnered by expensing a large amount of time or money. Swedish company Safello uses an open blockchain protocol to provide a transparent means to exchange bitcoin against fiat currencies. By doing so, it provides resources (e.g., foreign currency) that would have been otherwise not available or only available at additional expense. Centbee, in South Africa, enables the users of its mobile app to send bitcoin to users' contact lists. Centbee users can move money simply and cheaply across borders to support family and friends without incurring exorbitant currency exchange fees. Safello and Centbee disintermediate by reducing the requirement for a centralized bank, or even eliminating a currency exchange service for transactions.

Moreover, blockchain technology can also provide faster or less expensive transactions than those completed in traditional settings. As an illustration, the customer value proposition of certified notaries for homebuyers is based on facilitating the ownership transfer of the asset from seller to buyer by

authenticating the documentation of the respective contracts. Working with a notary for home purchases or sales requires time and is often expensive. Here, blockchain technologies can reduce the transaction cost and time for the respective parties. This may be achieved by using smart contracts. As an example, ChromaWay's private blockchain protocol will enable Swedish citizens to use smart contracts to purchase or sell a house and reduce time and costs during the transaction.

3.3. Channels

The *channels* building block "describes how a company communicates with and reaches its customer segments to deliver a value proposition" (Osterwalder & Pigneur, 2013, p. 26). These channels may be the company's own sales force, website, or stores, or the channels may be the stores of its partners or wholesalers. One impact of using blockchain is the simplification of doing business. Middle parties may become disintermediated. In the previous section, we mentioned an example of real estate transactions that are facilitated by smart contracts. This is accomplished by removing the requirement for time and personnel required to complete a validity check or a transaction. New types of channels may also be introduced within an organization (e.g., by sharing common code to strengthen a supply chain; Montecchi, Plangger, & Etter, 2019).

3.4. Customer relationships

The *customer relationship* building block "describes the types of relationships that a company establishes with specific customer segments" (Osterwalder & Pigneur, 2013, p. 27). These relationships may be driven by a motivation to acquire customers, to retain customers, or to boost sales. Examples of categories of relationships include personal assistance, dedicated personal assistance, self-service, automated services, the creation of communities, or the co-creation of new content. For Lantmäteriet, the Swedish government's land registry authority, the pilot workflow powered by ChromaWay streamlined the process of transacting real estate. The digital ledger records each step of a real estate transaction as well as the property title. The application can also be accessed by bank representatives as well as by real estate agents and contains secure information that is up-to-date and easy to access. Lantmäteriet remains involved in the purchase throughout the process—rather than intermittently—and fulfills its aims of creating greater confidence and transparency in its dealings with Swedish citizens (Cheng, Daub, Domeyer, & Lundqvist, 2017).

3.5. Revenue streams

The fifth building block element of a business model is the *revenue streams*. The revenue streams block represents (Osterwalder & Pigneur, 2013, p. 30):

> The cash that a company generates from each customer segment. There are two kinds of revenue streams: Transaction revenues resulting from one-time payments and recurring revenues resulting from ongoing payments to either deliver a value proposition to customers or provide post-purchase customer support.

ABI Research (2018) estimated that $10.6 billion in revenue will be generated by blockchain projects by 2023, mainly from software sales and services (Mearian, 2018). Technology companies that provide blockchain-related professional services derive revenues from transaction fees for activity on a network, service level agreements for enterprise clients or platform fees for software-as-a-service (SaaS) contracts. The greatest revenues from blockchain, however, have been derived from crypto-crowdfunding, using *initial coin offerings* (ICOs). An ICO is a form of fundraising that uses the power of cryptocurrencies and blockchain-based trading and provides an alternative to classic debt/capital funding as provided by venture capital and private equity firms and banks. An ICO allocates tokens instead of shares to the early investors in a business. These tokens can be traded on an aftermarket and all transactions are verified on a blockchain. In 2017, 800 ICOs raised over $5 billion (CB Insights, 2018), whereas in the first 5 months of 2018, a total of 537 ICOs closed successfully with a volume of $13.7 billion (PwC, 2018a).

3.6. Key resources and activities

Osterwalder and Pigneur (2013, p. 34) defined *key resources* as "the most important assets required to make a business model work." These are the resources that create the value proposition, reach markets, maintain relationships with customer segments, and earn revenues. These resources may be physical, financial, intellectual, or human. *Key activities* encompass all activities required to deliver value (i.e., how a firm transforms the resources in value-creating ways). While resources and activities are considered as two separate elements in the Osterwalder and Pigneur (2013) framework, we discuss them jointly in this section because these two elements are tightly linked.

Blockchain technologies require firms to reconsider the key resources that make up their business model. In the following paragraphs, we discuss two

aspects of how blockchain technologies influence resources and activities. The first aspect concerns the opportunity to make resources more fluid, allowing firms to move away from the traditional ownership and to access resources only when required. This opportunity is especially pertinent to the application of public blockchain technologies in which, as described earlier, anyone can transact with another party in a peer-to-peer network. In some cases, firms can refrain from investments in IT infrastructure build and maintenance because, in the case of public blockchains, the network provides these resources and processes. Furthermore, both applications of public and private/federated blockchains enable firms to automate processes that were previously manual, enabling human resources to focus on other, more value-added activities. Examples of these processes include documentation, verification, and audit reporting.

The second important aspect of how resources and activities can be affected by blockchain technologies is when the users provide many of the key resources and processes and use blockchain technologies to facilitate resource exchange. Using the example of smart contracts in real estate transactions, resources such as human capital (e.g., knowledge, skills, experience) and physical capital (assets) are provided by the transacting parties while blockchain technologies facilitate the peer-to-peer exchange of these resources.

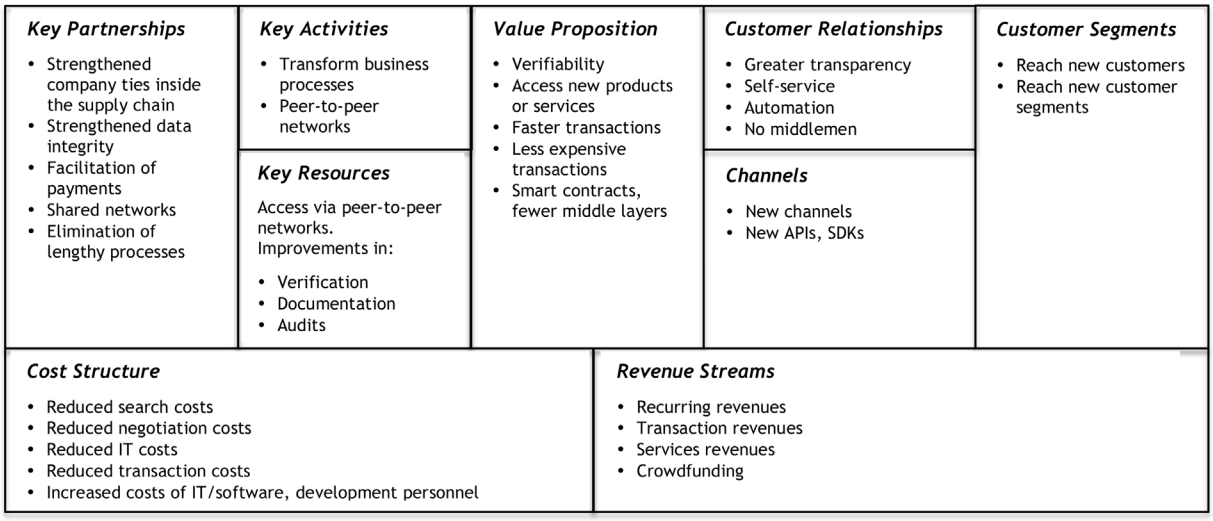
3.7. Key partnerships

The building block *key partnerships* describes "the network of suppliers and partners that make the business model work" (Osterwalder & Pigneur, 2013, p. 38). These partnerships may take forms such as strategic alliances, joint ventures, or buyer-supplier relationships to ensure reliable supplies. On the one hand, the use of blockchain may entail the disintermediation of traditional intermediaries (e.g., banks, notaries, currency exchanges) or transform financial institutions (e.g., credit card companies). The use of blockchain can also enable the addition of new partners such as technology companies that develop application programming interfaces (APIs) and software development kids (SDKs), and maintain the transactional algorithms. Centbee developed a merchant payment ecosystem in South Africa to enable retailers to quickly and easily accept bitcoin at point of sale without requiring the installation of additional terminal hardware. Blockchain also facilitates peer-to-peer partnerships between businesses, therefore strengthening and extending supply chains. Figure 2 summarizes the impact of blockchain technology on a firm's business model.

3.8. Cost structure

The final building block is the firm's *cost structure*. The cost structure "describes all costs incurred to operate a business model" (Osterwalder & Pigneur, 2013, p. 40). Blockchain implementations can reduce transaction costs such as negotiation costs and search costs, and eliminate the costs of intermediaries. In the financial services industry, blockchain technologies are expected to allow for annual cost savings of $15–$20 billion by 2022 (Gregorio, 2017). These savings are the result of a reduction in IT infrastructure costs and the

Figure 2. The blockchain and the business model canvas



elimination of manual processes that did not add much value to the firm.

Implementations of blockchain to manage financial transfers can shorten the authorization holds currently implemented in banking and credit card processing. Authorization holds can hold up funds for several days. Transaction consensus operation speeds can reduce these holds to mere minutes in public blockchain protocols. On private blockchains, these holds are reduced to microseconds (Vukolić, 2018). Operations powered by blockchain require fewer manual steps in aggregating, amending, and sharing data, or providing regulatory reporting and audit documents. Employees can, therefore, focus on activities that add more value and generate greater revenues while consumers save time and money. Citizens in Sweden who negotiate a home purchase by using a blockchain-powered smart contract and exclude previously required third parties from the transaction will save money and time during the transaction.

While our previous discussion considered the business model elements separately and relied on different examples for illustration, we close this section with an explanation of the impact of blockchain technologies by looking at one case study: How is blockchain application influencing Walmart's business model? Walmart recently launched a blockchain solution to detect and remove recalled food from its products list and track every bag of spinach and head of lettuce (Corkery & Popper, 2018). The system is powered by IBM's Hyperledger blockchain-based supply chain tracking system technology. The solution is implemented in response to a vexing business problem: tracing and immediately removing from shelves any food that is harmful to shoppers and removing only food that is harmful while leaving items that are safe to eat on the shelves to be sold. Upon completing a pilot program with 25 stock keeping units (SKUs) and 10 partners, Walmart is now bringing more than 100 suppliers into an immutable and transparent ledger that can track food from farm to store in seconds. Walmart expects to include additional products "on the scale of 50,000 to 70,000 SKUs" (Mearian, 2018).

It is instructive to review the potential of this major project through the lens of the business model canvas by Osterwalder and Pigneur (2013). The value proposition to Walmart's consumers is that of increased food safety while keeping Walmart's promise of Everyday Low Prices. Walmart's dominance in the food retail sector enables it to retain its profit formula with its revenue model protected, and cost structure, margins, and inventory turnover unchanged; in fact, automating the tracking of the supply chain using Hyperledger is expected to result in cost-savings for Walmart, thus increasing the potential for profit. The key resources and processes that are part of the supply chain implementation also contribute to the customer value. Data about food grown in farms and destined for Walmart will be logged on the blockchain at every step of processing and transport, by using manual entry as well as with Internet of Things devices (Corkery & Popper, 2018). Each step in the supply chain is "not only recorded but trusted because of the features of blockchain are immutable and use a consensus mechanism" (Mearian, 2018).

The implementation of the blockchain-powered tracking system enables Walmart to reduce the length of time required to trace the origin of fresh food—from the shelf all the way back to the farm—from 7 days to only a few seconds (Mearian, 2018), enabling it to act swiftly in case of any contaminations at source. Well-trained store employees will contribute to the swift removal of tainted food from local shelves. The implemented blockchain-based system is therefore expected to improve the value proposition to Walmart's customers of a ready supply of inexpensive, fresh, and, most importantly, safe foods.

4. Discussion

The critical mass of blockchain technology adoption has yet to be reached. Few blockchain projects have moved from a pilot stage to full implementation. Recent research by Gartner reveals that only 1% of responding CIOs reported any sort of blockchain adoption, and only 8% of respondents are engaging in short-term planning and pilot planning (Gartner, 2018). A report by Deloitte (2018a) is more positive: "While a majority (74%) of our survey respondents report that their organizations see a compelling business case for the use of blockchain technology, only 34% say their company has initiated deployment in some way." According to Deloitte (Schatsky, Arora, & Dongre, 2018), several obstacles continue to limit the mainstream adoption of blockchain technology:

- Blockchain operations are viewed as slow. Despite their ability to offer a significant increase in efficiency, when compared to standard multiday authorization holds by banks and credit companies, consensus operations still generate minutes-long delays on a public distributed ledger network. The additional layers of obfuscation and encryption required to keep data confidential

add to the processing time (Marvin, 2017). This has a bearing on customer value creation, as consumers and businesses expect speedy, nearly instantaneous operations.

- News reports about data breaches on cryptocurrency trading platforms, contrasted with corporate requirements for ironclad data security across disparate systems, are limiting managers' consideration of the technology.

- Blockchain architectures are not standardized. There were more than 6,500 active blockchain projects listed on GitHub in 2018, with projects based on different protocols, consensuses, privacy measures, and written in different coding languages.

- Given this lack of standardization, establishing business connections between firms by using blockchain architectures is difficult because of the challenges of integrating different architectures.

- Costs continue to be high: blockchain applications, developed to customer specifications, require expensive specialized developers and require complex integration efforts.

- The constraints brought by regulation are an obstacle to consideration, particularly for innovative projects such as smart contracts. Regulatory constraints, specifically in financial and medical applications, prevent the rollout of smart contracts in several countries.

- The final obstacle is the lack of a critical mass of users, enabling the mass adoption of blockchain technology. Initiatives such as Everest's large-scale humanitarian projects for the disenfranchised are built on the belief that using blockchain to address these needs will accelerate a wider use of the technology.

However, these obstacles to blockchain adoption are being overcome by recent developments in regulatory easing, collaborations between organizations, as well as new development in more efficient blockchain architectures (Schatsky et al., 2018):

- New consensus mechanisms used in Hyperledger, Stellar, R3, and Ripple implementations increase throughput and performance, reducing processing time from minutes to milliseconds (Vukolić, 2018). Consensus is the method by which participants in a blockchain network come to agree that the transactions recorded in the digital ledger are valid.

- Standardization efforts continue. There are currently more than 60 blockchain consortia initiating projects. These consortia bring together hundreds of private and public companies and government organizations eager to explore the potential of blockchain applications. Some develop use cases, set standards, develop infrastructure and applications, and operate blockchain networks. Others educate, conduct research, or provide advice to their members. This is a positive sign, as "the value of the network increases with the number of users" (Deloitte, 2018a). Some examples of these consortia include the Enterprise Ethereum Alliance with more than 600 members and the Hyperledger Foundation, which includes over 250 organizations. The number of companies that collaborate with one another outside of established consortia is also increasing.

- The complexity and cost of blockchain implementations are both declining. Amazon, IBM, and Microsoft offer cloud-based implementations of blockchain as well as templates at a cost that is lower than specialized development (Patrizio, 2018). These templates ease the setup process, reduce implementation time from months to days, and will enable organizations to reduce the costs of these initiatives.

- Finally, regulatory support is improving. Legislation has been passed in several states in the U.S. to facilitate the adoption of blockchain for some medical applications (Deloitte, 2018a).

The recent developments noted in Schatsky et al. (2018) stem from the growth in the number of collaborations and the increase in the formation of consortia. Organizations are carefully evaluating the blockchain movement and launching pilot projects as proofs of concept. Meanwhile, entrepreneurs issue and sell blockchain tokens and reshape entrepreneurship and innovation in fundraising, investing, community building, and open sourcing (Chen, 2018). A major decision for organizations undertaking blockchain projects lies in the selection of the blockchain model: private or public? The two types of blockchains that we described are differentiated by unique selling propositions: a private blockchain can save an organization time and cut costs, whereas a public blockchain has the potential to disrupt an industry, either through

disintermediation, as is the case in financial applications of Bitcoin and other cryptocurrencies, or by the creation of new business models (Tamayo, 2017).

Despite the small number of implementations, it is still encouraging to see an increasing interest by companies to explore opportunities with blockchain technology. In his widely-discussed and debated article "IT Doesn't Matter," published over 15 years ago in *Harvard Business Review*, Carr (2003, p. 43) noted that companies "steal a march on their competitors by having a superior insight into the use of a new technology." New technologies offer more efficient operating methods and lead to larger market changes. However, the window for gaining this advantage is open only for a short time. "By the end of the build-out phase," Carr (2003, p. 43) suggested that "opportunities for individual advantage are largely gone." Therefore, those executives who see a compelling case to begin a blockchain pilot should begin sooner, rather than later.

Whether the new blockchain projects lead to incremental or radical innovations is also worthy of examination. A useful model for categorization is Henderson and Clark's (1990) framework for defining innovation, based on the impact technological change has on a firm's established capabilities. We have observed in our small sample of case studies that consortia-led blockchain projects have the potential to lead to architectural innovations, whereas public blockchain projects can engender radical innovations. Architectural innovations reconfigure established systems to link existing components in a novel way. Walmart's use of a private blockchain can be considered an architectural innovation, as it enables it to create "new interactions and new linkages with other components in the established product" (Henderson & Clark, 1990, p. 12). It relays information with greater velocity and credibility about the origins and freshness of Walmart's supply of spinach and lettuce. Radical innovation, by contrast, is based on different principles and leads to new applications and markets such as those fueled by the recent surge in ICOs. It also enables the successful entry of new firms or the creation of a new industry (Henderson & Clark, 1990). Safello's Bitcoin exchange for European customers and ChromaWay's use of smart contracts for real estate transactions are also examples of radical innovations.

One limitation of our article is the early-stage nature of the implementations under discussion and the resulting small sample of active use cases. Many projects are early pilots and have not yet achieved full rollout. As more projects move from pilot stage to rollout, it will be interesting to explore which industries will create architectural innovations or generate radical innovations and to confirm whether these will be supported by private or public blockchains.

Empirical research can also explore which parts of the business model canvas are most affected by the implementation of a blockchain: customer segments, value propositions, channels, customer relationships, revenue streams, cost structures, key resources, key activities, or partnerships. An additional area for further investigation will be to examine whether a private or a public blockchain offers greater benefits for each of these elements. Such an investigation will require a larger sample of companies running applications on blockchain than is currently available.

5. Concluding remarks

We began this article with an explanation of blockchain technologies and continued with a description of their impact on a firm's business model. With a focus on an audience of general managers and executives, rather than blockchain experts, we highlighted how blockchain technologies operate and explained the two major types of blockchain—public and private—currently in application in practice. In addition, we clarified some of the blockchain-related terminologies, thus adding to the conceptual clarity of the construct.

The main contribution of our article lies in presenting the influence blockchain technologies can have on a firm's business model. By using the well-established business model framework from Osterwalder and Pigneur (2013), we explained how the two types of blockchain technologies delineated in our article present opportunities for value creation for a firm's business model (see Figure 2). We used illustrative examples, derived from our investigations of startup companies that pilot blockchain technology solutions in the areas of real estate transactions, payment systems, currency exchange, supply chain management, and applications for the billions of unbanked citizens in the developing world. We also identified directions for future research on the types of innovation generated by blockchain innovations and an opportunity for empirical examination of impacts to the elements of a firm's business model once a larger sample of blockchain implementations can be formed.

Managers can use the business model as an analytical framework to assess the impact of blockchain technology for their existing business model; alternatively, they may use the canvas to reinvent or

develop completely new business models. This exercise is useful because the addition of blockchain technology can affect how firms may run, operate, and compete. Managers must discern the potential impacts so as to not be left behind (Angelis & Ribeiro da Silva, 2019).

Blockchain holds promise in many organizational applications with several promising pilot projects underway. These focus on applications such as supply chain, Internet of Things, digital identity, digital records, digital currency, payments, and voting (Deloitte, 2018b). A survey by Credit Suisse (2016) identified the leading aims of blockchain technology pilots as the reduction of operational costs, shorter settlement time, reduction of risk, new revenue opportunities, and a reduction in the costs of capital.

Most of the current pilot projects pertain to financial services (PwC, 2018b). Although many of these projects have improved operations, there have also been instances of fraud, particularly in the cryptocurrency blockchain sector in the area of ICOs. Although most ICOs are legitimate efforts to raise funding for startups, with varying degrees of success, some ICOs have been fraudulent from inception and enabled fraudsters to abscond with tens of millions of dollars (Arnold, 2018).

Applications outside of finance also seek to improve operations. Manufacturing companies seek to trace goods from purchase to delivery around the globe reliably and quickly. Healthcare providers yearn for immutable and traceable patient records, to reduce pharmaceutical and insurance fraud, and improve data exchanges in clinical trials. Public sector projects include not only land claims but also digital identity projects that will facilitate travel, citizenship records and voting (Syeed, 2018). Additional pilots seek to improve operations for retailers and entertainment and media organizations. Blockchain has an opportunity to create benefits beyond digital currencies and influence all sectors of the economy.

Managers are well advised to continuously monitor blockchain technologies to assess their impact and consider the strategic importance of blockchain for their business. If they do not do so, they will lose their competitive edge to those managers of firms, whether new or old, who understand blockchain and who are ready to innovate their business models.

When evaluating a business case for blockchain adoption, executives and managers should ask the following questions:

- What are the sources of value that blockchain can provide?
- How will using blockchain align with the organization's goals and strategies?
- Does the organization have the right people, partnerships, and resources in place?
- Will the organization reach new customers, strengthen relationships, or increase sales?
- Will blockchain help service customer needs better and offer more value?
- Will blockchain tighten relationships inside the supply chain?
- Could smart contracts be used to transact faster, accelerate payments, or reduce costs?
- Will blockchain improve organizational cost structures?
- Can it integrate within the existing IT ecosystem?
- Will blockchain help reduce search costs and negotiation costs?
- Will blockchain enable the organization to compete more effectively?

Executives who are considering initiating blockchain projects will do well to consider the alignment of their project with their overall business strategy and reflect on which element of their business model will become most improved by the implementation. To help with this important task, our article provides a structured framework by which to assess the impact of blockchain technology on each business model element. In addition, managers will need to decide whether an open or a closed blockchain will help them realize their organizational objectives. With a growing number of consortia, a decrease in complexity and costs of implementation, and a larger number of pilots and experiments underway, blockchain is advancing rapidly toward greater acceptance. Astute executives and managers should understand how the technology fits in their business and how it can help improve operations in order to capture its advantages ahead of their competitors.

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