Beyond Bitcoin – What Blockchain and Distributed Ledger Technologies Mean for Firms

Alex Hughes\*

Falmouth Business School, Falmouth University, Penryn, Cornwall, UK.

alex.hughes@falmouth.ac.uk

01326 370400

Andrew Park

Beedie School of Business. Simon Fraser University. 500 Granville Street. Vancouver, BC. Canada. V6C 1W6. aparka@sfu.ca. +1 (778) 782-5800

Jan Kietzmann

Gustavson School of Business, University of Victoria, Victoria, BC, Canada.

Chris Archer-Brown

Falmouth Business School, Falmouth University, Penryn, Cornwall, UK TR10 9FE chris.archerbrown@falmouth.ac.uk

01326 370400

\* Corresponding Author

Beyond Bitcoin – What Blockchain and Distributed Ledger Technologies Mean for Firms

## Abstract

Bitcoin and blockchain technologies are benefiting from significant hype cycles in both societal and business contexts. Cryptocurrencies like Bitcoin have enjoyed rapid growth in user adoption over the past 8 years. However, blockchain technologies, which fuel cryptocurrencies, can be even more profoundly extended to other business applications. The blockchain can be leveraged to drive innovation and increase efficiencies in new domains including digital arts management, supply chains and healthcare. However, there continue to be technical, organizational and regulatory headwinds that must be overcome before mass adoption occurs in these areas. In this article, we provide a brief history of the blockchain and identify some of its key features that have enabled its popular uptake in the world of cryptocurrencies. We offer a discussion on how blockchains evolved from traditional software and web technologies. We then examine the underlying strengths of the blockchain and evaluate new, non-cryptocurrency use cases. We conclude by informing the thinking manager on the limitations of the blockchain and present several important considerations before they decide to implement it within their organizations.

## Keywords

Blockchain; Smart Contracts; Bitcoin; Distributed Ledger;

## the web’s frontier and BLOCKCHAIN

Jeff Bezos took to the stage at a *TED* event in 2003 to compare and contrast the digital zeitgeist with other periods in American history (Bezos, 2003). One such comparison was *The Gold Rush* - the run on land and mines in California in 1848, which created a social frenzy around the notion of gold prospecting, business, escaping the rat-race and simply ‘having a go’at entrepreneurship. The other more pertinent example given during the presentation was how the origin and implementation of electricity started with the clear goal of providing light within homes and streets. The subsequent evolution of a number of cottage industries became the consumer electronics industry that currently contributes $2.9 trillion to global GDP. Bezos used these comparisons to highlight his thinking in the context of the nascent world wide web and Amazon. He believed that society had only scratched the surface of the web’s capabilities, and that the best was yet to come.

He was clearly right. In the 15 years since his presentation, Amazon have grown and innovated their offering to a near trillion-dollar market cap, providing goods and services that have far exceeded the original scope of the Amazon vision “to become Earth’s biggest bookstore”.In other areas, too, hastechnology made dramatic strides towards becoming seamlessly integrated into social and organizational lives, providing the kind of utility that we had only previously imagined within science fiction. Artificial Intelligence (Kietzmann et al., 2018), Virtual Reality (Farshid et al., 2018), Internet of Things (Robson, 2016) and robotics (Wirtz, 2018), to name a few, are starting to become normative experiences, disrupting the ways in which we consider business challenges and retain our competitive advantage in the market. In the same way that Bezos saw the early development of electricity as the foundation for something with greater potential, we would like to append the same sentiment to the topic of blockchains and discuss what they are, why they are important and how they can provide exponential value to business operations.

The benefits and utility of a cryptocurrency are relatively simple to explain and understand, as are their implications for the financial services industry. However, with the promise of lowering costs, increasing process efficiency, and changing the importance of intermediaries, the underlying blockchain technology has significant potential to disrupt all sorts of business operations. At this relatively early stage of most blockchain applications, these changes and their organizational implications are far harder to analyse or predict, and as a result, blockchain technologies and their potential impact are very difficult for managers to understand. This confusion has led to some frustration within the business community about if and how firms should incorporate blockchain developments to create or retain competitive advantages within their respective industries. In this article, we hope to dispel some of the confusion by first explaining blockchain principles and then outlining its benefits. Next, we discuss some of its organizational applications and consider what the future might bring for blockchain.

## Blockchain Principles

Between 2007-08, the World was plunged into turmoil by the financial crisis; a man-made chain reaction of financial collapses built on bad debt and even worse administration, the likes of which had not been seen since The Great Depression. During a period of emergency mergers and bail outs, the world witnessed the fragility and instability of a tightly interwoven, highly leveraged global financial system that appeared to be failing quickly. In response to these events, in October 2008, an unknown person (or persons) identifying themselves as Satoshi Nakamoto published a whitepaper to a cypherpunk mailing list (Nakamoto, 2008), introducing the world to the topic of blockchains by outlining the benefits of an electronic cash system called “Bitcoin”. To date, bitcoin and other cryptocurrencies are arguably the most commonly recognized use-case of blockchain and, as such, are a suitable basis with which to explain the operating principles of the technology.

Blockchains are described in various ways, the most generally accepted being that they are distributed public ledgers (Kim & Laskowski, 2016; Zhao, Fan & Yan, 2016) or a “meta-technology” (technologies made up of several technologies) (Mougayar, 2016, p. 10). Blockchains are exactly what their name suggests: a ledger of transactions, or *blocks*, that form to make a systematic, linear *chain* of all transactions ever made. Whilst the blocks themselves are highly encrypted and anonymised, the transaction headers are made public and not owned or mediated by any specific person or entity. The headers are publicly available to those who would like to scrutinise transactions, as long as they have the wallet information details, also known as the hash, available. Every time a new transaction takes place on a blockchain, a new block is resolved by a miner - an individual in the network whose job it is to verify each operation.

In the case of the Bitcoin blockchain, miners create new blocks and add them to the chain on the network every ten minutes by solving cryptographic puzzles; this process is known as proof of work. The new blocks include immutable timestamps, which provide a proof of work of what has happened before. Timestamps and immutability ensure that the chain of transactions cannot be tampered with, since each sequential block references the prior block. More clearly, blockchains are tamper resistant since earlier blocks in the chain validate the transactions up to the present moment. If prior block information does not validate, the new blocks cannot form new parts of the existing chain and are rejected. As a result, a transparent and distributed accounting ledger of every transaction ever made on the network engenders trust. Blockchains are extremely robust and less vulnerable than traditional IT infrastructures to malware and attacks from hackers.



Fig. 1: Each new block must reference a previous block, creating a chain. Reprinted from *Bitcoin blockchain in Ada: Lady Ada meets Satoshi Nakamoto*, by Johannes, Kanig, retrieved from https://blog.adacore.com/bitcoin-in-ada

## Blockchain Benefits

Since the release of the Nakamoto whitepaper, and the launch of the Bitcoin blockchain, Bitcoin has evolved into a de facto blockchain currency (cryptocurrency) and trading instrument with a market cap of over $100 billion. In this context, cryptocurrencies - the built-in currency of the blockchain payments and transactions, are native to the technology (Mougayar, 2016). However, not everything about the underlying blockchain is new, and many benefits are derived from established technologies.

### Secure and Transparent, Distributed Accounting Ledgers

Blockchains are novel combinations of multiple computer engineering paradigms that have actually already existed for decades. For example, a fundamental feature of a blockchain is secure transaction signing by each party that wants to send another party digital money, in the case of cryptocurrencies. This mechanism relies on the interplay between hashing algorithms (e.g., SHA-256) and the provision of private and public software keys to each participant in the blockchain network. Private and public key modules (e.g., GPG and the aforementioned hashing algorithms) have existed for over 20 years.

Similarly, distributed databases have been a well-researched problem in computer science for several decades (Lake & Crowther, 2013). Even today, trusted databases with distribution capabilities, like MongoDB and PostgreSQL, suffer from lost data and inconsistent reads or writes due to network disruptions, power failures, data races, and more. While blockchains don’t currently have the scaling capabilities of traditional distributed databases, they have proficiently addressed the issue of inconsistent data writes using artificial rate limiting through its consensus algorithms. Put another way, by insisting that parties who wish to write to the blockchain ledger spend resources and time to solve computationally intensive hash problems, the blockchain network buys itself time to properly order these parties before committing writes from any of them. The trade-off here is that writing to a blockchain is much more resource and time hungry than writing to a traditional database, but it’s offset by the advantages in write consistency and uptime.

### Decentralized Networks

The combination of hash algorithms, private and public keys, and the decentralized ledger are what makes blockchains powerful in modern Internet architecture. Parties who wish to transact with each other do not even need to know each other’s identities but they can be assured that the intended party is sending or receiving a transaction, since only the intended party has access to their own private key. These parties can also be reasonably assured that committed transactions will be written in the correct order. Moreover, the parties have the confidence knowing that even if one party defects from the network, as long as the number of participants in the network is large, their transaction histories will not be lost or corrupted.

Further, blockchains are unique in that they don’t require a large central server to store and maintain data. As long as the network achieves consensus regarding what transactions happened in the past, the network collectively acts as a server to host the data. If one rogue participant decides to modify previous data, they will quickly get outvoted by the network majority. Even cloud computing is not truly decentralized, as servers for cloud computing providers like Digital Ocean, Linode and Amazon host data are placed in designated, physical, central locations.

### Trust, Transaction Time & Cost

To *consumers*, the specific promises of blockchains are manifold, mainly based on the fact that peer-to-peer systems do not require intermediaries or third parties - transactions can occur intelligently between sole parties. In the context of cryptocurrencies like Bitcoin, for example, tamper-resistant blockchain solutions can prevent ‘double-spending’ programmatically and ensure that transactions are debited from one account and credited to a different account, without risk of the same funds being allocated more than once. And since monetary transactions are made between individual parties, they reduce concerns around trust placed on financial institutions. The resulting efficiencies mean that costs and transaction times can be reduced significantly.

*Organizations* see the benefits of blockchains too. In many parts of the World, hyperinflation has decimated local economies and digital currencies have been introduced to stabilise the economy; Ecuador, Senegal and Venezuela are three such countries that have already adopted digital currencies, either wholly or in part (Heathman, 2017). In other parts of the world, Japan, Estonia, India, and Sweden, (to name a few), are investigating methods by which they can adopt digital currency given the decline in use of traditional notes and coins (Catalini & Gans, 2016; Mason, 2017). As of this writing, the Bank of England are researching ways in which a digital currency might be introduced into the existing banking system to complement the pound (Bank of England, 2018; Meakin, 2018).

It is important to note that even with blockchain decentralization, it is not immune to data corruption or network attacks. If the number of participants in a blockchain is low, a coordinated group of malicious parties can create enough nodes to produce a network majority, forcing mutated data upon the rest of the benign nodes. Moreover, a participant who loses and inadvertently gives up their private key, for example, through a phishing scam, will have handed full control of their stored digital assets to the hacker. However, the putative benefits of the blockchain to consumers and organizations have created much excitement in business circles, far exceeding the specific context of cryptocurrencies like Bitcoin. Blockchains can also be logic-based transaction platforms, where digital representations of items of value (car, house, holiday, code for unlocking a door etc.) can be written into so-called *Smart Contracts,* as seen in another blockchain called Ethereum. Here, transactions can be processed by code, instead of simply being recorded, and stored permanently within the blockchain, ensuring transparency for all transactions, all without the requirement of intermediaries. The potential applications seem limitless, as “any transaction, product life cycle, workflow, or supply chain could, in theory, use blockchains” (Takahashi, 2017).

## Blockchain Applications

There is no shortage of use cases for blockchain adoption that promise to protect firms’ business dealings, manage assets differently, prevent theft, simplify and speed up organizational processes, reduce errors, and remove the necessity for third parties. Opportunities arise everywhere, and in this section, we point to some of the most compelling blockchain applications.

### Blockchain & Entrepreneurship

Exploitation of the technology is evident in a number of business communities, including start-ups and intrapreneurs, whereby the disruptive potential of blockchains is driving innovation within business modelling and value propositions (Magretta, 2002; Nowiński, 2017). As a development platform, the blockchain provides a bedrock for new sets of software applications that are decentralised and cryptographically secure. As open source software, most blockchains are open to development from everyone, which will encourage incremental innovation and further improve the robustness of the blockchain ecosystem. The removal of third-party intermediaries combined with convergent solutions, (such as IoT and AI), is driving competition, driving down costs, and lowering barriers to entry.

### Blockchain & Governments

For governments, the potential for blockchain adoption is equally compelling, with a variety of use cases that could aid and protect democratic principles. Land titles in developing countries have long been an issue for citizens, where registry has been lost due to lack of ownership proof. In Honduras, blockchains are being used to ensure that land rights are digitised to ensure that consecutive governments cannot strip land owners of what is rightfully theirs by successive dictatorships (Lemieux, 2016).

In the context of voting, individual citizens’ details could be stored to blockchains to ensure that voting is executed lawfully, and that foreign government influence could be mitigated since the potential for vote tampering would be marginal. A malicious party cannot cast a vote on behalf of another individual because each individual has a unique private key that only they can access.

### Blockchain & Digital Rights Management

The music industry has a long heritage in unfair practices and nefarious contract agreements that have always favoured the labels (Gopal, Sanders, Bhattacharjee, Agrawal & Wagner, 2004). Musical blockchains are disrupting this power by giving back the control, ownership and distribution rights to the artists themselves (Moyon et al., 2014; Dickson, 2016). Since the digital revolution of the 1990s, consumers have also been able to re-produce and download albums and songs without moderation on a peer-to-peer basis, highlighting the issues and flaws in current IP, copyright and licensing laws. This has given rise to a remix culture (Lessig, 2010), meaning modern technology and infrastructure have allowed consumers to copy, edit and re-distribute original digital content without any meaningful repercussion, or with little regard to legal and moral considerations (Kietzmann and Angel, 2014).

On a musical blockchain, the balance of power would be given back to the artist, since hash representations of their music could be written into a block with a unique ID and metadata including ownership and licensing rights. This means that the content couldn’t be easily misattributed, unless the artist allowed it. Payments could be made using a digital currency, and the artist could control the way that they distribute or sell the music. For example, different rates could be given for different types of population- students and the elderly could have music at hugely discounted rates (Dickson, 2016; Tapscott, 2016).

### Blockchain & Supply Chain Management

Supply chain management is a $16TN (£11.8TN) sector with large overheads in terms of costs, error handling, fraud and administration (Boucher, 2017). Blockchain appears to be ripe to disrupt this sector, especially when synthesised with an Internet of Things(IoT) strategy. The promise of a blockchain/ IoT approach is that a lot of the issues associated with supply chain handling can be eliminated or drastically ameliorated, thus reducing overhead significantly for businesses. This works by ensuring each party, who holds a private key that only they can access, writes a confirmation to the blockchain that they have received a product. This secure chain of custody allows for high confidence verification of where and how a product was handled, and allows each member of the supply chain to identify and inspect where any mishandling might have occurred.

The granularity and information that IoT and Blockchain promise has given rise to companies such as Provenance, [Smartlog](https://www.kinno.fi/en/smartlog) and Everledger, who offer transparency services, tracking and provenance of everyday goods (Montecchi, 2019). Whilst this may seem overzealous, provenance can be crucial to certain industries which rely on evidencing the source of goods, and to consumers who want to ensure companies align with their personal values.

An example of this would be diamond supply, where the provenance of stones is integral to the underlying value of the stones (Iansiti and Karim R Lakhani, 2017; Tapscott and Tapscott, 2017). Similarly, ordinary consumer goods such as clothing, meats, wine, seafood and postal services are being affected by documentation issues; whilst proving the authenticity of goods is one aspect of their appeal, many companies are finding that it gives them a competitive advantage with consumers who are increasingly concerned with the origin of goods sourced from around the world. (Armstrong, 2016). The promise of this type of use case in driving The Circular Economy is significant; providing consumers with information on the re-used / recycled components in the products they buy.

Finally, blockchains can protect consumers from deceptive counterfeit fraud (the type where the customer does not know they have bought a fake). By registering the initial purchase onto a blockchain, the authenticity of the product can be permanently stored and the ownership of the certificate can be passed along in a transaction that can be managed through smart contracts. Further, by connecting the physical product with the blockchain via the use of an IoT device such as a sensor, the connection between the product and its authentication certificate is locked.

### Blockchain & the Energy Sector

In the energy sector, companies are currently developing blockchain solutions to disrupt and diversify their operations model entirely. Prosumers (consumers who produce their own energy via solar) can now sell any excess reserves of energy back to the market using blockchain powered apps, which provide added value to consumers who care about the provenance of their energy source and supplemental income to prosumers.

### Blockchain & Healthcare

Our current healthcare system is plagued with information siloes and inefficient data interchange between Electronic Health Record vendors, Providers, Insurance Companies, Research Organizations and Patients. The fax machine is still the primary mode of patient health data exchange due to factors like organizational bureaucracy, provider apathy, misaligned incentives, and inertia (Withers, 2016). Moreover, inconsistent and unsecure data storage has led to massive breaches of patient data from large healthcare entities globally (Reuters, 2017). This has led to significant public backlash and mistrust in the way patients’ data are stored, interpreted and potentially sold without their knowledge. Most alarmingly, because of inefficient data sharing, physicians have incomplete pictures of a patients’ health profiles, leading to slower treatment and poorer health outcomes (Wicks 2010).

Blockchains have the potential to revolutionise the way health data is stored, handled and efficiently exchanged between healthcare entities while maintaining these entities’ incentives. For example, after a patient receives a lab result, the data, instead of being stored centrally on the lab’s servers, can be stored encrypted on the blockchain network (or, to comply with privacy laws, stored off-chain with a referent to the data on the blockchain). The data itself can be tagged with the creator of the data (the lab) so any parties who access data in the future can see who generated it. This allows for the preservation of commercial incentives for the lab, as they will still be able to bill insurance companies and receive funding based on their work. However, the control of the data is now given to the patient, who can actively decide to share it with a new family doctor, or send it to a University for research purposes. This reduces concerns surrounding lost or corrupt data, slow exchange of data, and unknown reselling of data. Many blockchain-based healthcare start-ups like Doc.ai and Encrypgen have already developed decentralised health data solutions.

## THE REALITIES OF MASS ADOPTION

There is little doubt that they have caught the attention of businesses, governments and central banks, who are all considering the broader implications of absorbing the technology into their respective operations, but future of blockchains and cryptocurrencies is contentious as of this writing. Many academics and observers agree that they have much potential, (Pazaitis, De Filippi and Kostakis, 2017; Takahashi, 2017; White, 2017) but the scope of their usefulness is still moot.

Comparisons about the roadmap to full maturity have been aligned with the developments of the early web; many academics (Swan 2015; Zhao, Fan and Yan, 2016) see the evolution of the blockchain in three decade-long iterations, where each iteration faces its own unique technical and business challenges to larger adoption. For example, in the case of cryptocurrencies, we are seeing wild fluctuations in market value, as users tend to be more interested in exploiting market returns than using them as a medium of value exchange. We have entered the age of *Smart Contracts*, where the blockchain is being used as a decentralized, programmable logic platform. However, most Smart Contracts are still comprised of programs to create new cryptocurrencies. Regulation and organizational acceptance are still in its infancy and will need to open up dramatically before the blockchain is used more broadly in any application. We have not yet come close to this stage. Despite the feature-based merits of the blockchain, it still faces many technical and societal barriers.



Fig. 2: Roadmap of blockchain adoption

## TECHNICAL AND SOCIETAL Challenges

We are currently living through the first iteration of blockchain, (cryptocurrencies), however, it is the second and third iterations which offer the most promise for disrupting business paradigms, processes and economic impact (Swan, 2015; Zhao, Fan and Yan, 2016).

In order to advance the progress of developing blockchain adoption towards future iterations of development, various obstacles need to be overcome. First and foremost, there are a wealth of technical challenges to consider, that mostly involve developing and nurturing the eco-system required to support maturity and wider adoption (Wang, Chen and Xu, 2016). The issues are various and would require research and input from developers, start-ups, software engineers, venture capitalists, and users, to solve issues such as secure transactions, interoperability between blockchains and endless scalability (Mougayar, P. 67).

Moreover, a large proportion of society does not yet understand what blockchains or cryptocurrencies are, or how they can use them. This will mean that there will be an impetus on the blockchain community to lobby for the technology within their own communities and beyond. If blockchains or currencies are going to be adopted within business operations and society generally, then there is a lot of work to be done to simplify and demystify these concepts and usage for colleagues, consumers and critics. This will clearly take time, and evangelists within the technology space will need to provide leadership and vision in order to produce the next generation of killer apps to whet consumer appetite.

The development of a killer app would clearly expedite the route to wider adoption if it caught the imagination of the public at large. One such development that aligns with this idea is the recent announcement from Facebook CEO Mark Zuckerberg in which he stated that Facebook will start to research decentralisation and cryptocurrencies for the company as part of his 2018 personal challenge: *“*I'm interested to go deeper and study the positive and negative aspects of these technologies, and how best to use them in our services.” (Zuckerberg, 2018).

Other challenges facing blockchain adoption are questions relating to legal issues and regulation (Deloitte, 2016; Boucher, 2017; Dennis, 2017). Whilst the pace of technology is fast moving, regulation and lawmaking are slow moving processes. This has been evidenced within the fintech industries, which have taken a progressive approach to many evolving technologies, such as distributed ledger technologies, algorithmic trading and the potential of peer-to-peer transactions. The Financial Conduct Authority (FCA) in the U.K. currently holds a ‘technology neutral’ stance on the adoption of blockchains in finance and considers their future usage acceptable ‘as long as risk are acknowledged and mitigated’ (Clarke, 2018). In the U.S., Jay Clayton, chairman of the Securities and Exchange Commission, has taken a hardline stance that all cryptocurrencies are securities and should be regulated as such, imposing stringent oversight on new blockchain projects (Higgins, 2018).

## Managerial Implications

The preceding pages of this article have hopefully illustrated the potential of blockchains and digital currencies to add utility to business, society and the web. It is a lot to consider, and for managers wondering about implementation, clearly, there are potential risks as well as benefits to acknowledge. In terms of guidance as to whether a blockchain solution is suitable for the business, there are a number of decision models available. Each offer differing guidance about the appropriate conditions for implementation, including this tongue-in-cheek model (Meunier, 2018):



Figure 3: Managerial bias towards blockchain.

Clearly this is not a serious illustration of whether an organization should think about adopting blockchain; however, it is an illustration of many managers’ current thinking and bias against blockchain. A more appropriate way to think about adopting blockchain is to consider organizational problems in search for solutions, and how these could possibly be blockchain-based.

For managers thinking about using a blockchain solution, there are several important considerations that should serve as the bedrock of their decision-making processes.

### Trust: Resolving a lack of trust between parties in an ecosystem is arguably the most important benefit of the blockchain. Notions of trust operate along a broad spectrum and there are a number of ways in which blockchains solicit trust between stakeholders in various exchanges. Most notably are the removal of intermediaries between cash transactions, which is the current model of digital currencies such as Bitcoin but could be adapted within any intermediary business model (e.g., peer-to-peer auctions, insurance, banking etc.). Because of the implementation of consensus algorithms and cryptography, parties in a network can interact and transact with each other relatively safely and with assurances their transactions and identities won’t be stolen or corrupted.

**High uptime requirements**: the decentralised nature of blockchains ensures high uptime since they do not have a single point of failure.

**Immutability**: if a business requires an immutable, chained log of transactions then a blockchain may be a suitable solution for future auditing purposes.

**Transaction speed variability**: the speed of transactions can vary depending on which blockchain is used. If slow transaction times are reductive to the stakeholder experience then a blockchain solution should be evaluated more carefully, since different blockchains operate at different velocities. Examples of currency blockchain times vary from between 7 transactions per second (TPS) in the case of Bitcoin to nearly 3,000 TPS, in the case of EOS (Williams, 2018).

The manager wears many hats within their role, and part of that role is nurturing innovation and finding operational efficiencies that benefit the business. In this context, there is an argument for managers to think about blockchains beyond the realms of the decision model, and to take a position of innovation and creativity that contribute to the evolution of the company via process and business modelling innovation (Morkunas, 2019).

## LOOKING AHEAD

It is clear that blockchain technologies are still in their infancy and a lot of their promise still lies within speculation and hyperbole. Much of this speculation appears to be fueled by the ongoing and polarizing debate that questions the utility and value of cryptocurrencies and how they could complement existing fiat currencies.

Similarly, there is a clear position that the blockchain has a long way to go before it matures to become an integral societal product, though there are pockets of implementation within various areas of business. The use cases detailed in this article speak to the potential of the technology and give the reader a view of what a blockchain future could look like. Just like the early web, it appears that the success of blockchains and digital currencies will depend upon the business communities’ appetite to disrupt and embrace the way that we transact value. Furthermore, it will require a lot of heavy lifting by the blockchain community to develop the tools and infrastructure required to nurture a vision of the web that advances society, culture, technology and business.

Just like Jeff Bezos did.

**REFERENCES**

Bank of England. (2018, August 22). *Digital currencies.* Retrieved from

<https://www.bankofengland.co.uk/research/digital-currencies>.

Bezos, J. (2003). The electricity metaphor for the web’s future. *TED.* Retrieved from

<https://www.ted.com/talks/jeff_bezos_on_the_next_web_innovation/transcript?language=en#t-1014524>

Catalini, C., & Gans, J. S. (2016). *Some simple economics of the blockchain* (No. w22952).

National Bureau of Economic Research.

Clarke, L. (2018, July 17). How is the UK approaching financial blockchain regulation?.

*ComputerWorld UK.* Retrieved from

<https://www.computerworlduk.com/security/how-is-uk-approaching-financial-blockchain-regulation-3680781/>

Farshid, M., Paschen, J., Eriksson, T., & Kietzmann, J. (2018). Go boldly!: Explore

augmented reality (AR), virtual reality (VR), and mixed reality (MR) for business. *Business Horizons*, *61*(5), 657-663.

Gopal, R. D., Sanders, G. L., Bhattacharjee, S., Agrawal, M., & Wagner, S. C. (2004). A

behavioral model of digital music piracy. *Journal of organizational computing and electronic commerce*, *14*(2), 89-105.

Heathman, A. (2017, September 27) Move over bitcoin, these countries are creating their

own digital currencies. *The Verdict.* Retrieved from <https://www.verdict.co.uk/bitcoin-countries-digital-currency/>

Higgins, S. (2018, February 7). SEC Chief Clayton: Every ICO I’ve Seen is a Security.

*Coindesk.* Retrieved from <https://www.coindesk.com/sec-chief-clayton-every-ico-ive->seen-security

Iansiti, M. and Lakhani, K. R. (2017). It will take years to transform business, but the journey

begins now. *Harvard Business Review,* 95(1), 172.

Iansiti, M., & Lakhani, K. R. (2017). The truth about blockchain. *Harvard Business*

*Review*, *95*(1), 118-127.

Kanig, J. (2018, February 15). Bitcoin blockchain in Ada: Lady Ada meets Satoshi

Nakamoto. *AdaCore Blog*. Retrieved from https://blog.adacore.com/bitcoin-in-ada

Kietzmann, J. H., & Angell, I. (2014). Generation-C: creative consumers in a world of

intellectual property rights. *International Journal of Technology Marketing*, *9*(1), 86-98.

Kietzmann, J., Paschen, J., & Treen, E. (2018). Artificial Intelligence in Advertising: How

Marketers Can Leverage Artificial Intelligence Along the Consumer Journey. *Journal of Advertising Research*, *58*(3), 263-267.

Kim, H. M., & Laskowski, M. (2018). Toward an ontology‐driven blockchain design for

supply‐chain provenance. *Intelligent Systems in Accounting, Finance and Management*, *25*(1), 18-27.

Lake, P., & Crowther, P. (2013). Concise guide to databases. *Undergraduate Topics in*

*Computer Science, DOI*, *10*, 978-1.

Lemieux, V. L. (2016). Trusting records: is Blockchain technology the answer?. *Records*

*Management Journal*, *26*(2), 110-139.

Lessig, L. (2010). Re-examining the remix. *TED.* Retrieved from

<https://www.ted.com/talks/lessig_nyed#t-573398>.

Magretta, J. (2002). Why Business Models Matter. *Harvard Business Review.* Retrieved from

<https://hbr.org/2002/05/why-business-models-matter>

Mason, B. (2017). The Next Cryptocurrency Evolution: Countries Issue their Own Digital

Currency. *FX Empire*. Retrieved from <https://www.fxempire.com/education/article/the-next-cryptocurrency-evolution-countries-issue-their-own-digital-currency-443966>

Meakin, L. (2018, January 5). What Has the BOE Actually Said About Starting a

Cryptocurrency?. *Bloomberg*. Retrieved from <https://www.bloomberg.com/news/articles/2018-01-05/what-has-the-boe-actually-said-about-starting-a-cryptocurrency>

Meunier, S. (2018). When do you need blockchain? Decision models. *Medium.* Retrieved

from [https://medium.com/@sbmeunier/when-do-you-need-blockchain-decision-models-a5c40e7c9ba1](https://medium.com/%40sbmeunier/when-do-you-need-blockchain-decision-models-a5c40e7c9ba1)

Montecchi, M., Plangger, K., & Etter, M. (2019). It’s Real, Trust Me! Establishing Supply

Chain Provenance Using Blockchain. *Business Horizons*, 62(3).

Morkunas, V., Paschen, J., & Boon, E. (2019). How blockchain technologies impact your

business model. *Business Horizons*, 62(3).

Mougayar, W. (2016). *The business blockchain: promise, practice, and application of the*

*next Internet technology*. John Wiley & Sons.

Moyon, E. et al. (2014). Online Business Models in Creative Industries. *International Studies*

*of Management and Organization*, 44(4), 83–101.

Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system. Retrieved from: https://bitcoin.org/bitcoin.pdf

Nowiński, W., & Kozma, M. (2017). How Can Blockchain Technology Disrupt the Existing

Business Models? *Entrepreneurial Business and Economics Review*, *5*(3), 173-188.

Persistence Market Research. (2017, January 3). Global Consumer Electronics Market to

Reach US$ 2.9 Trillion by 2020. *PR Newswire.* <https://www.prnewswire.com/news-releases/global-consumer-electronics-market-to-reach-us-29-trillion-by-2020---persistence-market-research-609486755.html>

Piersen, B. (2017). Anthem to pay record $115 million to settle U.S. lawsuits over data

breach. *Reuters*. Retrieved from <https://www.reuters.com/article/us-anthem-cyber-settlement/anthem-to-pay-record-115-million-to-settle-u-s-lawsuits-over-data-breach-idUSKBN19E2ML>

Robson, K., Pitt, L. F., & Kietzmann, J. (2016). APC Forum 1: Extending Business Values

through Wearables. *MIS Quarterly Executive*, *15*(2).

Swan, M., (2015) Blockchain: Blueprint for a New Economy, O’Reilly.

Wicks, P., Massagli, M., Frost, J., Brownstein, C., Okun, S., Vaughan, T., ... & Heywood, J.

(2010). Sharing health data for better outcomes on PatientsLikeMe. *Journal of medical Internet research*, *12*(2).

Williams, S., (2018, May 28) Ranking the Average Transaction Speeds of the 15 Largest CryptocurrenciesRetrieved from: https://www.fool.com/investing/2018/05/23/ranking-the-average-transaction-speeds-of-the-15-l.aspx

Wirtz, J., Patterson, P., Kunz, W., Gruber, T., Lu, V. N., Paluch, S., & Martins, A. (2018).

Service robots in the front line: will it be a brave new world?. *Journal of Service Management*, *29*(5).

Withers, R. (2018, June 6). Why in the world do doctor’s offices still use fax machines?.

*Slate*. Retrieved from <https://slate.com/technology/2018/06/why-doctors-offices-still-use-fax-machines.html>

Zuckerberg, M. (2018, January 4). *Facebook*. Retrieved from:

https://www.facebook.com/zuck/posts/10104380170714571